Letters

RESEARCH LETTER

Association of Cigarette Sales With Comprehensive Menthol Flavor Ban in Massachusetts

In April 2021, the US Food and Drug Administration announced its intention to ban menthol flavors from cigarettes and cigars.[1] Before this announcement, Massachusetts was the only state to implement a statewide comprehensive flavor ban on tobacco products in June 2020.[2] Evidence of the effectiveness of comprehensive flavor bans on cigarette sales and smoking remains inconclusive in the US; studies have found decreases in menthol and overall tobacco product sales[3] and no changes in the intensity of smoking[4] after San Francisco's flavor ban. In addition, no study, to our knowledge, has quantified a potential switch to nonflavored tobacco after banning flavored tobacco products. We examined changes in menthol and nonflavored cigarette sales in Massachusetts compared with sales in states without a flavor ban.

Invited Commentary

Supplemental content

Methods | In this cohort study, we used Nielsen Retail Scanner Data of sales volume (reported in 4-week cycles) of menthol and nonflavored cigarette brands sold by US-based retailers. Our outcomes were state-level sales per 1000 people of packs of menthol, nonflavored, and all (menthol and nonflavored)

Table 1. Cigarette Sales and Sociodemographic Characteristics for Massachusetts and Comparison States[a]

	Massachusetts	Comparison states[b]	Mean difference (SE)	*P* value
Price per pack in Feb 2021, $				
Menthol cigarettes, mean (SD)	10.16 (0.28)	6.79 (1.31)	3.36 (0.17)	<.001
Nonflavored cigarettes, mean (SD)	9.87 (0.28)	6.58 (1.36)	3.29 (0.18)	<.001
All (menthol and nonmenthol) cigarettes, mean (SD)	9.94 (0.25)	6.65 (1.34)	3.31 (0.18)	<.001
Sociodemographic characteristics				
Sex, % (SD)				
Male	48.26 (0.99)	48.40 (1.05)	−0.15 (0.14)	.29
Female	51.74 (0.99)	51.60 (1.05)	0.15 (0.14)	.29
Marital status, % (SD)				
Married	49.28 (1.04)	52.24 (2.26)	−2.96 (0.30)	<.001
Unmarried	50.72 (1.04)	47.76 (2.30)	2.96 (0.30)	<.001
Age, % (SD)				
<25 y	28.06 (1.12)	29.70 (2.08)	−1.64 (0.27)	<.001
25-44 y	26.68 (1.08)	24.61 (1.66)	2.07 (0.22)	<.001
45-64 y	27.52 (1.29)	26.85 (1.62)	0.68 (0.21)	.002
≥65 y	17.74 (1.65)	18.84 (2.27)	−1.10 (0.30)	<.001
Race and ethnicity, % (SD)				
Asian	7.20 (0.78)	3.83 (2.73)	3.37 (0.36)	<.001
Black	7.23 (0.97)	13.51 (8.97)	−6.29 (1.17)	<.001
White	82.57 (1.65)	79.24 (8.41)	3.33 (1.10)	.002
Other[c]	3.00 (0.81)	3.41 (2.56)	−0.41 (0.33)	0.22
Educational level, % (SD)				
No high school diploma	10.60 (0.92)	13.87 (2.46)	−3.27 (0.32)	<.001
High school diploma	24.09 (1.50)	29.15 (3.76)	−5.06 (0.49)	<.001
Some college	21.08 (0.91)	26.80 (3.07)	−5.72 (0.40)	<.001
College or higher degree	44.23 (2.18)	30.18 (5.56)	14.05 (0.73)	<.001
Household income, % (SD)				
<$10 000	19.03 (1.77)	19.49 (3.43)	−0.46 (0.46)	.31
$10 000-$29 999	10.12 (1.79)	14.31 (3.72)	−4.19 (0.49)	<.001
$30 000-$59 999	15.69 (1.68)	22.71 (3.14)	−7.02 (0.41)	<.001
$60 000-$149 999	32.71 (1.39)	32.54 (3.76)	0.17 (0.49)	0.73
$150 000+	22.46 (2.33)	10.95 (4.61)	11.51 (0.61)	<.001
Unemployment rate, % (SD)	4.97 (3.14)	4.92 (2.39)	0.05 (0.32)	.87
Mean COVID-19 infection cases per 1000 people (SD)	13.84 (29.31)	14.13 (30.75)	−0.29 (4.07)	.94
Observations, No.	59	1593	NA	NA

Abbreviation: NA, not applicable.

[a] The Nielsen Retail Scanner Data used in the study contains universal product code-level sales of cigarette products reported in dollar and unit volumes at 4-week cycles collected at the point-of-sale from convenience stores, including gas stations, and other channels, such as food or grocery, drug, and mass-market stores.

[b] The eMethods in Supplement contains the full list of states included in the comparison states.

[c] Other included the following races and ethnicities as included in the US Census Bureau Basic Monthly Current Population Survey: American Indian, Alaska Native only, Hawaiian/Pacific Islander only, and multiple races.

Table 2. Four-Week Sales of Packs of Menthol, Nonflavored, and All Cigarettes per 1000 People Before and After Massachusetts' Menthol Flavor Ban

	Per 1000 people (95% CI)						Difference-in-differences estimate (95% CI)		
	Massachusetts			Comparison states[a]					
Type of cigarette	Before flavor ban (January 2017-May 2020)	After flavor ban (June 2020-July 2021)	Difference	Before flavor ban (January 2017-May 2020)	After flavor ban (June 2020-July 2021)	Difference	Unadjusted	Adjusted[b]	*P* value
Menthol cigarettes	404.93 (391.00 to 418.85)	32.24 (8.16 to 56.32)	−372.68 (−399.77 to −345.60)	738.33 (709.71 to 766.95)	717.73 (668.84 to 766.61)	−20.60 (−77.28 to 36.08)	−352.08 (−648.84 to −55.32)	−372.27 (−428.90 to −315.64)	<.001
Nonflavored cigarettes	916.37 (872.72 to 960.01)	856.79 (807.24 to 906.33)	−59.58 (−138.82 to 19.66)	1524.85 (1469.01 to 1580.68)	1361.00 (1268.00 to 1454.00)	−163.85 (−273.74 to −53.95)	104.27 (−470.83 to 679.36)	120.25 (72.61 to 167.88)	<.001
All cigarettes	1321.32 (1265.04 to 1377.60)	887.69 (818.16 to 957.22)	−433.63 (−536.85 to −330.40)	2263.36 (2181.19 to 2345.53)	2180.56 (1942.59 to 2218.54)	−182.80 (−344.84 to −20.76)	−250.83 (−1098.24 to 596.58)	−282.65 (−356.07 to −209.23)	<.001
Observations, No.	44	15	NA	1188	405	NA	1652	1652	NA

Abbreviation: NA, not applicable.

[a] See the eMethods in Supplement for the list of states included in the comparison states.

[b] The adjusted cigarette sales were obtained using linear regression models and an indicator for a menthol flavor ban in Massachusetts in June 2020. Models included mean cigarette price, state fixed effects controlling for time-invariant smoking characteristics, state-level time-varying factors (unemployment rate, age, sex, marital status, household income, education, race and ethnicity, and COVID-19 infection cases), and survey date fixed effects to account for time-invariant characteristics that are common in the fiscal year and seasonality in smoking. Standard errors were clustered within states.

cigarettes from January 2017 to July 2021 based on state-level annual population data obtained from the US Census Bureau. For the population data not available in 2021, we used the average population growth rate to calculate the population for each state in 2021. We used a controlled before and after design with difference-in-differences (eMethods in the Supplement) to examine temporal changes in cigarette sales in Massachusetts before (January 2017 to May 2020) and after (June 2020 to July 2021) the comprehensive flavor ban. The temporal changes were then compared with changes in the 27 states in Nielsen Retail Scanner Data that did not implement state or local flavor bans, and the analyses were controlled for product prices, state-level time-varying factors, seasonality, and state time-invariant factors. State-level time-varying sociodemographic factors were obtained from the US Census Bureau Basic Monthly Current Population Survey. The study did not directly involve human participants and did not require institutional review board approval or informed consent in accordance with the Common Rule. The study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline.

All statistical tests were 2-sided, and $P < .05$ was considered to be statistically significant. Analyses were conducted using Stata, version 15.1 (StataCorp).

Results | We analyzed 1652 four-week sales of cigarette data consisting of 59 observations from Massachusetts (44 from before and 15 from after the menthol flavor ban) and 1593 observations from the comparison states (1188 from before and 405 from after the menthol flavor ban). Mean (SD) cigarette prices per pack were higher in Massachusetts than in comparison states ($9.94 [$0.25] vs $6.65 [$1.34]) (**Table 1**). Individuals in Massachusetts compared with those in the comparison states were less likely to be married (49.28% vs 52.24%) and more likely to be aged 25 to 64 years (54.20% vs 51.49%), Asian (7.20% vs 3.83%) or White (82.57% vs 79.24%) persons, have a college degree (44.23% vs 30.18%), and have a household income of $150 000 or more (22.46% vs 10.95%). There were nondivergent trends in state-level sales of menthol and nonflavored cigarette packs per 1000 people in Massachusetts and comparison states during the period before Massachusetts's comprehensive flavor ban. After the comprehensive flavor ban, the unadjusted 4-week sales of packs of cigarettes per 1000 people decreased in Massachusetts for menthol (404.93 to 32.24), nonflavored (916.37 to 856.79), and all (1321.32 to 887.69) cigarettes (**Table 2**). In comparison states, the unadjusted 4-week sales of packs of cigarettes per 1000 people decreased for menthol (738.33 to 717.73), nonflavored (1524.85 to 1361.00), and all (2263.36 to 2180.56) cigarettes after the Massachusetts comprehensive flavor ban. After the flavor ban, the adjusted 4-week sales of cigarettes in Massachusetts vs the comparison states decreased by 372.27 (95% CI, −428.90 to −315.64; $P < .001$) packs per 1000 people for menthol cigarettes but increased by 120.25 (95% CI, 72.61-167.88; $P < .001$) packs per 1000 people for nonflavored cigarettes. Overall, the adjusted 4-week sales of all cigarettes decreased by 282.65 (95% CI, −356.07 to −209.23; $P < .001$) packs per 1000 people in Massachusetts vs the comparison states.

Discussion | The comprehensive flavor ban in Massachusetts was associated with a statistically significant decrease in state-level menthol and all cigarette sales. Limitations of the study include that cross-border or online cigarette sales in Massachusetts were not accounted for, that states with partial bans were not included, and that Massachusetts enacted other tobacco-related legislation that may have affected the results.[5] Also, the findings should be interpreted cautiously as sales data may not fully capture cigarette consumption.

Nonflavored cigarette sales in Massachusetts vs the comparison states increased after the ban, suggesting the potential substitution of nonflavored cigarettes for menthol cigarettes. The US Food and Drug Administration plans to implement a nation-

wide menthol ban that can regulate the manufacturing, marketing, and sale of menthol cigarettes; therefore, policies and interventions are needed to address possible menthol cigarette users' switching to nonflavored cigarettes that can undermine the effectiveness of the menthol flavor ban. Future studies are needed to examine changes in noncombustible and other combustible tobacco product sales and in cigarette consumption.

Samuel Asare, PhD
Anuja Majmundar, PhD
J. Lee Westmaas, PhD
Priti Bandi, PhD
Zheng Xue, MSPH
Ahmedin Jemal, PhD
Nigar Nargis, PhD

Author Affiliations: Tobacco Control Research, Surveillance & Health Equity Science, American Cancer Society, Kennesaw, Georgia (Asare, Majmundar, Xue, Nargis); Population Science, American Cancer Society, Kennesaw, Georgia (Westmaas); Risk Factors & Screening Surveillance Research, Surveillance & Health Equity Science, American Cancer Society, Kennesaw, Georgia (Bandi); Surveillance & Health Equity Science, American Cancer Society, Kennesaw, Georgia (Jemal).

Accepted for Publication: August 20, 2021.

Published Online: January 4, 2022. doi:10.1001/jamainternmed.2021.7333

Corresponding Author: Samuel Asare, PhD, Tobacco Control Research, Surveillance & Health Equity Science, American Cancer Society, 3380 Chastain Meadows Pkwy NW, Ste 200, Kennesaw, GA 30144 (samuel.asare@cancer.org).

Author Contributions: Dr Asare had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Drs Jemal and Nargis contributed equally to the work as co–first authors.
Concept and design: Asare, Jemal, Nargis.
Acquisition, analysis, or interpretation of data: All authors.
Drafting of the manuscript: Asare, Bandi, Nargis.
Critical revision of the manuscript for important intellectual content: All authors.
Statistical analysis: Asare.
Administrative, technical, or material support: Asare, Nargis.
Supervision: Jemal, Nargis.

Conflict of Interest Disclosures: None reported.

Funding/Support: This study was supported by the Department of Surveillance & Health Equity Science of the American Cancer Society.

Role of the Funder/Sponsor: The funder had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Additional Information: The authors' own analyses and calculations were based in part on data reported by Nielsen through its Scantrack Service for the cigarette category for the 4-week period ending July 2021, for the stateline market and convenience and all other retail channels. Copyright © 2021, The Nielsen Company. The conclusions drawn from the Nielsen data are those of authors and do not reflect the views of Nielsen. Nielsen is not responsible for and had no role in analyzing and preparing the results reported herein.

1. US Food and Drug Administration. FDA commits to evidence-based actions aimed at saving lives and preventing future generations of smokers. Accessed June 1, 2021. https://www.fda.gov/news-events/press-announcements/fda-commits-evidence-based-actions-aimed-saving-lives-and-preventing-future-generations-smokers

2. Delnevo CD, Ganz O, Goodwin RD. Banning menthol cigarettes: a social justice issue long overdue. *Nicotine Tob Res*. 2020;22(10):1673-1675. doi:10.1093/ntr/ntaa152

3. Gammon DG, Rogers T, Gaber J, et al. Implementation of a comprehensive flavoured tobacco product sales restriction and retail tobacco sales. *Tob Control*. 2021;tobaccocontrol-2021-056494. doi:10.1136/tobaccocontrol-2021-056494

4. Guydish JR, Straus ER, Le T, Gubner N, Delucchi KL. Menthol cigarette use in substance use disorder treatment before and after implementation of a county-wide flavoured tobacco ban. *Tob Control*. 2021;30(6):616-622. doi:10.1136/tobaccocontrol-2020-056000

5. Massachusetts Department of Public Health. Public Health Council approves regulations restricting access to vaping and tobacco products. Accessed July 21, 2021. https://www.mass.gov/news/public-health-council-approves-regulations-restricting-access-to-vaping-and-tobacco-products