



The impact of a comprehensive tobacco product flavor ban in San Francisco among young adults



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ARTICLE INFO

Keywords:

Flavor
Flavor ban
Cigarettes
E-cigarettes
Cigar
Smoking
Vaping

ABSTRACT

Objective: Flavors play an important role in the initiation and use of tobacco products. The FDA, states, and cities have been implementing or considering banning flavored e-cigarettes or any flavored tobacco products. This study empirically assessed the impact of one of the first comprehensive bans of all flavored tobacco products other than tobacco-flavored e-cigarettes among young adults in San Francisco, California.

Methods: Using Amazon Mechanical Turk, a sample of San Francisco residents aged 18–34 who previously used tobacco products (N = 247) were surveyed about their tobacco use both before and after the ban. Descriptive statistics and regression models were applied.

Results: The prevalence of overall flavored tobacco use decreased from 81% and 85% to 69% and 76% for 18–24 years and 25–34 years old, respectively. The prevalence of flavored e-cigarettes decreased from 57% and 56% to 45% and 48% for 18–24 years and 25–34 years old, respectively. The prevalence of cigars uses reduced as well. However, cigarette smoking increased, although not statistically significant among 25–34 years old. 66% of participants did not support the ban and 65% believed the ban had not been enforced completely. Most users reported being able to obtain flavored tobacco products in multiple ways despite the ban.

Conclusions: These findings suggest that comprehensive local flavor bans, by themselves, cannot sharply reduce the availability or use of flavored tobacco products among residents. Nevertheless, local bans can still significantly reduce overall e-cigarette use and cigar smoking but may increase cigarette smoking.

1. Introduction

Starting in 2013, the United States has experienced a surge in youth e-cigarette use that the FDA has termed an epidemic (Cullen, 2019; Gentzke, 2019; United States, 2019; U.S. Department of Health and Human Services, 2018). E-cigarettes have the potential of being a less-harmful alternative to current smokers if they switch from smoking to e-cigarettes completely and flavors in e-cigarettes may help such switching (Litt et al., 2016; Buckell et al., 2019; Russell, 2018). At the same time, research indicates that flavors increase youth initiation into e-cigarette use (Zare et al., 2018; Landry, 2019; Schneller, 2019; Soneji et al., 2019), and flavored e-cigarette use may lead some youth into smoking who otherwise would not (Villanti, 2017; Harrell, 2017). In 2009, the Family Smoking Prevention and Tobacco Control Act banned all characterizing flavors in cigarettes except menthol and tobacco, but there are no federal restrictions on flavors for e-cigarettes, cigars, and other tobacco products. A key challenge for the FDA and tobacco control regulators in other

countries is how to regulate flavors effectively to maximize public health gains (e.g., by increasing total cessation and complete switching from smoking to e-cigarettes reducing) while minimizing related public health losses (e.g., by reducing tobacco use initiation).

In response to the surge in youth e-cigarette use – and the separate outbreak of sudden lung diseases and deaths from vaping (King, 2020) – the FDA, Congress, and many states and cities have been implementing or considering laws and policies with various flavor bans or restrictions. The FDA has implemented a new enforcement policy to stop the sale of all cartridge-based e-cigarettes with flavors other than tobacco or nicotine unless or until their manufacturers show that allowing the marketing of the e-cigarettes with additional added flavors would be “appropriate for the protection of public health” (FDA, U.S., 2020). In the second half of 2019, several states temporarily or permanently banned or restricted the sale of vaping products, and the bans in some states have been blocked by court orders partially due to the risk of pushing e-cigarette users back to smoking (Kounang and Erdman, 2019;

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<https://doi.org/10.1016/j.abrep.2020.100273>

Received 21 January 2020; Received in revised form 19 March 2020; Accepted 27 March 2020

Available online 01 April 2020

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Eggert, 2019; Foden-Vencil, 2019; Marcelo, 2019).

Determining the optimal regulatory approach to flavors remains difficult because of insufficient experience and research. Due to the potential substitutability and complementarity among various tobacco products (Feng et al., 2018), a flavor ban on some tobacco products may promote the use of other products. For example, in response to a menthol ban for cigarettes, some menthol cigarette smokers may reduce or quit smoking (Buckell et al., 2018; Guillory, 2019; Chaiton, 2018; Chaiton and Ban, 2019; Soule, 2019), while some may switch to menthol/other flavored e-cigarette or other products. (Buckell et al., 2018; Chaiton, 2018; Soule, 2019; Rose, 2019). At the same time, banning flavors in e-cigarettes alone would prompt e-cigarette use cessation and reduce e-cigarette initiation but may also push some e-cigarette users to turn to cigarette smoking and could prompt some youth to initiate into smoking instead of e-cigarette use. Additionally, current users' reactions to a flavor ban may be complicated by heterogeneity among users such as gender, age, and socioeconomic status, and contextual effects such as the influence of social and retailer environment. For example, flavors are more attractive to women, youth, and young adults than other groups (Hoffman, 2016; Rath, 2016). Another key concern is whether local or state flavor bans will simply prompt users to obtain their flavored tobacco products in nearby jurisdictions that still sell them, from illegal local sellers, or through Internet sales, thereby reducing any beneficial public health impacts.

Research on the impact of flavor bans is crucial to inform evidence-based decision-making and policy change. Unfortunately, only a small number of studies have examined the impact of actual/hypothetical flavor bans or restrictions (Glantz and Gardiner, 2018). Particularly, most studies focused on a specific tobacco product (e.g., cigarette) or a specific flavor (e.g., menthol) and our knowledge on the impact of a comprehensive flavor ban are limited. Early evidence indicated that the Family Smoking Prevention and Tobacco Control Act's ban on all cigarette flavors other than menthol and tobacco reduced cigarette smoking, but this already small positive effect was diminished due to the availability of menthol-flavored cigarettes and a wide range of flavored smoked tobacco products labeled as little cigars or filtered cigars that are virtually identical to conventional cigarettes (Lindblom and Has, 2020; Lindblom, 2019; Delnevo, 2006; Delnevo and Hrywna, 2007) and other flavored smoked tobacco products (Courtemanche et al., 2017). Some experimental studies (Buckell et al., 2018; Guillory, 2019), empirical surveys in Canada (Chaiton, 2018; Chaiton and Ban, 2019; Soule, 2019), and simulation models (Levy, 2011) indicate that a ban of menthol flavor in cigarettes increase quitting among menthol smokers and reduce overall smoking, and other evidence indicates that a menthol ban for only cigarettes would likely increase the use of alternative flavored tobacco products, such as e-cigarettes and cigars (Buckell et al., 2018; Chaiton, 2018; Soule, 2019; Rose, 2019). Similarly, one experimental study (Buckell et al., 2018) indicates that a flavor ban for only e-cigarettes would reduce e-cigarette use but increase cigarette smoking, and a ban on both menthol cigarettes and flavored e-cigarettes might decrease e-cigarette use and reduce menthol cigarette smoking, but also increase the use of non-menthol cigarettes.

In January 2019, San Francisco, California implemented a comprehensive ban on the sale of all flavored e-cigarettes (other than tobacco flavor), menthol cigarettes, and other non-tobacco flavored tobacco products (San Francisco, 2018; Francisco, 2018). In this study, we aimed to empirically assess the impact of the flavor ban policy among young adults (18–34 years old) in San Francisco, focusing on the change in the uses of menthol cigarettes, e-cigarettes, and cigars. We focused on young adults because young adulthood is the period during which experimental tobacco use often transitions into regular use and nicotine dependence (U.S. Department of Health and Human Services, 2012; Pierce et al., 2009).

2. Methods

Data were collected on Amazon Mechanical Turk (MTurk) (Keith

et al., 2017). MTurk is efficient, reliable, and cost-effective for generating sample responses that are largely comparable to those collected via more conventional means (Mortensen and Hughes, 2018). Recently, MTurk has been used widely in tobacco studies (Morean, 2018; Bauhoff et al., 2017; Jo, 2018; Hall et al., 2014; Lipkus and Mays, 2018; Mays, 2017; Scott-Sheldon and Stroud, 2018). MTurk workers tend to be young adults who live in large cities (Huff and Tingley, 2015), consistent with our target population. Inclusion criteria were: age 18–34 years; lived, worked or studied in the city of San Francisco from December 2018 (one month before the ban went into effect) until the time of the survey without interruption; ever used any tobacco product including cigarettes, e-cigarettes, cigars, hookah/waterpipe, pipes, smokeless/dissolvable tobaccos from December 2018 until the time of the survey; and $\geq 90\%$ approval rating from previous MTurk tasks. Eligible participants were given access to the survey, hosted by Qualtrics (<https://www.qualtrics.com/>). The “Prevent Ballot Box Stuffing” option provided by Qualtrics was used to keep participants from taking the survey multiple times. To further increase the quality of the survey and prevent fake information, we designed a zip-code double-checking mechanism. First, participants were requested to provide the zip-code where she/he lived and the zip-code where she/he spent most of her/his day time (likely to be a workplace or college campus), and the input was checked to make sure at least one of two zip-codes was in the city of San Francisco. Second, before the end of the survey (at this stage, the participants were not allowed to roll back to review their previous input), each participant was asked to provide the zip-code where she/he lives again, and those who could not provide an identical zip-code that they provided at the beginning of the survey were considered as “fake participants” and were excluded. A brief introduction of San Francisco's flavor ban was provided at the beginning of the survey and pictures of the major tobacco products were provided repeatedly in the survey as reminders. The survey was active in MTurk between November 9 and 23, 2019. Each approved participant was compensated \$ 0.3. The Institutional Review Board at the University of Memphis approved this study.

Participants reported basic demographic information such as age, gender, race/ethnicity, educational attainment, employment status, and student status. Parents' educational attainment was requested as a proxy of the participant's socioeconomic status because direct measures such as the household income may not accurately reflect a young adult's status since they may live with their parents or may not have completed their education (Erola et al., 2016; Williams, 2017; Patrick, 2012). Participants reported their attitudes towards the ban in general by responding to “I am glad the City banned all sales of flavored tobacco-nicotine products”, attitudes towards the ban for each of five product categories by checking the product that the participant thinks should not be banned, and perceptions of retailers' compliance to the ban by answering “Do you agree or disagree with the following statement: the flavor ban has been enforced completely and there are no retailers in San Francisco that sell flavored tobacco or vape/e-cigarette products?”. Participants also reported their subjective reaction to the flavor ban (e.g., try to quit/reduce the use of tobacco product, was able/unable to quit/reduce the use, stock up flavored products before the ban, buy flavored products from illegal sellers after the ban). Participants were asked to check all products that had been used at least once both before the ban (during December 2018) and currently (during the past 30 days). For each of five categories including cigarettes; e-cigarettes; cigars (including cigars, cigarillos, and little cigars, referred to as cigars in the following text); hookah/waterpipe; and smokeless/dissolvable tobacco, if a participant used any products in these categories, there was a follow-up question to ask how/where they typically obtained that products (e.g., online, from friends, tobacco retailers in/outside of San Francisco).

To analyze the data, we first used descriptive statistics to depict the prevalence of several smoking/vaping products and the distribution of various ways of obtaining each product category before and after the

flavor ban. Chi-square tests were used to test differences in demographics among those who used menthol cigarettes, flavored e-cigarettes, and flavored cigars before the ban, respectively. Paired t-tests were used to test for the change in the prevalence of each smoking/vaping product among participants, stratified by two age groups including 18–24 and 25–34 years. Chi-square tests were used to test the difference in the distribution of ways of obtaining smoking/vaping products before and after the ban. Second, we summarized the participants' attitudes, perceptions, and subjective reactions to the flavor ban. Third, we examined the switch/change of tobacco product use after the ban among those who used menthol cigarettes, flavored e-cigarette, and flavored cigars before the ban. Finally, logistic regression models (PROC LOGISTIC in SAS, version 9.4) were used to estimate the odds of using flavored products after the flavor ban among the whole sample, for menthol cigarettes, flavored e-cigarette, and flavored cigars, respectively. The regression models adjusted for basic demographics and tobacco use before the ban (whether the specific flavored product had been used, whether the specific non-flavored product had been used, and for dual/poly use of tobacco products). Analyses were performed using SAS 9.4.

3. Results

As shown in Table 1, among the 247 participants who completed the survey, the majority were male (61%), between 25 and 34 years of age (75%), white (61%), with high educational attainment (93% with college/associate degree, bachelor degree, or above), and had a full-time job (76%). The mean age was 27.2 years, with a standard deviation of 4.3 years. The demographic characteristics were not significantly different between those who smoked menthol cigarettes, those who used flavored e-cigarettes, and those who used flavored cigars before the ban, except that women were less likely to use flavored cigars, the younger group (18–24 years old) was less likely to use menthol cigarettes compared with other products, and Black and Asian American respondents were more likely to use menthol cigarettes and flavored cigars than e-cigarettes (although not statistically significant).

As presented in Table 2, among both the 18–24 and 25–34 age groups, the prevalence of using any tobacco products (both overall and flavored) decreased significantly after the flavor ban, and the

prevalence of using any smoking products including both cigarettes and cigars kept stable. For both age groups, the prevalence of using flavored e-cigarettes decreased significantly after the flavor ban as well, as one might expect, with increases in the use of still-permitted tobacco-flavored e-cigarettes. However, among the 18–24 age group, there was also a significant increase in cigarette smoking overall, but a significant decrease in the smoking of cigars, both flavored and overall. Among the 25–34 age group, there was a significant decrease in the exclusive use of e-cigarettes and the dual use of e-cigarettes with cigars.

As shown in Table 3, the proportions of e-cigarettes, cigarettes, and cigars obtained over the Internet or through the mail increased after the ban, and the proportions obtained from retailers outside of San Francisco also increased overall. But the overall distribution was only significantly different for e-cigarettes and not for cigarettes or cigars.

As shown in Table 4, 70% of participants who used menthol cigarettes exclusively before the ban continued to use them exclusively after the ban. Likewise, 73.8% of those who used menthol cigarettes along with other products before the ban continued to do so after. Among those who exclusively used flavored e-cigarettes before the ban, about 60% continued to use them exclusively after the ban, and among those who used flavored e-cigarettes and other products before the ban, 65% continued to do so after the ban. However, nearly 21% of those who exclusively used flavored e-cigarettes before the ban quit all tobacco/nicotine use, including vaping, after the ban, and the proportion of those who quit was much smaller among those used menthol cigarettes whereas, in contrast, only about 4% of those who used flavored e-cigarettes and other tobacco products before the ban quit the use of all tobacco/nicotine products after the ban.

As shown in Table 5, the odds of using menthol cigarettes, flavored e-cigarettes, or flavored cigars were substantially greater among those who had (vs. had not) used the same product before the ban. Differences in the odds ratio of using the same product before the ban indicate that among flavored tobacco products, the use of menthol cigarettes (odds ratio of 54.9) was the least likely to quit after the ban, and flavored cigar smoking (odds ratio of 5.7) was the most likely to quit after the ban. After the ban, women were less likely to use menthol cigarettes and flavored e-cigarettes compared with males. Participants who were 25–34 years of age, as well as blacks, students, and those with higher educational attainment were more likely to use flavored cigars

Table 1

Characteristics of young adults (N = 247) who lived or worked in the city of San Francisco and used tobacco or vaping products between December 2018 and November 2019.

		Use of flavored tobacco products before the ban %			
		All (N = 247) %	Menthol cigarettes (N = 81)	Flavored e-cigarettes (N = 139)	Flavored cigars (N = 42)
Gender	Female	38.1	44.4	36.7	28.6 *
	Male	60.7	56.8	61.9	71.4 *
	Else	1.2	1.2	1.5	0 *
Age	18–24	25.1	11.1 **	25.2	28.6
	25–34	74.9	88.9 **	74.8	71.4
Race /ethnicity	White	60.7	55.9	69.8	62.2
	Black	9.7	18.9	5.7	16.2
	Asian	12.6	17.6	11.5	21.6
	Hispanic	13.4	14.8	8.6	11.9
	Others and mixed	3.6	1.4	4.3	0
Education	Below bachelor	47.8	45.6	50.4	40.5
	Bachelor and above	52.2	54.4	49.6	59.5
Parental education	Below bachelor	49.4	51.8	50.3	54.7
	Bachelor and above	50.6	48.2	49.7	45.3
Employment status	Full-time work	75.7	77.8	77.0	85.7
	Part-time work	15.4	14.8	15.1	9.5
	Not employed	8.9	7.4	7.9	4.8
Student status	Full-time student	21.1	16.0	17.3	9.5
	Part-time student	14.2	9.8	14.4	19.1
	Not a student	64.8	74.1	68.3	71.4

Note: boldface indicates statistical significance, with * for P < 0.05, and ** for P < 0.01.

Table 2
Prevalence (%) of tobacco or vaping products before and after the flavor ban.

		18–24 years (N = 62)			25–34 years (N = 185)		
		Before the ban	After the ban	Difference (95% CI)	Before the ban	After the ban	Difference (95% CI)
Any tobacco products		100	82.3	-17.7 (-27.5, -8.0) ***	100	92.4	-7.6 (-11.4, -3.7) ***
Any smoking products including cigarettes and cigars		43.6	43.6	0 (-10.43, 10.3)	68.7	67.0	-1.6 (-7.2, 3.9)
Any flavored tobacco products		80.7	69.4	-11.3 (-23.6, 1.0)*	84.9	76.2	-8.6 (-14.0, -3.3) ***
Cigarettes	Any	27.4	37.1	9.7 (-1.3, 20.7) *	57.8	58.4	0.5 (-5.6, 6.7)
	Menthol flavor	14.5	19.4	4.8 (-3.7, 13.4)	38.9	38.4	0.5 (-6.1, 5.0)
	Non-flavored	17.7	21	3.2 (-4.7, 11.2)	29.2	29.7	-0.5 (-5.2, 6.3)
E-cigarettes	Any	56.5	46.8	-9.7 (-21.6, 2.2)	60	50.8	-9.2 (-15.4, -3.0) ***
	Any flavors	56.5	45.2	-11.3 (-22.7, 0.07) *	56.2	48.1	-8.1 (-14.7, -1.5) **
	Menthol flavor	19.4	12.9	-6.4 (-16.6, 3.7)	26.5	24.9	-1.6 (-7.0, 3.7)
Cigars (incl. cigars, little cigars, cigarillos)	Any	22.6	12.9	-9.7 (-20.7, 1.3) *	22.7	19.5	-3.2 (-9.1, 2.6)
	Flavored	19.4	6.5	-12.9 (-23.7, -2.1) **	16.2	13	-3.2 (-9.3, 2.8)
	Non-flavored	8.1	8.1	0 (-9.2, 9.2)	11.4	8.7	-2.7 (-7.1, 1.7)
Hookah	Any	24.2	24.2	0 (-11.2, 11.3)	24.2	21.6	-2.6 (-7.4, 4.1)
	Flavored	19.4	21	1.6 (-10.1, 13.3)	21.6	20	-1.6 (-7.8, 4.5)
	Non-flavored	8.1	3.2	-4.8 (-12.0, 2.3)	7	3.8	-3.2 (-7.2, 0.7)
Smokeless/dissolvable tobacco products	Any	6.5	8.1	1.6 (-5.7, 8.9)	6.5	6.5	0.0 (-3.0, 3.0)
	Flavored	3.2	8.1	4.8 (-2.3, 12.0)	3.8	4.9	1.1 (-1.9, 4.1)
	Non-flavored	4.8	0	-4.8 (-10.3, 0.7) *	2.7	2.7	0.0 (-2.1, 2.1)
Exclusive use	Cigarettes	9.7	12.9	3.2 (-4.7, 11.2)	22.2	22.7	0.5 (-3.6, 4.7)
	E-cigarettes	33.9	24.2	-9.7 (-20.7, 13.1) *	22.2	19.5	-2.7 (-8.0, 2.6)
	Cigars	4.8	1.6	-3.2 (-7.8, 13.0)	4.3	4.9	0.5 (-3.0, 4.1)
Dual use and poly-use	Hookah	6.5	8.1	1.6 (-5.6, 8.8)	3.2	2.7	-0.5 (-2.9, 1.9)
	Smokeless/dissolvables	3.2	1.6	-1.6 (-4.8, 1.6)	0.5	1.1	0.5 (-0.5, 1.6)
	Cigarettes & e-cigarettes	11.3	12.9	1.6 (-4.7, 7.2)	28.6	26.5	-2.2 (-7.8, 3.5)
Cigarettes & cigars	Cigarettes & cigars	6.4	6.4	0 (-8.0, 8.0)	11.9	10.8	-1.1 (-5.4, 3.2)
	E-cigarettes & cigars	8.1	6.4	-1.6 (-8.9, 5.7)	14.1	9.7	-4.3 (-8.6, -0.1) **
	Cigarettes, e-cigarettes, & cigars	1.6	1.6	0 (-4.6, 4.6)	9.7	7.0	-2.7 (-6.2, 0.8)

Note: boldface indicates statistical significance, with * for P < 0.1, ** for P < 0.05, and *** for P < 0.01.

Table 3
Distribution (%) of various ways to obtain tobacco or vaping products before and after the ban.

Ways to obtain smoking or vaping products	Cigarettes		Cigars (incl. cigars, little cigars cigarillos)		E-cigarettes **		
	Before the ban	After the ban	Before the ban	After the ban	Before the ban	After the ban	
Over the Internet/through the mail	3.2	6.9	7.1	11.4	15.8	26.8	
Friends, family members, or other persons	23.4	19.9	25.0	22.7	18.5	15.5	
A smoke shop, tobacco specialty store or tobacco outlet store, etc.	In SF*	21.8	19.9	19.6	15.9	11.6	2.4
	Out of SF	10.5	13.7	7.1	6.8	4.8	8.1
A supermarket, convenience store, gas station, grocery, drug store, etc.	In SF	33.1	31.3	10.7	15.9	8.9	7.3
	Out of SF	8.1	7.6	3.6	2.3	3.4	5.7
A cigar bar	In SF	N/A	N/A	21.4	13.6	N/A	N/A
	Out of SF	N/A	N/A	5.4	11.4	N/A	N/A
A vape shop or vapor lounge	In SF	N/A	N/A	N/A	N/A	27.4	19.5
	Out of SF	N/A	N/A	N/A	N/A	8.9	13.0

* Here SF refers to the city of San Francisco.

** the distribution of ways to obtain e-cigarettes was significantly different before and after the ban, with p < 0.001.

compared to those aged 18–24 years, of other races/ethnicities, who were not students, and those with lower educational attainment.

In terms of participants' attitudes and reactions to the ban, 8.1% of participants supported the flavor ban, and 35% agreed that the ban had been enforced completely in San Francisco (see Table A.1 in the Appendix A). A greater percentage of participants opposed the ban on flavored cigars (approximately 66%) than opposed the ban on flavored e-cigarettes (42%). Overall, 20% of participants reported that they quit using tobacco and another 14% reported that they reduced their tobacco use after the

ban. Some participants reported that they kept using the banned flavored products by evading the ban in various ways such as purchasing online (15%), stocking up before the ban (13%), purchasing from outside of the city (12%), making illegal purchases (5%), or purchasing from otherwise legal retailers in SF that did comply with the ban (4.5%).

Among the 36 participants who left informative comments about the ban, 20 were negative, nine were positive, and seven were neutral. The negative comments repeatedly included adjectives such as ridiculous, stupid, and invasive. One commented "The ban does nothing except make

Table 4
Change in smoking or vaping products use after the ban, among those who used menthol cigarettes and flavored e-cigarette before the ban.

Before the ban		After the ban	Percent
Menthol cigarettes	Exclusive use (N = 20)	Maintained exclusive use, n = 14	70.0%
		Quit any tobacco use, n = 1	5.0%
	Use together with other products (N = 61)	Use any other products, n = 5	25.0%
		Maintained use together with other products, n = 45	73.8%
Flavored e-cigarettes	Exclusive use (N = 58)	Quit any tobacco use, n = 2	3.3%
		Use any other products, n = 14	23.0%
		Maintained exclusive use, n = 35	60.3%
	Use together with other products (N = 81)	Quit any tobacco use, n = 12	20.7%
		Use any other products, n = 11	19.0%
		Maintained use together with other products, n = 53	65.4%
	Quit any tobacco use, n = 3	3.7%	
	Use any other products, n = 25	30.9%	

people want it more” and another commented, “I no longer live in San Francisco!”. Among the positive comments, one mentioned “I quit tobacco and hate the smell of cigarettes. Would love to see less of them around.” Another who reportedly quit tobacco use after the ban stated: “The ban definitely influenced my decision a little bit and for that reason, I think it would be nice if cigarettes were banned completely forever in all forms from retailers.”

4. Discussion

To our knowledge, this is the first study to examine self-reported changes in tobacco use after a comprehensive flavor ban in a large metropolitan area, and the first to provide evidence (albeit preliminary) of the impact of a flavor ban that includes e-cigarettes. Despite the small sample size and convenience sampling, the findings may provide insights for policies related to tobacco flavors at local, state and federal levels and provide some useful insights to guide future research.

Our results indicate that among young adults, comprehensive local flavor bans for tobacco products are likely to reduce the use of tobacco products overall and flavored tobacco products overall. Specifically, the ban reduced cigarette use and cigar smoking by reducing the use of flavored tobacco products but can also increase, or not reduce, cigarette smoking as some former users of the banned flavored tobacco products switch to smoking. In particular, the findings indicate that the use of flavored cigars is more likely to decrease after the ban than the use of

menthol cigarettes or flavored e-cigarettes. However, the number of participants who used flavored cigars in this study was relatively small and larger studies will be needed to confirm this finding. Our finding that menthol cigarette smokers, especially exclusive users, were the least likely to change their use among all flavored tobacco product users. Our finding is consistent with previous studies that reported a lower likelihood of switching to other tobacco products or quit smoking among the users of menthol cigarettes (Wackowski et al., 2015; Pearson, 2012; D’Silva et al., 2015). Also consistent with other studies, this study found that banning flavors not only prompted flavored e-cigarette users to switch to other products but also significantly increased their total cessation (Harrell, 2017; Harrell, 2017).

Our study found that the younger age group (18–24 years) was more sensitive to the ban than the older group (25–34 years) and that observation produced both gains (e.g., reductions in e-cigarette use and cigar smoking) and harms (e.g., increases in cigarette smoking). Two factors may have contributed to this difference. First, younger age groups tend to be at earlier stages of tobacco use, with higher levels of experimentation and lower levels of regular, addicted use (U.S. Department of Health and Human Services, 2012; Pierce et al., 2009; Hammond, 2005; Freedman et al., 2012). Second, compared with the older group, the younger group may have fewer economic and other resources to facilitate obtaining flavored tobacco products after the ban.

We found that retailer compliance with the flavor ban in San Francisco

Table 5
Odds of using menthol cigarettes, flavored e-cigarettes, and flavored cigars after the flavor ban among young adults (N = 247) in the city of San Francisco, with the 95% confidence interval shown for statistically significant differences by product.

		Menthol cigarettes	Flavored e-cigarettes	Flavored cigars
Age groups	25–34 years	1.03	1.18	4.14 (1.06, 16.21) **
	18–24 years (ref)	1	1	1
Gender	Female	0.44 (0.18, 1.10)*	0.52 (0.25, 1.08)*	0.60
	Male (ref)	1	1	1
Race/ethnicity	Black	2.51	0.58	3.50 (0.98, 12.53) *
	Asian	0.91	0.71	0.60
	Hispanic	0.62	0.75	1.12
	Others and mixed	1.17	6.72 (0.90,50.33) *	< 0.001
	White (ref)	1	1	1
Work status	Work	1.90	1.05	0.54
	Not work (ref)	1	1	1
Student status	Student	1.24	1.10	4.35 (1.51, 12.50) ***
	Not student (ref)	1	1	1
Educational attainment	Bachelor and above	1.93	0.92	2.85 (1.01, 8.04) **
	Below bachelor (ref)	1	1	1
Parents’ educational attainment	Bachelor and above	0.98	1.61	0.46
	Below bachelor (ref)	1	1	1
Use the same product before the ban	Yes	54.89 (19.47, 154.70) ***	15.28 (7.02, 33.23) ***	5.71 (2.02, 16.16) ***
	No (ref)	1	1	1
Use the non-flavor of the product before the ban	Yes	0.76	2.74	0.68
	No (ref)	1	1	1
Dual or poly use before the ban	Yes	0.75	2.15 (1.00, 4.66) *	1.56
	No (ref)	1	1	1

Note: boldface indicates statistical significance, with * for p < 0.10, ** for p < 0.05, and *** for p < 0.01.

was moderate, as indicated by only 35% of participants agreeing that the flavor ban had been enforced completely and significant percentages reporting that they still purchased e-cigarettes from San Francisco retailers. Similarly, previous studies examining the 2010 New York City ban on the sale of flavored tobacco products other than cigarettes or e-cigarettes (Rogers, 2017) and the 2016 partial ban on menthol cigarettes in Chicago (Czaplicki, 2018) found only moderate retailer compliance.

More generally, the proportion of participants who continued to obtain their tobacco products from retailers within San Francisco decreased only slightly, or, for some products, did not change after the ban. At the same time, the proportion of participants who obtained tobacco products from friends or purchased them online increased slightly for most products, and purchases from sales outlets outside of San Francisco increased. This indicates that the flavor ban made it less convenient to obtain flavored tobacco products within the city but most users could readily continue buying and using flavored tobacco products in a variety of ways. For example, one participant commented “I usually bought ... on my way to & from school & work I rarely had to buy them while in SF”. Similar comments included “I can find alternative outlets to find flavored products”, and “just like banning anything else, if people want to get it they will”.

Nevertheless, only 8.1% of respondents supported the ban, similar to other studies finding support for flavor bans higher among never users than among former or current tobacco users (Soule, 2019; Agaku, 2019). For each of the five flavored product categories, we examined, about half of the participants thought the flavored products should not be banned. Among flavored e-cigarette users, two-thirds were against the ban.

Our findings should be interpreted cautiously in light of two major limitations. First, our sample was a relatively small convenience sample. However, the demographic characteristics of our sample share several unique features with the general population of young adults in San Francisco, including a higher proportion of minorities and those with a college degree and above (Census and City, 2020). Due to the small sample size, however, we could not rigorously examine switching patterns before and after the ban. Second, the flavor ban was implemented in January 2019 while our survey was conducted in November 2019, and some participants might not have recalled their past tobacco use patterns precisely. More importantly, we cannot exclude the possible impact of factors other than the flavor ban policy; for example, the reported outbreak of sudden lung injuries and deaths associated with vaping in 2019 (King, 2020) could have reduced nicotine e-

cigarette use, including switching back to cigarette smoking.

One novelty of this study is our design of zip-code double-checking mechanism. The zip-codes where the participants lived and worked (or studied) are valuable geographical information themselves because they could help to examine the influence of the retailer environment. More important, using double-checking, we increased the survey quality by keeping fake information out and that is a major problem for most crowdsourcing survey platforms.

Overall, our study indicates that a comprehensive ban of all flavors, even when done by an individual city, will significantly reduce flavored tobacco product use, despite incomplete compliance and the availability of flavored tobacco products online or in nearby jurisdictions. Besides, those reductions in flavored tobacco use and other user responses, such as increased quit attempts, will likely reduce e-cigarette use and cigar smoking but could also increase cigarette smoking. Accordingly, cities and other jurisdictions implementing flavor bans might consider complementary strategies such as public education campaigns to encourage total cessation and discourage new or continued smoking, and restricting smoked tobacco product sales to adult-only sales outlets.

To provide more certain knowledge and guidance regarding the optimal way to structure and implement flavor bans to prevent and reduce overall use and harms, additional research should take advantage of the different types of flavor bans and restrictions being implemented by different states and localities (see several examples mentioned in the introduction). These different state and local policies provide a “laboratory” to examine and compare how existing users and nonusers, including youth, react to different restrictions implemented in different policy contexts. Such evaluations of state flavor restrictions would be especially insightful, given their more homogeneous policy environments compared with city-specific restrictions.

Funding

This research was supported by the National Institute of Drug Abuse of the National Institutes of Health (R03DA048460).

6. Ethics approval

University of Memphis Institutional Review Board.

Appendix A

See Table A.1.

Table A.1
Attitudes and reactions to the flavor ban in San Francisco.

	Percent (%)
General perception	
Support the flavor ban	8.1
Heard of the flavor ban before the survey	62.8
Agreed that the flavor ban has been enforced completely	34.9
The product that should NOT be banned	
Menthol cigarettes	51.8
Flavored e-cigarettes	42.5
Flavored cigars, little cigars, and cigarillos	66.4
Flavored hookah	51.4
Flavored smokeless/dissolvable tobacco product	39.3
Positive reactions	
Quit	19.8
Tried but was unable to quit	16.2
Reduced use	14.2
Tried but was unable to reduce use	8.5
Negative reactions	
Stocked up on flavored products before the ban	13.4
Bought flavored products online after the ban	15.4
Bought flavored products outside of SF after the ban	12.2
Flavored products were still available in SF after the ban	4.5
Bought flavored products illegally in SF after the ban	5.3

Appendix B. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.abrep.2020.100273>.

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