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Research paper

Cannabis sales increases during COVID-19: Findings from Alaska, Colorado, Oregon, and Washington[☆]



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ABSTRACT

Background and aims: Following emergency declarations related to COVID-19 in the United States, many states issued stay-at-home orders and designated essential business categories. Most states allowed medical and/or non-medical adult-use cannabis retailers to remain open. This study assesses changes in cannabis sales across Alaska, Colorado, Oregon, and Washington before and during the pandemic.

Methods: Pre-tax sales data from cannabis marketplaces in four states were analyzed to identify trends from January 2018–December 2020. Mean monthly sales and relative percent change in mean monthly sales were compared by state from April–December (coinciding with the pandemic) in 2018, 2019, and 2020. Differences were assessed using the nonparametric Mann-Whitney-U test.

Results: Mean monthly cannabis sales in all four states were higher during the pandemic period in 2020 compared to the same period in 2019. Sales reached a three-year peak in Washington in May 2020 and in Alaska, Colorado, and Oregon in July 2020. From April–December, the percent change in mean monthly sales from 2019 to 2020 was significantly higher than 2018–2019 in all four states, though Alaska saw similar increases between 2018–2019 and 2019–2020.

Conclusion: To date, cannabis sales in Alaska, Colorado, Oregon, and Washington have increased more during the COVID-19 pandemic than in the previous two years. In light of these increases, data monitoring by states and CDC is warranted to understand how patterns of use are changing, which populations are demonstrating changes in use, and how such changes may affect substance use and related public health outcomes.

Introduction

On February 29, 2020, the Washington state governor issued the first emergency declaration in the United States regarding the novel coron-

avirus (COVID-19) (State of Washington; Office of the Governor, 2020). By mid-March, all states had issued similar emergency declarations (Moreland et al., 2020), followed in many states by stay-at-home orders, which designated specific essential business categories (National Governors Association, 2020). In most states with legal cannabis marketplaces, medical and/or non-medical cannabis retailers were deemed

[☆] The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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essential and allowed to remain open (Marijuana Business Daily, 2020; National Governors Association, 2020).

Cannabis¹ (also called marijuana) is the most widely used federally illicit substance in the U.S. (Substance Abuse and Mental Health Services Administration (SAMHSA), 2020). As of July 2021, 36 states and the District of Columbia (DC) have legalized medical cannabis use, and 18 of those states and DC have legalized adult non-medical cannabis use (sometimes called recreational or retail cannabis use) (National Conference of State Legislatures, 2021). Despite rapidly changing state policies legalizing cannabis, the science around the health effects of cannabis is still emerging (National Academies of Sciences Engineering & Medicine, 2017; Volkow et al., 2014; Volkow, Baler, Compton, & Weiss, 2014). Data suggest that cannabis and/or cannabinoids are effective for treatment of chronic pain in adults, as antiemetics in the treatment of chemotherapy-induced nausea and vomiting, for improving patient-reported multiple sclerosis spasticity, and for symptoms from severe seizure disorders (National Academies of Sciences Engineering & Medicine, 2017). However, cannabis use has also been associated with a number of health risks, including chronic respiratory conditions; memory and attention impairment; schizophrenia and other psychoses; cannabis use disorder; and other substance use disorders (National Academies of Sciences Engineering & Medicine, 2017; Volkow et al., 2014a, 2014b; World Health Organization, 2016).

Research suggests that COVID-19-related mitigation measures contributed to increases in alcohol consumption and opioid use and overdose (Centers for Disease Control & Prevention Health Alert Network, 2020; Haley & Saitz, 2020; Niles, Gudin, Radcliff, & Kaufman, 2020; Pollard, Tucker, & Green, 2020a, 2020b), but trends in cannabis consumption are not yet fully understood. Two web-based studies using convenience samples and self-reported substance use data explored changes to cannabis use (but not sales) during the COVID-19 stay-at-home period. A study of U.S. adults who reported current medical cannabis use in April and May 2020 reported that over a third of respondents increased cannabis use, while 25% reduced use (Boehnke, McAfee, Ackerman, & Kruger, 2020). A survey of 3632 Belgian adults found no significant changes in cannabis use (Vanderbruggen et al., 2020).

The purpose of this study was to assess pre-tax combined medical and non-medical cannabis sales data in four U.S. states (Alaska [AK], Colorado [CO], Oregon [OR], and Washington [WA]) that have well-established state-regulated medical and non-medical cannabis marketplaces to better understand how legal cannabis sales changed during the COVID-19 outbreak in the U.S.

Methods

Sample

Data for this study came from cannabis regulatory agencies in AK, CO, OR, and WA.² These states were selected because they have the oldest U.S. state-regulated adult use cannabis marketplaces of the 18 states that currently allow non-medical adult cannabis use. CO and WA were the first two U.S. states to legalize adult cannabis use in 2012, and state-regulated marketplaces opened in both states in 2014 (Carnevale, Kagan, Murphy, & Esrick, 2017; Ghosh et al., 2017). OR and AK voted to le-

¹ For the purposes of this study, the term cannabis (both medical and adult use cannabis) refers to all parts of the plant *Cannabis sativa* L., including flower, seeds, and extracts that have $\geq 0.3\%$ delta-9 tetrahydrocannabinol [THC] concentration.

² Cannabis regulatory agencies in each state are: The Alcohol & Marijuana Control Office in the Alaska Department of Commerce, Community, and Economic Development; the Marijuana Enforcement Division in the Colorado Department of Revenue; the Oregon Liquor Control Commission; and the Washington Liquor and Cannabis Board.

galize adult cannabis use in 2014, with markets opening in 2015³ in OR and 2016 in AK (Caulkins & Kilborn, 2019). Some increase in year-over-year sales is expected even in established state-based cannabis markets because the cannabis industry continues to market to broad audiences, to diversify product offerings, and increasingly, to capture some of the illicit market (Demko & Nieves, 2020). However, sales are expected to be more stable in these four states than in states that legalized more recently and have less mature marketplaces.

Data and measures

In all four states, cannabis sales data are collected through “track and trace” systems that monitor regulated cannabis products from seed to sale.⁴ States submitted pre-tax sales data for each month from January 2018 to December 2020. Per capita state sales data are also presented for reference, given that state populations vary widely across the four states.

Sales data for this study include both medical and non-medical adult use sales, in part because WA and AK have a single marketplace for both medical and non-medical adult use cannabis and are unable to disaggregate medical and non-medical sales data. In CO and OR, separate medical marketplaces still exist. OR data represent adult-use sales and sales to medical cannabis patients from adult-use retailers but do not include sales from exclusively medical cannabis dispensaries (which are not prevalent – there were seven exclusively medical cannabis dispensaries in operation at the start of the study period and one at the end of the study period). Medical cannabis sales data from CO were combined with adult-use sales data for the purposes of these analyses.

Analyses

Analyses for this study describe: (1) monthly pre-tax cannabis sales by state from January 2018 – December 2020, (2) mean monthly per capita sales by state for 2019 and 2020 (to demonstrate how overall sales distribute across state populations), and (3) mean monthly sales with ranges and relative percent change in mean monthly sales by state from April – December in 2018, 2019, and 2020. The period April through December was selected for comparison each year because those months span the period in 2020 during which the U.S. COVID-19 outbreak was widespread and mitigation measures were implemented (Moreland et al., 2020; National Academy for State Health Policy, 2020). Relative percent changes in mean monthly sales were calculated and compared over time periods. Differences in means were compared using the nonparametric Mann Whitney U test (reported as U statistic in results). Differences in relative percent changes between 2018–2019 and 2019–2020 for each state were compared using two proportion t-tests. Analyses were conducted in Microsoft Excel and SAS 9.4 in February 2021. P-values <0.05 were considered statistically significant.

Results

Mean monthly cannabis sales in all four states were higher during the pandemic period (April – December) in 2020 compared to the same period in 2019. Monthly cannabis sales in all four states from 2018 to 2020 are presented in Fig. 1. Sales reached a three-year peak in WA

³ Oregon’s adult use cannabis market initially opened through an early start program that allowed for purchase of adult use cannabis in medical dispensaries. That program lasted from October 2015 through December 2016, after which time adult use cannabis was only allowed to be sold by licensed adult use cannabis retailers.

⁴ “Seed to Sale” is a phrase used in state statutes and by cannabis regulators and the cannabis industry to refer to the intensive regulatory and compliance tracking that happens on all regulated cannabis plants from the time they are seedlings until they are sold.

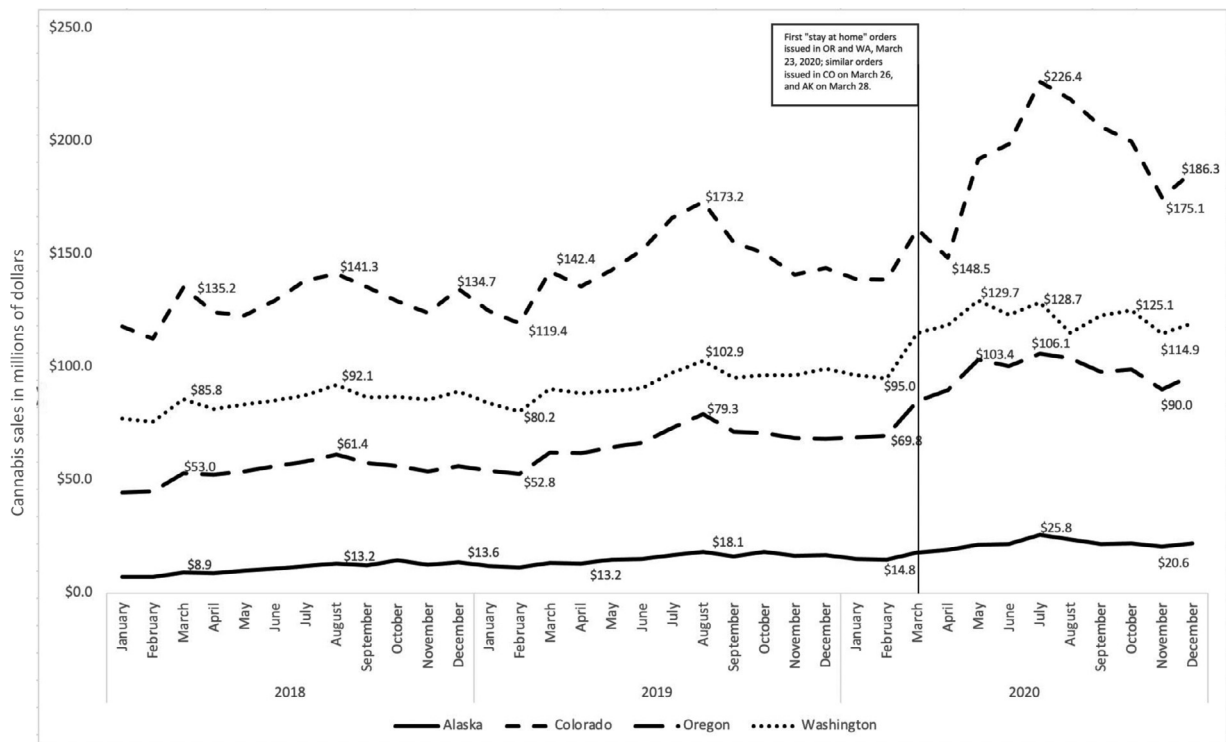


Fig. 1. Pre-Tax Monthly Cannabis Sales Revenues in AK, CO, OR, and WA, 2018–2020, in Millions of Dollars.

in May 2020 (\$129.7 million), and in AK (\$25.8 million), CO (\$226.4 million), and OR (\$106.1 million) in July 2020. In 2020, relative to 2019, mean monthly per capita cannabis sales increased in AK from \$20.77 to \$28.15 (a 35.5 percent increase), in CO from \$25.17 to \$31.38 (a 24.2 percent increase), in OR from \$15.61 to \$21.68 (a 38.9 percent increase), and in WA from \$12.26 to \$15.28 (a 24.6 percent increase) (data not shown in figures).

During April to December, mean monthly cannabis sales increased significantly in all four states from 2018 to 2019, and from 2019 to 2020. From 2018 to 2019, mean monthly cannabis sales increased 35.4% in AK ($U = 16.0, P = 0.01$), 15.4% in CO ($U = 17.0, P = 0.02$), 23.5% in OR ($U = 15.0, P = 0.006$), and 10.0% in WA ($U = 18.0, P = 0.03$). From 2019 to 2020, mean monthly sales increased 36.4% in AK ($U = 15.0, P = 0.006$), 28.7% in CO ($U = 18.0, P = 0.03$), 42.0% in OR ($U = 15.0, P = 0.006$), and 28.2% in WA ($U = 15.0, P = 0.006$) (Fig. 2). Mean monthly sales in millions of dollars during the pandemic period in 2020 were \$22.1 in AK (range: \$19.2–\$25.8), \$194.7 in CO (range: \$148.5–\$226.4), \$98.6 in OR (range: \$89.7–\$106.1), and \$121.9 in WA (range: \$114.9–\$129.7). The relative percent change in mean monthly cannabis sales from 2019 to 2020 was greater than that from 2018 to 2019 in all four states ($P < 0.05$ for all); however, Alaska saw similar increases between 2018–2019 and 2019–2020 (35.4% [$t = -4.0, P = 0.004$] v. 36.4% [$t = -4.87, P = 0.001$]).

Discussion

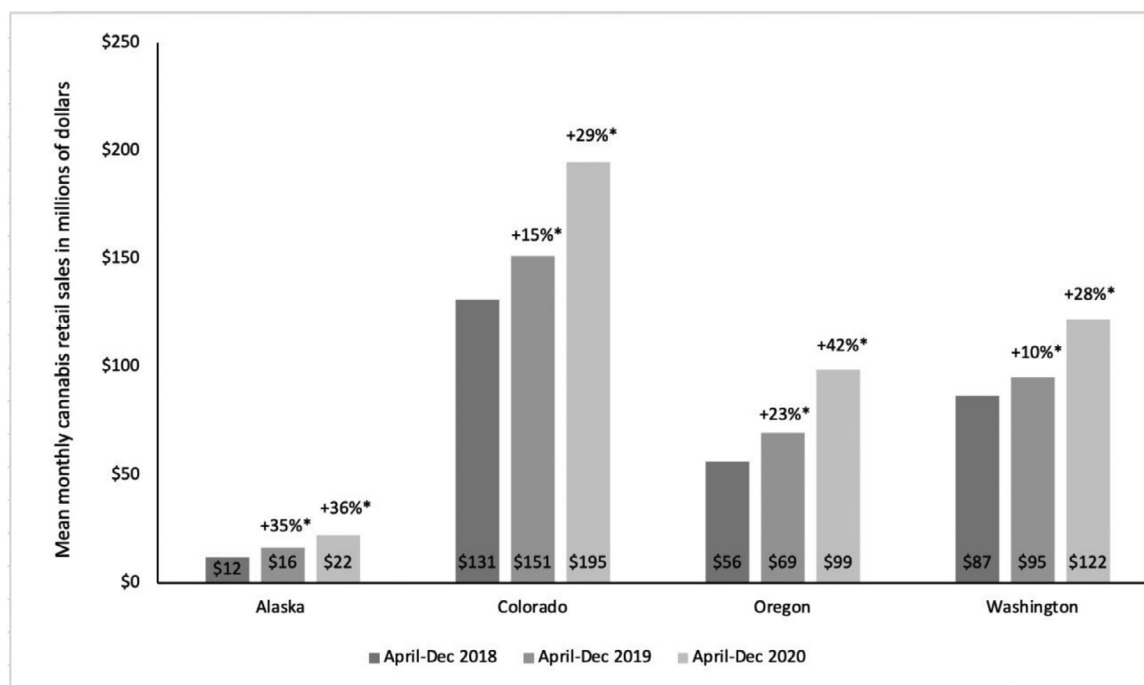
This is the first study in the academic literature to document changes in U.S. cannabis sales data during the COVID-19 pandemic. Findings show a general increase in cannabis sales following stay-at-home orders issued in AK, CO, OR, and WA in late March 2020. In all four states, those increases were greater than percent increases observed in the preceding two years.

Sales and consumption of other substances such as alcohol have increased during the pandemic and increases in positive urine drug tests and nonfatal opioid overdose have also been observed (Ochalek, Cump-

ston, Wills, Gal & Moeller, 2020; Wainwright et al., 2020). Findings from this study add to the body of research indicating increased substance use during the COVID-19 pandemic by documenting increases in cannabis sales in states with both medical and non-medical adult cannabis use policies.

While not explored through these analyses, the observed sales increases may be related to a number of factors. First, as reported previously, individuals may have initiated or increased cannabis use to cope with stressors brought on by the pandemic (e.g., social isolation, mental health conditions, financial hardship) (Czeisler et al., 2020; Rogers, Shepherd, Garey & Zvolensky, 2020). Further, state cannabis regulatory policy changes to promote social distancing during the pandemic may have increased the convenience or ease of purchasing cannabis for certain customers. For example, policies permitting curbside pick-up that were enacted during the pandemic in all four states (Marijuana Policy Project, 2020) may have facilitated easier access for people with mobility issues, or for those with small children in their care (since stores are open only to ages 21 and older, but policies like curbside pick-up allowed children to be in the car in most states). Policies like curbside pick-up could also have resulted in decreased ID verifications and sales to underage customers, though evidence does not currently exist to suggest that occurred. Sales to underage customers could also have increased through existing cannabis home delivery policies in the three states (AK, CO, OR) that had legal home delivery for cannabis in place. Exploration of these alternative explanations was out of the scope of the current study.

Stay-at-home orders may also have resulted in individuals who previously purchased cannabis on the illicit market moving to legal sources of cannabis (Demko & Nieves, 2020), which would result in an increase in sales that may not correspond to changes in use but rather in the source of purchase. Finally, demand for certain more expensive cannabis products (e.g., concentrates and oils) may have changed coinciding with the pandemic period, and/or the price of cannabis products may have increased in response to increases in demand for certain cannabis product types (Downs, 2020; Long, 2021). Additional research is warranted to



* $p < .05$

Percentages over 2019 bars (medium gray) indicate percent change in mean monthly retail sales from April-December 2018 to April-December 2019.

Percentages over 2020 bars (light gray) indicate percent change in mean monthly sales from April-December 2019 to April-December 2020.

Significant percent changes ($P < .05$) are indicated with an asterisk (*).

Numbers at the base of the bars refer to the mean cannabis sales for the indicated timeframe.

Fig. 2. April-December Mean Cannabis Sales and Relative Percent Change in Oregon, Washington, Colorado, and Alaska: 2018, 2019, 2020.

explore the possible explanations for the sales increases reported in this manuscript.

Understanding the policies and populations that may be driving cannabis sales increases in states is important for the protection of public health, as rising cannabis consumption and initiation could result in increases in overconsumption, cannabis use disorder, negative behavioral health outcomes, unsafe storage of products in the home, and other risk-taking behaviors (Freeman & Winstock, 2015; National Academies of Sciences Engineering & Medicine, 2017; Richards, Smith, & Moulin, 2017; Schoeler et al., 2016; Shi, 2017). Unfortunately, these sales data do not contain information about the characteristics of individuals purchasing cannabis or details about their purchase and consumption behaviors. Understanding whether the sales increases observed are driven by expanded numbers of legal-market cannabis consumers or by existing cannabis consumers who expanded their consumption would be beneficial. Furthermore, given that different potential risks accompany different modes of consumption (e.g., smoking, vaping, eating), understanding if and how modes and patterns of use have changed during the pandemic could inform health education messaging and substance use prevention efforts in particular populations.

The public health impact of increases in cannabis sales across these four states amidst the COVID-19 pandemic is still unknown. However, existing research suggests increased consumption and more frequent use are associated with greater risk for a range of adverse health outcomes (National Academies of Sciences Engineering & Medicine, 2017; Volkow et al., 2014). Results from this study demonstrate that sales increased markedly at the onset of the pandemic and continued to increase thereafter, as opposed to an acute or initial increase that might reflect “stockpiling” when COVID-19 mitigation measures were initially implemented. Sales in states included in this sample have continued to increase year over year (or at a minimum hold steady) into 2021,

further suggesting that findings in this study are not due to “stockpiling” (Colorado Department of Revenue Marijuana Sales Data, 2021; Oregon Liquor Control Commission Marijuana Market Data, 2021).

While data from this study denote only increases in sales as opposed to use, the finding that sales were not attenuated as time passed is suggestive of increased per capita consumption. Increases in consumption could precede negative social and physical health outcomes associated with frequent cannabis use (Freeman & Winstock, 2015; National Academies of Sciences Engineering & Medicine, 2017; Schoeler et al., 2016; Volkow, Compton, & Weiss, 2014). Accordingly, ongoing monitoring of cannabis sales trends, and in particular, novel efforts to collect data at the state level on cannabis use initiation, frequency of use, and methods of use during this pandemic period are warranted. Such information could be useful for developing universal and targeted public health strategies to protect public health and safety. Likewise, data that help to identify and evaluate emerging policy approaches to mitigate potential health impacts from increased consumption, changes in consumption of certain cannabis products, and changing cannabis prices would be useful.

Given scientific evidence supporting specific medicinal uses of cannabis and cannabinoids, it is also possible that increased consumption may be due to self-treatment of medical conditions, including due to potential pandemic-related barriers to usual sources of medical care. More research is warranted to assess how the pandemic may have changed reasons for consumption, and potential resulting increases to medicinal cannabis use.

This study is subject to limitations. First, data are from four states and may not represent trends in cannabis sales in other states. This study included data from states with legalized non-medical cannabis use; states with legal medical cannabis only may show different trends. As noted, these four states were selected specifically because their non-medical

adult use cannabis marketplaces have been in operation the longest of all states and are likely less prone to large market growth-related fluctuations that often follow development of new markets (Firth, Davenport, Smart, & Dilley, 2020). Second, data cannot be used to determine reasons for changes in sales during the assessed time periods. While results demonstrate the timing of sales increases coincided with the onset of stay-at-home orders following the COVID-19 pandemic and continued to increase thereafter, additional research is needed to determine whether a causal association between the pandemic and cannabis use and sales exists and whether specific populations disproportionately contributed to increased use and sales. Further, some increase in sales could be attributable to changes in pricing over time; data were not available to examine this possibility. Third, these data represent sales from both medical and non-medical purchases. Marketplaces are increasingly fluid, and some states, like Washington and Alaska, do not have a separate medical marketplace, making analysis of separate medical data challenging. Finally, data are time-limited and only available through December 2020. Although results demonstrate that cannabis sales remained higher throughout 2020 than in earlier time periods examined, ongoing monitoring is warranted to assess whether sales increases are sustained over time.

Conclusion

Cannabis sales increased overall in four states with legal adult use cannabis marketplaces during April to December 2020, compared with the two prior years. In light of these increases, data monitoring is warranted to understand how patterns of use may be changing and, if so, whether they affect a range of public health outcomes including the incidence of cannabis and other substance use disorders.

Declarations of Interest

None.

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