



Short communication

Kratom availability in California vape shops

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ARTICLE INFO

Keywords:

Tobacco industry
Marketing
Retail
Policy
Compliance
Mitragyna speciosa

ABSTRACT

Kratom products are derived from trees native to Southeast Asia and have dose-dependent stimulant and opioid-like effects. Despite being on the Drug Enforcement Administration “Drugs and Chemicals of Concern List,” kratom is legal for sale in most US states. However, there are scarce data on its availability. The goal of this study was to examine kratom availability in vape shops across the state of California and assess shop compliance with a local kratom sales ban (enacted in 2016) in San Diego City. As part of a larger study about retail tobacco marketing near colleges, availability of kratom was assessed in summer 2019 in a random sample of 614 vape shops that was stratified to compare stores near (≤ 3 miles) and distant (>3 miles) from colleges. Logistic regression examined kratom availability as a function of store type (stores that sold vape products only vs. stores selling other tobacco), nearness to college, and tract-level demographics. Kratom was available in 62.4% of observed stores and more often in vape-and-smoke (81.1%) than vape-only shops (11.5%, AOR = 40.4, 95% CI = 23.3–74.1). Kratom availability did not differ by nearness to colleges. In San Diego City, 46.2% of observed stores (95% CI = 28.8–64.5) sold kratom products. Findings indicate that kratom was available in the majority of vape shops and most commonly in vape-and-smoke shops. Widespread availability in tobacco specialty shops suggests the need for research on dual use with tobacco, kratom advertising and cross-product promotion, and the potential of state and local tobacco retail licensing to prohibit sales.

1. Introduction

Kratom is derived from leaves of a tree native to Southeast Asia that contain Mitragynine, which produces stimulant effects at low doses (approximately 1–5g raw kratom) and opioid-like effects at higher doses (>5 g) (Anand and Hosanagar, 2022). Kratom products can be smoked, vaped, drunk, or swallowed as pills or capsules (Prozialeck et al., 2021). The US Food & Drug Administration (FDA) classifies kratom as an herbal product, which yields little surveillance or regulation over kratom products. The Drug Enforcement Administration lists kratom on its “Drugs and Chemicals of Concern List” but does not schedule kratom (Anand and Hosanagar, 2022). Although Rhode Island legalized kratom, six states – Alabama, Arkansas, Indiana, Tennessee, Vermont, Wisconsin – and some localities continue to prohibit its sale. A recent review highlights risk for withdrawal and numerous adverse effects of kratom, such as nausea, constipation, sleep problems, and diuresis (Anand and Hosanagar, 2022). Although rare, kratom has been listed as a

contributing factor in deaths in the US and may be especially likely to increase risk for adverse events (e.g., respiratory depression, seizure) when adulterated or ingested with other drugs (Prozialeck et al., 2021). The FDA issues warning letters to companies about unsubstantiated marketing claims for kratom (e.g., opioid cessation usefulness or analgesic properties) and between 2014 and 2016, FDA seized over \$5 million worth of kratom-containing products (Food and Drug; Office of the Commissioner, 2023). As recently as June 2023, the agency updated its bulletin on kratom, urging consumers not to use kratom and emphasizing the need for more research to understand kratom use and co-use with other drugs (Office of the Commissioner, 2023).

Kratom has been used for centuries in Southeast Asia but only within recent decades in the US (Prozialeck et al., 2021). The 2019 National Survey on Drug Use and Health estimated 0.7% prevalence of past-year use among individuals age 12 and older, although this is expected to be an underestimate (Palamar, 2021). Kratom use is more common among males, non-Hispanic White adults, people who are employed, and those

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<https://doi.org/10.1016/j.pmedr.2023.102380>

Received 28 July 2023; Received in revised form 21 August 2023; Accepted 22 August 2023

Available online 23 August 2023

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with higher educational attainment (Covvey et al., 2020; Rogers et al., 2021; Smith et al., 2022). Data are discordant as to whether kratom use is more common among middle-aged adults or young adults (Covvey et al., 2020; Rogers et al., 2021). Reported reasons for use include stimulation, relief from fatigue, mood enhancement, pain alleviation, anxiety reduction, and opioid withdrawal management (Smith et al., 2022). Kratom use is positively associated with substance use disorder history and withdrawal symptom severity (Rogers et al., 2021).

1.1. Why assess kratom availability within tobacco retailers?

Tobacco use is associated with kratom use among both adults and adolescents. In an online survey of US adults, three quarters of participants who reported past-year kratom use also reported at least monthly tobacco use (Covvey et al., 2020). Individuals who vape nicotine (compared to those who do not) have >3 times higher odds of using kratom (Smith et al., 2022). Lifetime kratom use was more common among adolescents who reported past-year cigarette smoking (Sharma et al., 2022). Kratom's dose-dependent effects may make it especially appealing to those who use nicotine. Kratom is used at lower doses as a stimulant substitute among some nicotine users and its anxiolytic properties at higher doses may motivate use among those experiencing nicotine withdrawal (Smith et al., 2022). Moreover, clinical observation suggests kratom use can increase desire to smoke nicotine (Müller et al., 2020). The association between tobacco and kratom use may in part result from a lack of regulation on where kratom products can be sold.

In the face of state and local sales restrictions on flavored tobacco, vape shops may promote alternative products that can be used in vaping devices, such as kratom (Berg et al., 2022). There are few or no restrictions on selling kratom in most jurisdictions, and accumulating evidence suggests tobacco retailers sell substances other than nicotine (e.g., delta-8-THC, CBD) (Leas, 2021). Adults who used kratom at least once in their lifetime reported purchasing from a variety of brick-and-mortar retail sources, including smoke shops and "head" shops (which sell paraphernalia for cannabis and tobacco use), raising concerns about the potential appeal of cross-production promotion with tobacco (Smith et al., 2022). Extant data on harmful consequences of use warrant better understanding of kratom availability in the tobacco retail environment to inform regulatory efforts.

1.2. Kratom use among college students

College attendance confers unique risks for substance experimentation and misuse (Welsh et al., 2019), and substance use early in life interferes with acquisition of healthy coping skills and increases risk for substance use disorder, mental health disorders, and poor physical health (Hall et al., 2016). In a survey of >80,000 US college students, 0.4% reported past-month kratom use, which was more common among males and those identifying as transgender, gender nonconforming, or sexual minority – population subgroups that also report significantly higher rates of tobacco use (Parent et al., 2022). Though tobacco use was not assessed in this college sample, kratom use was found to be associated with current use of alcohol and marijuana as well as depressive symptoms, all of which predict higher rates of tobacco use. While limited research has focused on kratom use among college students, the unique dose-dependent effects of kratom may appeal to students in that lower doses may be used to facilitate studying and higher doses may be used for relaxation. However, the broader substance use literature has demonstrated robust associations between access to substances and risk for using (Freisthler and Gruenewald, 2014), highlighting substance availability as one way to assess potential risk for using.

1.3. Present study

This report contributes to existing research on kratom in two ways. It is among the first studies to assess the availability of kratom in vape

shops (LoParco et al., 2023), leveraging a statewide sample in California. Because data were derived from a study that focused on retail observations of vape shops stratified by distance to colleges, this research is uniquely positioned to examine kratom availability to college students. We hypothesized that stores near colleges would be more likely to sell kratom, given recent evidence of uptake among college students (Parent et al.,). This study is also first to evaluate compliance with a local law that restricts kratom sales. Kratom is legal for sale in California except in the City of San Diego, which banned manufacturing, sale, distribution, and possession of novel synthetic and psychoactive drugs in 2016.

2. Methods

This study did not involve human subjects and was exempt from IRB approval. In summer 2019, six trained professional data collectors recorded whether vape shops sold other tobacco products (vape-only vs. vape-and-smoke shops) and kratom in any form as part of a larger study about retail tobacco marketing (n = 614; completion rate = 93.0%) (Ali et al., 2021). Inter-rater reliability was assessed in 51 stores: other tobacco kappa = 0.94; kratom kappa = 0.67. Shops were classified as "vape-and-smoke" if they sold cigarettes, little cigars/cigarillos, blunts/blunt wraps/cigar wraps, large cigars, hookah tobacco/shisha, or chewing tobacco/snus; "vape only" shops did not sell any other tobacco products.

This secondary analysis of retail observations compared shops located near and at a distance to both community colleges and 4-year universities. The population of vape shops was identified by querying Yelp and Google, then geocoded to latitude/longitude and census tract (mapping rate = 99.0%) (Ali et al., 2021). We calculated straight-line distance from each shop to nearest college campus boundary using shapefiles that we curated or created: <https://www.californiaschoolcampusdatabase.org>. A random sample of 660 vape shops was drawn from two strata, shops near (within 3 miles) or distant from (>3 miles) college campuses (Dai and Hao, 2017). Data collectors attempted 660 store observations with the goal of yielding 600 observations, but only 46 were incomplete (n = 614). Reasons for incomplete were refusal (n = 25), temporary closure (n = 12), vaping products not sold (n = 6), membership or fee required to enter (n = 1), and other (n = 2).

We used R (R Core Team, 2021) to compute descriptive statistics for retail availability of kratom in any form as well as compliance with the kratom sales ban among stores in San Diego. Multivariable logistic regression tested whether vape shops near colleges were more likely to sell kratom (reference = farther than 3 miles). In a sensitivity analysis, distance from campus was treated as a continuous variable. Observed shops (n = 614) were located within 565 census tracts, of which 92% had one store, 7.3% had two, and four had three stores. Models included quartiled versions of tract-level demographics (population density, median household income, race and ethnicity), using estimates obtained from the American Communities Survey 2013–2017. Reference groups were the first quartiles, representing the lowest values for each tract variable.

3. Results

Overall, 165 stores were vape-only shops and 449 were vape-and-smoke shops that sold other tobacco products. Kratom was sold in 62.4% of shops overall, in 81.1% of vape-and-smoke shops and 11.5% of vape-only shops (AOR = 40.43, 95% CI = 23.26–74.11, see Table 1). Kratom availability did not differ between stores near and farther from colleges (see Table 1). Treating distance from campus as a continuous measure similarly yielded null findings (AOR = 1.06, 95% CI = 0.74–1.62).

Stores located in census tracts with the fourth quartile of population density (vs. first) (AOR: 0.34; 95% CI: 0.16–0.68) and the third quartile of median household income (vs. first) (AOR: 0.49; 95% CI: 0.25–0.94)

Table 1

Nearness to college, store type, and tract-level demographic correlates of kratom availability in California vape shops, 2019 (n = 614).

| | Adjusted Odds Ratio | 95% Confidence Interval |
|---|---------------------|-------------------------|
| Near any college (ref = no) | 0.93 | (0.05, 6.01) |
| Vape-and-smoke (ref = vape-only)*** | 40.43 | (23.26, 74.11) |
| Population density ^a | | |
| Quartile 2 (2841 – 5805) | 0.68 | (0.35, 1.31) |
| Quartile 3 (5825 – 9390) | 0.69 | (0.35, 1.33) |
| Quartile 4 (9407 – 81,714)** | 0.34 | (0.16, 0.68) |
| % Non-Hispanic Black | | |
| Quartile 2 (0.94% – 2.58%) | 0.65 | (0.34, 1.23) |
| Quartile 3 (2.69% – 6.35%) | 1.14 | (0.58, 2.24) |
| Quartile 4 (6.37 – 53.78%) | 0.78 | (0.39, 1.53) |
| % Non-Hispanic Asian | | |
| Quartile 2 (2.98% – 7.52%) | 1.33 | (0.70, 2.54) |
| Quartile 3 (7.54% – 14.68%) | 1.12 | (0.57, 2.18) |
| Quartile 4 (14.70% – 88.18%) | 1.59 | (0.76, 3.33) |
| % Non-Hispanic Pacific Islander/AIAN/ other and multi-racial | | |
| Quartile 2 (1.96% – 3.46%) | 1.04 | (0.55, 1.99) |
| Quartile 3 (3.47% – 5.21%) | 1.12 | (0.57, 2.21) |
| Quartile 4 (5.21% – 18.82%) | 0.95 | (0.47, 1.93) |
| % Hispanic | | |
| Quartile 2 (18.87% – 33.04%) | 0.83 | (0.43, 1.58) |
| Quartile 3 (33.10% – 52.04%) | 0.84 | (0.43, 1.64) |
| Quartile 4 (52.06% – 98.94%) | 1.12 | (0.53, 2.36) |
| Median household income | | |
| Quartile 2 (\$45,025 - \$60,171) | 1.16 | (0.60, 2.24) |
| Quartile 3 (\$60,243 - \$77,097)* | 0.49 | (0.25, 0.94) |
| Quartile 4 (\$77,176 - \$186,250) | 0.88 | (0.42, 1.84) |

Note. AIAN = American Indian and Alaska Native.

* $p < .05$, ** $p < .01$, *** $p < .001$.

^a Quartile 1 is the reference category for all tract-level demographics.

each had lower odds of selling kratom. Availability of kratom was not associated with tract-level measures of race and ethnicity.

Among the subsample of 26 vape shops located in the City of San Diego, 73.1% were vape-and-smoke shops (n = 19). Kratom was available in 12 shops overall; observed non-compliance with the local ordinance was 46.2% (95% CI = 28.8–64.5).

4. Discussion

Kratom was available in two-thirds of vape-and-smoke shops throughout California, which could signal appeal of these products among tobacco users. Retail availability of kratom is of concern given the lack of regulation and surveillance of kratom production, despite evidence that kratom can contribute to negative health outcomes¹. Availability did not differ by nearness to colleges, indicating risk for use based on availability may be comparable across college students and their non-college attending peers. Future research examining availability and use within the same study would be beneficial, as well as examination of reasons why kratom use is more likely among individuals who vape nicotine (Smith et al., 2022) (e.g., overlapping motives for stimulation effects, use of kratom to manage discomfort of nicotine withdrawal). Additionally, because kratom use is associated with substance use disorder (Rogers et al., 2021), it will be important for future studies to clarify the role that kratom availability plays in management of other substance use, including, but not limited to tobacco use.

Strengths of this research are novel assessment of kratom availability in a statewide stratified random sample of vape shops located near or far from college campuses. The main limitation is that the search strategy for vape shops excluded smoke shops that did not offer vaping products and other retail sources of kratom that do not sell tobacco (e.g., kratom e-commerce sites, kratom bars). In a prior study of kratom sales in stores with tobacco, alcohol, and/or CBD licenses in Fort Worth, Texas, 90% of stores that sold kratom had a tobacco retail license and two-thirds were smoke shops (LoParco et al., 2023). Future research should consider

availability and marketing of kratom in the larger tobacco retail environment, including smoke shops, gas/convenience stores and other retailers. This study focused on brick-and-mortar stores exclusively, and future research should consider kratom availability and marketing for online retailers because products purchased online contain higher concentrations of psychoactive alkaloids than the natural plant (Anand and Hosanagar, 2022). Although this was a statewide sample, the relatively small subsample of observed stores in San Diego yields an imprecise estimate of compliance with the local sales ban. More research to assess compliance with state and local laws that prohibit sales of kratom is needed. Nonetheless, nearly half of stores were selling kratom in a city with a local ban, indicating the potential ineffectiveness of drug prohibition implementation.

Research is needed to monitor awareness, use, and susceptibility to use kratom among young people as well as dual use with tobacco products. Such research could inform the priorities for marketing surveillance to assess kratom availability, advertising, and cross-product promotion with tobacco. Possible regulatory strategies include prohibiting tobacco retail licensees from selling kratom and establishing a kratom licensing and testing program. The regulatory potential of state and local retail licensing should be explored to restrict the sale of tobacco in stores that sell psychoactive products. Concerns for studying a “triangulum” defined by tobacco, e-cigarettes, and cannabis products could be broadened to consider the availability of psychoactive substances like kratom in the retail environment.

5. Conclusion

Kratom was available in the majority of vape shops assessed. Widespread availability in tobacco specialty shops suggests the need for research on dual use with tobacco as well as kratom advertising and cross-product promotion.

6. Author note

Data and R code are available upon request to the authors.

Funding

This research was supported in part by: The National Cancer Institute Grant 1R01-CA217165 (PI: Henriksen). This publication was made possible by an NHLBI-funded postdoctoral fellowship to MAB (5T32HL161270-02).

CRediT authorship contribution statement

Molly A. Bowdring: Formal analysis, Writing – original draft, Writing – review & editing. **Eric C. Leas:** Writing – review & editing. **Monika Vishwakarma:** Formal analysis, Writing – review & editing. **Nina C. Schleicher:** Data curation, Formal analysis, Writing – review & editing. **Judith J. Prochaska:** Writing – review & editing. **Lisa Henriksen:** Conceptualization, Funding acquisition, Project administration, Investigation, Methodology, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Dr. Prochaska has served as an expert witness against tobacco companies in lawsuits and has provided consultation to pharmaceutical and technology companies that make medications and other treatments for quitting smoking. No other authors have interests to declare.

Data availability

Data will be made available on request.

Acknowledgments

Authors are grateful for assistance from Amna Ali, Trent Johnson, Lindsey Winn, and Ewald and Wasserman Research Consultants.

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