



HHS Public Access

Author manuscript

Tob Control. Author manuscript; available in PMC 2023 September 01.

Published in final edited form as:

Tob Control. 2022 September ; 31(5): 659–662. doi:10.1136/tobaccocontrol-2020-056455.

Sources of flavoured e-cigarettes among California youth and young adults: associations with local flavoured tobacco sales restrictions

Shivani Mathur Gaiha¹, Lisa Henriksen², Bonnie Halpern-Felsher¹, Todd Rogers³, Ashley L Feld³, Jennifer Gaber³, Elizabeth Andersen-Rodgers⁴

¹Division of Adolescent Medicine, Department of Pediatrics, Stanford University School of Medicine, Stanford, California, USA

²Stanford Prevention Research Center, Stanford University School of Medicine, Stanford, California, USA

³Center for Health Analytics, Media, and Policy, RTI International, Research Triangle Park, North Carolina, USA

⁴California Tobacco Control Branch, California Department of Public Health, Sacramento, California, USA

Abstract

Purpose—This study compares access to flavoured JUUL and other e-cigarettes from retail, online and social sources among underage and young adult e-cigarette users who live in California jurisdictions that restrict sales of flavoured tobacco with the rest of the state.

Methods—An online survey used social media advertisements to recruit participants (n=3075, ages 15–29) who lived in one of nine jurisdictions that restrict sales (n=1539) or in the rest of state, and oversampled flavoured tobacco users. Focusing on past-month e-cigarette users (n=908), multilevel models tested whether access to flavoured JUUL and other e-cigarettes from retail, online and social sources differed by local law (yes/no) and age group (15–20 or older), controlling for other individual characteristics.

Results—The percent of underage users who obtained flavoured JUUL and other e-cigarettes in the past month was 33.6% and 31.2% from retail, 11.6% and 12.7% online, and 76.0% and 70.9% from social sources, respectively. Compared with underage and young adult users in the rest of California, those in localities that restrict the sales of flavoured tobacco were less likely to obtain

No commercial reuse. See rights and permissions

Correspondence to: Dr Lisa Henriksen, Stanford Prevention Research Center, Stanford University School of Medicine, Stanford, CA 94305, USA; lhenriksen@stanford.edu.

Contributors LH, TR, AF, BH-F and EA-R designed the study. TR, AF and JG supervised data collection and management. SMG led the analysis and drafted the manuscript. All authors contributed critical revisions and final approval. EA-R obtained funding.

Publisher's Disclaimer: Disclaimer The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the California Department of Public Health, NCI, NHLBI or FDA. The contents are the responsibility of the authors alone.

Competing interests BH-F provides expert witness testimony for some e-cigarette litigation.

Ethics approval A waiver of parental consent was approved by the RTI International Institutional Review Board.

flavoured JUUL from retail sources (Adjusted OR=0.54, 95% CI 0.36 to 0.80), but more likely to obtain it from social sources (Adjusted OR=1.55, 95% CI 1.02 to 2.35). The same pattern was observed for other brands of flavoured e-cigarettes.

Conclusion—Although local laws may reduce access to flavoured e-cigarettes from retail sources, more comprehensive state or federal restrictions are recommended to close the loopholes for online sources. Dedicated efforts to curtail access from social sources are needed.

INTRODUCTION

Brick-and-mortar retailers are a major source of e-cigarettes for youth. According to the 2019 Youth Risk Behavior Survey, 8.1% of US high school students who used e-cigarettes in the last 30 days reported buying them at a store, 3.6% bought them online, 21.3% gave someone else money to buy them, 11.1% got them from someone who could legally buy them, 42.8% borrowed them, 11.6% got them some other way and 1.6% took them from a store or another person.¹ In California, where this research was conducted, 31% of high school students who used and paid for e-cigarettes in the past 30 days bought them from a retail store, 9% bought them online, 58% obtained them from social sources and 2% from other sources.²

By 2019, the majority of US high school and middle school students who use e-cigarettes in the past 30 days named JUUL as their favourite brand.³ Among US youth (ages 12–17) who used flavoured JUUL in the past month, 74% obtained it from a retail source, 6% online and 52% from a social source in 2018.⁴ With concern for JUUL's contribution to the youth e-cigarette public health crisis,⁵ California's State Attorney General sued JUUL Labs, citing inadequate online age verification, violation of laws prohibiting sales to minors, as well as advertising and labelling practices.⁶

Given evidence that flavours enhance the appeal of e-cigarettes to youth,⁷ multiple US states and 304 localities had restricted the sales of flavoured e-cigarettes and other tobacco by February 2021.⁸ Local sales restrictions in California and elsewhere are associated with high retailer compliance,⁹ significant reductions in sales of flavoured tobacco^{10 11} and reductions in youth use of these products.^{12–14} However, there is limited evidence as to how sales restrictions affect youth access to e-cigarettes. To address this important gap and to inform ongoing litigation, the current study surveyed California youth and young adults about self-reported access to retail, online and social sources of JUUL and other e-cigarettes. We hypothesised that residing in a jurisdiction that restricts sales of flavoured tobacco (including e-cigarettes) would be associated with lower odds of accessing flavoured JUUL and other e-cigarettes from retail sources.

METHODS

Data are from an online survey of youth and young adults (n=3075, ages 15–29) that was designed to evaluate local sales restrictions on flavoured tobacco in California.¹⁵ Advertisements on Facebook and Instagram recruited respondents based on their self-reported location (county and city/town): half (n=1539) lived in one of nine jurisdictions with a local law restricting flavoured tobacco sales, and the other half (n=1536) lived in the

rest of California without local sales restrictions. Data were collected in January to March, 2019 and 83.2% of persons who screened as eligible participated. A waiver of parental consent was approved by the RTI International Institutional Review Board.

This analysis focuses on the subset of participants who reported using flavoured JUUL (n=602) and/or other e-cigarettes (n=650) in the past 30 days. Participants indicated all the ways they obtained the products in the past 30 days from this list: (1) vape, smoke or head shop, (2) another type of store (eg, convenience store, liquor store, gas station), (3) JUUL.com, (4) other retail website, (5) social media, (6) family member, (7) gave someone money to buy it, (8) friends, (9) someone at school and (10) other. Source 5 was omitted from the question about other flavoured e-cigarettes because we were not aware of evidence that the products were available from social media. Responses were then collapsed into retail sources (1–2), online sources (3–5) and social sources (7–9). Individual-level sociodemographic information assessed age (15–20 vs 21–29), gender, sexual orientation, race/ethnicity and household finances.

Descriptive statistics were tabulated by source (retail, online and social) separately for JUUL and other e-cigarettes. Propensity score weights were created based on age group, race/ethnicity, gender and parents' education. These weights were applied to balance demographic differences in the subset of survey participants who used either flavoured JUUL or other flavoured e-cigarettes (n=908) in jurisdictions where local law restricts sales of flavoured tobacco compared with the rest of California. Multi-level logistic regression (454 participants clustered in jurisdictions and 454 in the rest of California) modelled six outcomes: access to flavoured JUUL from retail, online and social sources, and access to other flavoured e-cigarettes from each source, including sociodemographic covariates. Data were analysed using Stata V.15.1.

RESULTS

Descriptive statistics for unweighted and weighted data are summarised in online supplemental file. Among past-month flavoured JUUL users who were underage (ages 15–20), 33.6% (95% CI 27.9 to 39.7) reported obtaining the product from a brick-and-mortar retailer in the past month, and 11.6% (95% CI 8.1 to 16.4) reported obtaining flavoured JUUL online (see online supplemental file). In the past month, 31.2% (95% CI 25.5 to 37.5) of underage users reported obtaining flavoured e-cigarettes other than JUUL from retail stores and 12.7% (95% CI 8.9 to 17.7) purchased them online. Social sources (friend, someone at school, giving someone else money to buy it) were most common for underage users of flavoured JUUL (76.0%, 95% CI 70.3 to 80.9) and other e-cigarettes (70.9%, 95% CI 64.6 to 76.5) (see online supplemental file).

As hypothesised, participants who lived in a jurisdiction with a local law that restricts flavoured tobacco sales were significantly less likely to report obtaining flavoured e-cigarettes from retail sources in the past month, both for JUUL (Adjusted Odds Ratio AOR=0.54, 95% CI 0.36 to 0.80) and other e-cigarettes (AOR=0.48, 95% CI 0.32 to 0.72) (see table 1). Living in a jurisdiction with a local sales restriction was not associated with a lower likelihood of obtaining a flavoured JUUL or other e-cigarettes from online sources

in the past month (see table 1). However, local sales restrictions were associated with higher odds of obtaining flavoured e-cigarettes from social sources in the past month, both for JUUL (AOR=1.55, 95% CI 1.02 to 2.35) and for other e-cigarettes (AOR=1.94, 95% CI 1.29 to 2.90).

Controlling for residence (local law vs rest of California), underage users were significantly less likely than young adult users (ages 21–29) to obtain flavoured JUUL (AOR=0.61, 95% CI 0.40 to 0.90) and other e-cigarettes (AOR=0.26, 95% CI 0.17 to 0.38) from retail sources. Similarly, underage users were significantly less likely than young adult users to obtain flavoured JUUL online (AOR=0.54, 95% CI 0.31 to 0.94). However, underage users of other e-cigarettes were just as likely as legal-age users to report obtaining flavoured products online. Participants who reported that household finances did not meet or just met basic expenses were significantly less likely than their peers to report purchasing flavoured e-cigarettes other than JUUL online in the past month (AOR=0.46, 95% CI 0.22 to 0.95).

Compared with young adult e-cigarette users, underage users were more than two times as likely to obtain flavoured JUUL from social sources (AOR=2.19, 95% CI 1.44 to 3.30) and three times more likely to obtain other flavoured e-cigarettes from social sources (AOR=3.07, 95% CI 2.04 to 4.64). Women were just as likely as men to obtain flavoured JUUL from social sources but more likely than men to obtain flavoured other e-cigarettes from social sources (AOR=1.67, 95% CI 1.11 to 2.53). Race/ethnicity and identifying as LGBTQ (Lesbian, Gay, Bisexual, Transgender, Queer) were not associated with how users obtained flavoured JUUL or other e-cigarettes.

DISCUSSION

Results from this statewide survey of youth and young adults suggest that at least 1 in 3 underage users of JUUL or other e-cigarettes purchased flavoured products from brick-and-mortar retailers and 1 in 10 obtained these products online in the past month. These results underscore concern about high rates of underage sales of e-cigarettes found in a study with decoys (ages 18–19) in California.¹⁶

As hypothesised, living in a jurisdiction that restricts sales of flavoured tobacco was associated with significantly lower odds of youth obtaining flavoured JUUL and other e-cigarettes from retail sources. Evidence of important gaps in local laws were also observed. Youth and young adults living in a jurisdiction that restricts the sales of flavoured tobacco were just as likely to report obtaining flavoured e-cigarettes online as their peers in the rest of California. To address these apparent loopholes in local laws, more comprehensive state and/or federal laws are needed to increase vendor compliance with age-of-sale regulations in the brick-and-mortar retail environment and reduce youth access online.

Compared with underage users in the rest of the state, those in a jurisdiction with a local sales restriction were more likely to obtain flavoured JUUL and other e-cigarettes from social sources. Therefore, interventions to address social sources of e-cigarettes are also warranted. That female youth were significantly more likely than male youth to

obtain flavoured e-cigarettes (other than JUUL) from social sources suggests that tailoring messages to young women may be an effective prevention strategy.

Study strengths include oversampling to obtain a sufficient sample of past-month flavoured e-cigarette users, as well as linking data about participants' residence with policy data about local laws that restrict flavoured tobacco sales. Propensity score weighting adjusted for demographic differences between those who lived in a jurisdiction with a local law and those in the rest of the state. In addition, brand-specific data about JUUL are helpful to inform ongoing litigation about the manufacturer's online sales practices.⁶

Although a majority of underage users obtained flavoured e-cigarettes from social sources, this study was not designed to assess the online and retail origins of social sources. Research with social network data are needed to better characterise these distribution chains. This study did not address tobacco-flavoured e-cigarettes, which could underestimate youth access from all sources. The cross-sectional design is not suitable for drawing causal inferences about the impact of local laws. Due to low representation of some racial/ethnic groups in the sample, some priority populations (defined by higher rates of tobacco use) were combined. Future studies with larger samples of past-month users are needed to inform racial/ethnic and gender-specific differences in youth access and response to tobacco retail restrictions.

Evidence from this study suggests that local laws to restrict sales of flavoured tobacco may reduce underage users' access to flavoured e-cigarettes in brick-and-mortar stores. Such laws should have sufficient funding earmarked for routine compliance checks and enforcement, with penalties that include license suspension and revocation.¹⁷ To remedy concerns about online sources in this study and others,^{18–20} stricter enforcement of online age verification and restrictions on postal delivery will be necessary to implement the new federal law, the Preventing Online Sales of E-Cigarettes to Children Act.²¹ Additionally, continued social norm strategies are needed to support state and local laws to restrict flavoured tobacco sales. School prevention curricula and media campaigns that denormalise e-cigarette use could address social sources to complement local, state and federal efforts to reduce youth access to e-cigarettes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements

The authors are grateful for the assistance of: Jessica Pikowski, Joel Hampton, Andrew Freeman, Josh Goetz, Alicia Wentz and Matthew Farrelly (RTI International); Jamie Guillory (Prime Affect Research); and Nina Schleicher and Trent Johnson (Stanford Prevention Research Center).

Funding

Funding for this study was provided by the Centers for Disease Control and Prevention Grant #5 NU58DP005969-04-00 and the California Department of Public Health under contract from Stanford Prevention Research Center to RTI International (Contract #17-10041). Additional funding for LH was provided by the National Cancer Institute (5R01-C067850). Additional funding for BH-F was through grant number U54

HL147127 from the National Heart, Lung, and Blood Institute (NHLBI) and the Food and Drug Administration (FDA) Center for Tobacco Products and from the Taube Research Faculty Scholar for BH-F and SMG.

REFERENCES

1. Creamer MR, Everett Jones S, Gentzke AS, et al. Tobacco product use among high school students - youth risk behavior survey, United States, 2019. *MMWR Suppl* 2020;69:56–63. [PubMed: 32817607]
2. Zhu S-H, Zhuang YL, Braden K. Results of the statewide 2017–18 California student tobacco survey. Center for Research and Intervention in Tobacco Control (CRITC), University of California, San Diego. Available: <https://www.cdph.ca.gov/Programs/CCDC/DCDC/CTCB/CDPH%20Document%20Library/ResearchandEvaluation/Reports/2017-18CaliforniaStudentTobaccoSurveyBiennialReport.pdf> [Accessed 22 Oct 2020].
3. Cullen KA, Gentzke AS, Sawdey MD, et al. E-Cigarette use among youth in the United States, 2019. *JAMA* 2019;322:2095–103. [PubMed: 31688912]
4. Initiative Truth. Where are kids getting JUUL? Available: <https://truthinitiative.org/news/where-are-kids-getting-juul> [Accessed 12 Jun 2020].
5. Office of the Attorney General. Attorney General Becerra and Los Angeles leaders announce lawsuit against JUUL for deceptive marketing practices targeting underage Californians and endangering users of its vaping products. State of California, Department of Justice, Los Angeles, California, 2019. Available: <https://oag.ca.gov/news/press-releases/attorney-general-becerra-and-los-angeles-leaders-announce-lawsuit-against-juul> [Accessed 22 Oct 2020].
6. Superior Court of the State of California. The People of the State of California v. JUUL Labs, INC., PAX Labs, INC., and Does 1–100, Inclusive (Case No. RG19043543). Complaint for Permanent Injunction, Abatement, Civil Penalties, and Other Equitable Relief (Bus. & Prof. Code, §§ 17200, et seq., 17500, et seq., 22950, et seq.; Cal. Civ. Code §§ 3479, et seq.; Cal. Code Civ. Proc. § 731); Redacted Complaint (Redacted Pursuant to Court Order on Jan 28, 2020), 2020. Available: <https://oag.ca.gov/system/files/attachments/press-docs/91186258.pdf> [Accessed 19 Feb 2021].
7. Office of the Surgeon General. E-cigarette use among youth and young adults: a report of the Surgeon General (2016). US Department of Health and Human Services. Available: https://www.cdc.gov/tobacco/data_statistics/sgr/e-cigarettes/index.htm#report [Accessed 14 Dec 2020].
8. Campaign for Tobacco Free Kids. States & localities that have restricted the sale of flavored tobacco products, 2021. Available: <https://www.tobaccofreekids.org/assets/factsheets/0398.pdf> [Accessed 8 Mar 2021].
9. Vyas P, Ling P, Gordon B, et al. Compliance with San Francisco’s flavoured tobacco sales prohibition. *Tob Control* 2021;30:227–230. [PubMed: 32300030]
10. Rogers T, Brown EM, McCrae TM, et al. Compliance with a sales policy on flavored non-cigarette tobacco products. *Tob Regul Sci* 2017;3:84–93.
11. Rogers T, Feld A, Gammon DG, et al. Changes in cigar sales following implementation of a local policy restricting sales of flavoured non-cigarette tobacco products. *Tob Control* 2020;29:412. [PubMed: 31341001]
12. Hawkins SS, Kruzik C, O’Brien M, et al. Flavoured tobacco product restrictions in Massachusetts associated with reductions in adolescent cigarette and e-cigarette use. *Tob Control* 2021;tobaccocontrol-2020–056159.
13. Kingsley M, Setodji CM, Pane JD, et al. Short-term impact of a flavored tobacco restriction: changes in youth tobacco use in a Massachusetts community. *Am J Prev Med* 2019;57:741–8. [PubMed: 31668668]
14. Farley SM, Johns M. New York City flavoured tobacco product sales ban evaluation. *Tob Control* 2017;26:78–84. [PubMed: 26872486]
15. Feld AL, Rogers T, Gaber J. Impact of local flavored tobacco sales restrictions on policy related attitudes and perceived access among California residents. New Orleans, LA: Society for Research on Nicotine and Tobacco, 2020.
16. Roeseler A, Vuong TD, Henriksen L, et al. Assessment of underage sales violations in tobacco stores and vape shops. *JAMA Pediatr* 2019;173:795–7. [PubMed: 31233124]

17. Patel M, Donovan EM, Perks SN, et al. E-cigarette tobacco retail licensing laws: variance across us states as of January 1, 2020. *Am J Public Health* 2020;110:1380–5. [PubMed: 32673117]
18. Laestadius L, Wang Y. Youth access to JUUL online: eBay sales of JUUL prior to and following FDA action. *Tob Control* 2019;28:617–22. [PubMed: 30185531]
19. Williams RS, Derrick J, Ribisl KM. Electronic cigarette sales to minors via the Internet. *JAMA Pediatr* 2015;169:e1563. [PubMed: 25730697]
20. Gaiha SM, Lempert LK, Halpern-Felsher B. Underage youth and young adult e-cigarette use and access before and during the coronavirus disease 2019 pandemic. *JAMA Netw Open* 2020;3:e2027572. [PubMed: 33270127]
21. 116th US Congre. Preventing Online Sales of E-Cigarettes to Children Act, Division FF, Title VI of the Consolidated Appropriations Act, 2021, H.R. 133–1955 (December 2020) (page 1955). Available: <https://www.congress.gov/bill/116th-congress/senate-bill/1253> [Accessed 2 Mar 2021].

What this paper adds

- Local sales restrictions on flavoured tobacco (including e-cigarettes) are associated with high rates of retailer compliance, decreased sales and lower use among youth.
- This study compared how underage and young-adult users obtain flavoured JUUL and other e-cigarettes in jurisdictions with a local sales restriction on flavoured tobacco versus the rest of the state.
- Youth and young adults residing in jurisdictions that restrict sales of flavoured tobacco were less likely to obtain flavoured e-cigarettes from retail sources, and more likely to obtain it from social sources than their peers in the rest of the state.

Local law and individual-level correlates of access to flavoured JUUL and other e-cigarettes from retail, online and social sources: California, 2019

Table 1

	Retail			Online			Social		
	JUUL (n=543)	Other e-cigarettes (n=587)	JUUL (n=543)	Other e-cigarettes (n=543)	JUUL (n=543)	Other e-cigarettes (n=587)	JUUL (n=543)	Other e-cigarettes (n=587)	
Age group									
15-20	0.61 (0.40 to 0.90)	0.26 (0.17, 0.38)	0.54 (0.31 to 0.94)	0.59 (0.35 to 1.00)	2.19 (1.44 to 3.30)	3.07 (2.04 to 4.64)	Ref	Ref	
21-29	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	
Gender*									
Female	0.89 (0.59 to 1.34)	0.67 (0.45 to 1.02)	1.31 (0.74 to 2.29)	0.76 (0.46 to 1.27)	1.13 (0.75 to 1.71)	1.67 (1.11 to 2.53)	Ref	Ref	
Male	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	
LGBTQ									
Yes	0.70 (0.43 to 1.13)	1.03 (0.67 to 1.61)	0.82 (0.39 to 1.73)	1.26 (0.71 to 2.23)	1.37 (0.83 to 2.26)	1.05 (0.67 to 1.65)	Ref	Ref	
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	
Race/ethnicity									
Hispanic, non-black	1.31 (0.78 to 2.17)	1.15 (0.71 to 1.85)	1.16 (0.54 to 2.53)	0.71 (0.37 to 1.37)	1.07 (0.63 to 1.82)	0.92 (0.60 to 1.42)	Ref	Ref	
Other (including Asian, other/multi-race and black) [‡]	1.04 (0.64 to 1.68)	0.92 (0.56 to 1.51)	1.97 (0.96 to 4.05)	1.09 (0.59 to 2.02)	1.09 (0.65 to 1.80)	1.01 (0.61 to 1.71)	Ref	Ref	
White, non-Hispanic	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	
Household finances									
Just meet/have difficulty meeting basic expenses [‡]	0.89 (0.53 to 1.50)	0.98 (0.59 to 1.63)	0.86 (0.41 to 1.80)	0.46 (0.22 to 0.95)	1.39 (0.81 to 2.36)	1.23 (0.75 to 2.00)	Ref	Ref	
Meet needs with a little left over	0.82 (0.51 to 1.30)	0.75 (0.47 to 1.18)	1.06 (0.54 to 2.09)	0.71 (0.42 to 1.23)	0.88 (0.54 to 1.44)	1.17 (0.75 to 1.80)	Ref	Ref	
Live comfortably	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	
Lives in locality that restricts sales of flavoured tobacco [‡]									
Yes	0.54 (0.36 to 0.80)	0.48 (0.32 to 0.72)	0.76 (0.43 to 1.36)	0.93 (0.55 to 1.59)	1.55 (1.02 to 2.35)	1.94 (1.29 to 2.90)	Ref	Ref	
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	

Cell entries are adjusted ORs and 95% CIs from a multi-level model (participants nested in jurisdictions). Bold indicates p<0.05. Values were not treated as missing completely at random for Taylor series variance estimation.

* Too few respondents identifying gender as other (lowest count: 4), therefore omitted from the analysis.

[‡] Too few black respondents who used e-cigarettes and obtained e-cigarettes online in the past 30 days (count: 8); therefore, combined with other racial groups, including Asian/Pacific Islander, non-Hispanic and other/multi-race, non-Hispanic.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Localities included nine California counties and municipalities with restrictions on sales of flavoured non-cigarette tobacco products and/or menthol cigarettes that were effective on or before 1 January 2019. Excluded were two jurisdictions with local laws that applied only to retailers located near schools or youth-populated areas. In California, county laws only apply to retailers located in unincorporated areas. Due to concern that youth and young adult survey respondents who live in these unincorporated areas (covered by the law) may inaccurately self-report living in a more well-known incorporated jurisdiction, we excluded all county laws except the city and county of San Francisco.

LGBTQ, Lesbian, Gay, Bisexual, Transgender, Queer.