

Online Sales of Marijuana: An Unrecognized Public Health Dilemma

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INTRODUCTION

The Internet hosts many unregulated marketplaces for otherwise regulated products.^{1,2} If extended to marijuana (or cannabis),³ online markets can undermine both the U.S. Controlled Substances Act, which bans marijuana sales, and the regulatory regimes of states that have legalized marijuana. Consequently, regardless of the regulatory regime, understanding the online marijuana market should be a public health priority. Herein, the scale and growth trajectory of the online marijuana marketplace was assessed for the first time by analyzing aggregate Internet searches and the links searchers typically find.⁴

METHODS

First, the fraction of U.S. Google searches including the terms *marijuana*, *weed*, *pot*, or *cannabis* relative to all searches was described monthly from January 2005 through June 2017 using data obtained from Google. Searches were also geotagged by state (omitting Alaska, Montana, North Dakota, South Dakota, Vermont, West Virginia, and Wyoming because of data access restrictions). The subset of shopping searches was then monitored by tracking queries that also included *buy*, *shop*, and *order* (e.g., *buy marijuana*) in aggregate. Searches that included *killer*, *cooking*, or *clay* (e.g., *weed killer*) were considered unrelated and excluded from all analyses.

Linear regressions were used to compute pooled means to compare between time periods and log-linear regressions were used to compute average growth. Raw search volumes were estimated based on total Google search volume using comScore (www.comscore.com).

Searches in a Google Chrome browser without cached data were executed during July 2017 using the 12 combinations of marijuana and shopping root terms (i.e., *buy marijuana*). The results would be indicative of a Google user's typical search results. The first two pages of links, including duplicates (N=279, with seven to 12 links per page), were analyzed (because nearly all searchers click a link on the first two pages, with as much as 42% selecting the first link⁵). Investigators recorded whether each linked site advertised mail-order marijuana (excluding local deliveries in legal marijuana states) and its order in the search results. Two authors agreed on all labels. Analyses were computed using R, version 3.4.1.

RESULTS

Marijuana searches grew 98% (95% CI=84%, 113%) as a proportion of all searches from 2005 through the partial 2017 year (Figure 1). The subset of marijuana searches indicative of shopping grew more rapidly over the same period (199%, 95% CI=165%, 243%), with 1.4–2.4 million marijuana shopping searches during June 2017.

Marijuana shopping searches were highest in Washington, Oregon, Colorado, and Nevada. The compounding annual growth rate for marijuana shopping searches since 2005 was significantly positive ($p < 0.05$) in 42 of the 44 studied locations (all but Alabama and Mississippi), suggesting demand is growing across the nation.

Forty-one percent (95% CI=35%, 47%) of shopping search results linked to retailers promising mail-order marijuana (Table 1). Retailers occupied 50% (95% CI=42%, 59%) of the first page results and for eight (of 12) searches, the first link led to a mail-order marijuana retailer. For some searches (e.g., *order marijuana*), all of the first-page links were marijuana retailers.

DISCUSSION

Millions of Americans search for marijuana online, and websites where marijuana can be purchased are often the top search result.

If only a fraction of the millions of searches and thousands of retailers are legitimate, this online marketplace poses a number of potential public health consequences.⁶ Children could purchase marijuana online. Marijuana could be sold in states that do not currently allow it. Initiation and marijuana

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0749-3797/\$36.00

<https://doi.org/10.1016/j.amepre.2018.01.032>

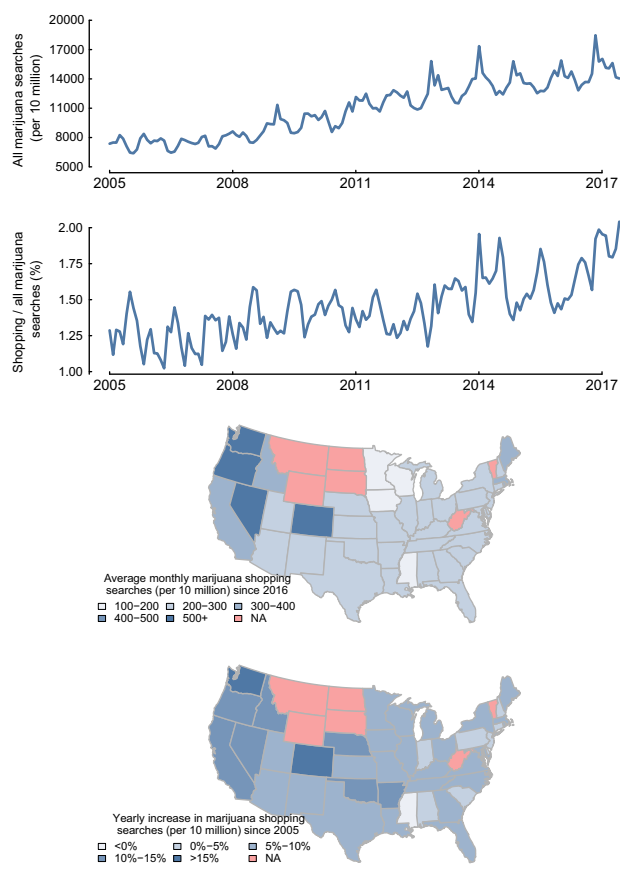


Figure 1. Internet searches for marijuana.

Note: “All Marijuana” searches are defined as searches including one or more of the following terms: *marijuana*, *pot*, *cannabis*, and/or *weed*. “Marijuana Shopping” searches are defined as searches including both one of the marijuana terms and one of the following shopping searches: *shop*, *order*, and/or *buy* after omitting ambiguous searches. Panel A shows All Marijuana searches nationally, as a fraction per 10 million total Google searches (query fraction). Panel B shows the ratio of marijuana shopping searches to all marijuana searches nationally. Panel C shows the average query fraction of Marijuana Shopping searches between January 2016 and June 2017 by state. Panel D shows the average annual increase in Marijuana Shopping searches since 2005, computed through a log-linear least squares regression model, where less than zero implies a declining trend.

dependence could increase.^{7,8} Products may have inconsistent potency or be contaminated. State and local tax revenue (which can fund public health programs) could be negatively impacted.

Regulations governing online marijuana markets (even if policy changes favor legalized marijuana) need to be developed and enforced. Policing online regulations will require careful coordination across jurisdictions at the local, state, and federal level with agreements on how to implement regulations where enforcement regimes conflict. Online sales are already prohibited under virtually every regulatory regime—all sales are illegal under federal statute and legal marijuana states like Colorado⁹ ban

Table 1. Online Mail-Order Marijuana Retailers on Internet Search Engines, 2017

Retailer	Search results			
	First link	First page	Second page	Total
Yes	8 (67)	66 (50)	48 (32)	114 (41)
No	4 (33)	65 (50)	100 (68)	165 (59)

Note: Data were collected by executing searches in July 2017. Cells show the frequency and percent of links (by column) in the first two pages of Google search results that claim to sell mail-order marijuana in response to 12 searches that contained unique combinations of the following terms: *cannabis*, *marijuana*, *pot*, or *weed* with *buy*, *order*, or *shop*, such as *buy cannabis*, *buy marijuana*, *buy pot*, or *buy weed*. Searches were executed on a new Google browser without cached data. Two authors agreed on the labels 100% of the time.

online sales—yet the market appears to be thriving. Government agencies might work with Internet providers to purge illicit marijuana retailers from search engines, similar to how Facebook removes drug-related pages.¹⁰ Moreover, online payment facilitators could refuse to support marijuana-related online transactions.

This study was limited in that who is buying/selling and the quantity of marijuana exchanged cannot be measured. Further, some searches may be unrelated to seeking marijuana retailers, and some retailers may be illegitimate, including scams or law enforcement bait.

The volume of searches and placement of marijuana retailers in search results is a definitive call for public health leaders to address the previously unrecognized dilemma of online marijuana.

ACKNOWLEDGMENTS

This work was supported by a grant from the National Institutes of Mental Health (R21MH103603). Mr. Caputi acknowledges scholarships from the Joseph Wharton Scholars and the George J. Mitchell Scholarship programs. Dr. Leas acknowledges a training grant from the National Heart, Lung, and Blood Institute (T32HL007034). No other financial disclosures were reported by the authors of this paper.

REFERENCES

- Mackey TK, Liang BA, Attaran A, Kohler JC. Ensuring the future of health information online. *Lancet*. 2013;382(9902):1404. [https://doi.org/10.1016/S0140-6736\(13\)62215-1](https://doi.org/10.1016/S0140-6736(13)62215-1).
- Allem JP, Ayers JW, Althouse BM, Williams R. When a ban really is not a ban: internet loopholes and Djarum flavoured cigarettes in the USA. *Tob Control*. 2016;25(4):489-490. <https://doi.org/10.1136/tobaccocontrol-2015-052309>.
- Richter KP, Levy S. Big marijuana—lessons from big tobacco. *N Engl J Med*. 2014;371(5):399-401. <https://doi.org/10.1056/NEJMp1406074>.
- Ayers JW, Althouse BM, Dredze M. Could behavioral medicine lead the web data revolution? *JAMA*. 2014;311(14):1399-1400. <https://doi.org/10.1001/jama.2014.1505>.

5. Advanced Web Ranking. 2014 Google Search CTR Study 2014. www.advancedwebranking.com/ebooks/Google-Organic-CTR-Study-2014.pdf. Accessed September 20, 2017.
6. National Academies of Sciences, Engineering, and Medicine. *The Health Effects of Cannabis and Cannabinoids: The Current State of Evidence and Recommendations for Research*. Washington, DC: National Academies Press, 2017.
7. Hasin DS, Saha TD, Kerridge BT, et al. Prevalence of marijuana use disorders in the United States between 2001–2002 and 2012–2013. *JAMA Psychiatry*. 2015;72(12):1235–1242. <https://doi.org/10.1001/jamapsychiatry.2015.1858>.
8. Schauer GL, King BA, Bunnell RE, Promoff G, McAfee TA. Toking, vaping, and eating for health or fun: marijuana use patterns in adults, U.S., 2014. *Am J Prev Med*. 2016;50(1):1–8. <https://doi.org/10.1016/j.amepre.2015.05.027>.
9. Colorado Department of Revenue. Complete Version of Current Permanent Retail Marijuana Rules. Effective April 14, 2017. www.colorado.gov/pacific/sites/default/files/Complete%20Retail%20Marijuana%20Rules%20as%20of%20April%2014%202017%20with%20D-OR%20Disclaimer.pdf. Accessed August 1, 2017.
10. Facebook. Advertising policies. www.facebook.com/policies/ads/prohibited_content/drugs. Accessed September 20, 2017.