

Short-Term Impact of a Flavored Tobacco Restriction: Changes in Youth Tobacco Use in a Massachusetts Community



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Introduction: To counter the high prevalence of flavored tobacco use among youth, many U.S. localities have passed policies that restrict youth access to these products. This study aims to evaluate the short-term impact of a flavored tobacco restriction policy on youth access to, and use of, flavored tobacco products in a Massachusetts community.

Methods: A community with the policy (Lowell) was matched to a community without the policy (Malden) with similar demographics, retailer characteristics, and point-of-sale tobacco policies. Product inventories were assessed in tobacco retailers in the 2 communities, and surveys were administered to high school-aged youth in those communities. Inventories and surveys were conducted around the time the policy took effect in October 2016 (baseline) and approximately 6 months later (follow-up); all data were analyzed in 2017. Chi-squared tests and difference-in-difference models were used to estimate the impact of the policy on flavored tobacco availability and youth perceptions and behaviors related to flavored tobacco use.

Results: Flavored tobacco availability decreased significantly in Lowell from baseline to follow-up periods by 70 percentage points ($p < 0.001$), whereas no significant changes in flavored tobacco availability were seen in Malden. In addition, current use of both flavored and non-flavored tobacco decreased in Lowell, but increased in Malden from baseline to follow-up; these changes were significantly different between communities (flavored tobacco: $-5.7%$, $p = 0.03$; non-flavored tobacco: $-6.2%$, $p = 0.01$).

Conclusions: Policies that restrict the sale of flavored tobacco have the potential to curb youth tobacco use in as few as 6 months.

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INTRODUCTION

In 2009, the Family Smoking Prevention and Tobacco Control Act banned sales of flavored cigarettes but not flavored cigars/cigarillos, smokeless tobacco, or e-cigarettes.¹ Since this time, sales of flavored non-cigarette tobacco products have risen, which are available in thousands of distinct flavors (including fruit, candy, and menthol).^{2,3} Flavored tobacco use among youth has also risen: From 2016 to 2017, flavored tobacco use increased significantly among high school-aged tobacco users nationwide (from 57.7% to 63.6%).⁴ Youth who use flavored tobacco

may be more likely to continue to use tobacco in the long term compared with youth who do not use flavored products.^{5,6}

Flavored tobacco products are widely sold and promoted in stores, including convenience stores, which

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youth frequently visit.^{7,8} The saturation of flavored tobacco products in retail stores increases availability of these products, which results in increased youth exposure to flavored tobacco. Previous research has found that increased access and exposure to tobacco products increases youth susceptibility to and experimentation with tobacco. For example, higher retail density near schools has been associated with higher youth ever-smoking rates.⁹

Results from the 2017 Massachusetts Youth Health Survey revealed that 79.8% of current (past 30-day) high school-aged tobacco users used a flavored tobacco product in the past 30 days. Students frequently obtain products from tobacco retailers, with 32.9% of current high school-aged tobacco users in Massachusetts reporting getting tobacco products from a retail store.¹⁰

A policy that removes flavored tobacco from the retail environment can address both availability and youth exposure to these products. In 2014, municipal Boards of Health in Massachusetts began passing regulations restricting the sale of flavored tobacco products (excluding menthol but including e-cigarettes) to adult-only (ages ≥ 21 years) establishments, such as smoking bars, vape shops, and tobacconists. As of April 2019, this policy has been passed by 147 municipalities in Massachusetts, covering 63% of the state's total population.¹¹

Previous research has focused on the impact of these policies on the sale and availability of flavored products. A recent study evaluating flavored tobacco restrictions across Massachusetts found drastic reductions in flavored tobacco availability in tobacco retailers following policy implementation.¹² However, limited research exists on the impact of reduced access to flavored tobacco on youth tobacco use. An evaluation of New York City's flavored tobacco restriction found significant declines in overall sales of flavored tobacco products included in the restriction (cigars, smokeless, pipe/roll your own) post-implementation, and that the odds of both flavored tobacco ever use and any tobacco ever use (not including e-cigarettes) among youth decreased 3 years after policy implementation (based on data from the New York City Youth Risk Behavior Survey).¹³ This paper aims to add to this evidence base by evaluating the short-term (6-month) impact of the flavored restriction policy in 1 Massachusetts community on youth access and use of all types of tobacco products, compared with a matched community without this policy. The study hypothesis was that the policy would result in greater reductions in retail availability of flavored tobacco than in a community without the policy. In addition, a greater increase in reported difficulty to obtain flavored tobacco and a greater decrease in youth initiation of tobacco use with a

flavored product and tobacco use overall were expected than in a community without the policy.

METHODS

Study Sample

In 2014, the Massachusetts Tobacco Control Program (MTCP) received funding from the Centers for Disease Control and Prevention to evaluate the impact of municipal flavored tobacco restriction policies on the point-of-sale retail environment and youth tobacco use. At the time, only 9 communities in Massachusetts had passed a policy. In June 2016, the city of Lowell passed a flavored tobacco restriction policy (which took effect in October 2016) and was selected for evaluation as a case community. Lowell was selected from a pool of communities with a population of at least 15,000 that passed the policy because of its high adult smoking rate and high tobacco retail density compared with other communities. In addition, Lowell was already funded by MTCP to conduct enforcement activities related to the policy, thus increasing the feasibility of conducting surveys in tobacco retailers and schools.

In Lowell, the period between policy passage and implementation was approximately 3.5 months. During this time, retailers were expected to sell down or otherwise remove their flavored tobacco stock. To aid local Board of Health staff in enforcement, the Massachusetts Association of Health Boards, an MTCP technical assistance provider, developed tools, including enforcement trainings, an enforcement protocol, and a flavored product list, with information on all known products with a characterizing flavor (type, brand name, and flavor name). In Lowell, enforcement agents were required to complete educational visits in retailers both before and after policy implementation to disseminate educational materials (such as the flavored product list) and answer policy-related questions.

To evaluate the impact of the policy (independent of community-level and retail-level characteristics), a comparison community was selected and matched to Lowell on the following variables: community demographics, retailer characteristics, and presence of other point-of-sale policies (Table 1 provides a complete list and description of variables). Using direct matching methods, Malden (a Massachusetts community about 30 miles from Lowell) was selected as a comparison community because it was most like Lowell—both in similarity of matching variables (greatest number of variables with $<20\%$ differences) and similarity of other passed point-of-sale policies.

Retailer inventories were conducted during education visits by MTCP-funded Board of Health regional staff in a census of all retailers in Lowell and Malden at baseline (September 2016) before Lowell's flavored restriction policy took effect on October 1, 2016 and 6 months later (March 2017). Data collection was conducted using an online platform that was developed in collaboration with Counter Tools.¹⁴ These surveys captured store information, presence of flavored product advertisements, a full inventory of flavored tobacco products available (cigars/cigarillos, hookah/shisha, smokeless/dissolvable, e-cigarette/nicotine liquid), and (in Lowell only) enforcement activities conducted during each visit. In Lowell, inventories were conducted at 118 retailers at baseline and 113 retailers at follow-up (of 125 total retailers). In Malden, inventories were conducted at 51 retailers at baseline and 48 retailers at follow-up (of 52 total retailers). Inventories were

Table 1. Community Matching Characteristics and Availability of Flavored Products at Baseline and 6-Month Follow-up

Variable	Lowell (case)	Malden (comparison)
Demographic characteristics ^a		
Total population	106,519	59,450
Male, %	49.6	48.4 ^b
White, %	60.3	56.7 ^b
Youth (under age 18 years), %	23.7	19.7 ^b
Median income, \$	50,192	56,347 ^b
Below poverty level, %	17.5	12.8
Smoking rate, %	21.6	18.9 ^b
Retail characteristics ^c		
Independent stores, %	79.8	85.9 ^b
Retail density	1.2	1.0 ^b
Illegal sales to minors, %	2.3	8.0
Selling flavored tobacco at baseline, %	77.3	76.6 ^b
Single cigar price, \$	2.54	2.50 ^b
Point-of-sale policies ^d		
Flavored tobacco restriction	Yes	No
Cigar packaging restriction	Yes	Yes
Retail capping	No	No
Pharmacy ban	Yes	Yes

^aSmoking rates are small area estimates based on data from 2011 to 2015 Massachusetts Behavioral Risk Factor Surveillance System.

^b<20% different than case community.

^cRetail density is calculated as the number of retailers per 1,000 adults (ages ≥18 years). The rate of illegal sales to minors (under age 18 years) is calculated as the number of sales made to minors during retail compliance checks in fiscal year 2015 (190 and 105 total checks conducted in Lowell and Malden, respectively).

^dThe flavored tobacco restriction restricts the sale of flavored tobacco products to adult-only retailers. The cigar packaging restriction sets a minimum price for single (\$2.50) and multi-pack (\$5.00) cigars. The retail capping policy sets a limit on the number of tobacco sales permits allowed in a community. The pharmacy ban policy prohibits the sale of tobacco products in pharmacies and all other healthcare institutions.

not conducted at all retailers at baseline and follow-up for the following reasons: retailer closed at time of survey, retailer went out of business, retailer not youth accessible (e.g., vape shops), or retailer opened after baseline data collection. The final analytical sample included only retailers with inventories conducted at both baseline and follow-up (111 in Lowell and 47 in Malden).

Youth surveys were conducted in both communities around the same time as retailer inventories and were administered to students in all grades (9th–12th) in public high schools, by local youth involved in MTCP's youth engagement program. A power analysis based on statewide average smoking rates for each grade was used to estimate the target sample sizes.¹⁵ Surveys were administered at baseline (November 2016 to January 2017 in Lowell and September 2016 in Malden) and follow-up (May 2017 in Lowell and April 2017 in Malden) on paper in randomly selected classrooms, and administration and data confidentiality procedures were overseen by Health Resources in Action, Inc. These surveys captured youth demographics, tobacco products used, and perceptions and behaviors related to flavored tobacco use (Appendix Figure 1 shows the complete survey instrument, available online). Data collectors were

instructed to return to the same classrooms at follow-up; however, students who took the survey may not be the same at both time points (surveys were cross-sectional). In Lowell, 593 surveys were completed at baseline, and 524 surveys were completed at follow-up. In Malden, 636 surveys were completed at baseline, and 646 surveys were completed at follow-up.

Measures

Stores were classified as having flavored tobacco products if they sold 1 or more flavored products at time of inventory; the number of unique flavored products in each store was summed. Availability of flavored products was assessed at baseline and follow-up.

Student demographics (age, grade in school, gender, and race/ethnicity) and tobacco-related outcomes were also assessed at baseline and follow-up. Students were provided with a list of tobacco products and asked whether they had ever used the product. Students were asked about both non-flavored (e.g., plain, tobacco, regular, menthol, and mint) and flavored products (e.g., grape, cherry, watermelon, berry, vanilla, rum, red, tropical crush, caramel, honey, and banana). Students who indicated any past use were classified as ever users. Students who indicated use within the past 30 days were classified as current users. These classifications are aligned with those used by many national and global youth tobacco surveys.¹⁶

Students responded to the question: *How easy do you think it is to get flavored tobacco products? With very easy, somewhat easy, somewhat difficult, or very difficult.* These response options were collapsed into 2 categories: easy and difficult.

Students responded to the question: *Was the first tobacco product (including e-cigarettes) you tried flavored? with yes, no, or I've never tried a tobacco product.*

Statistical Analysis

Data were analyzed in September 2017. Descriptive statistics were calculated for flavored product availability and demographic characteristics of students in Lowell and Malden at baseline and follow-up. Chi-squared tests were used to test for differences on these characteristics between Lowell and Malden and within communities between baseline and follow-up.

A difference-in-difference multivariate linear probability model was used to assess the impact of the restriction on 4 outcomes: (1) perception of ease of access to flavored tobacco, (2) initiation of tobacco use with a flavored product, (3) ever and current use of flavored and non-flavored tobacco products, and (4) perceived likelihood of using tobacco if flavored products were not available. These models controlled for age, gender, race/ethnicity, and baseline differences (and any unmeasured time confounder) between Lowell and Malden on the outcomes of interest.

All analyses were conducted using R, version 3.4.4.

RESULTS

In Lowell, the number of flavored products sold per retailer decreased significantly from baseline to follow-up (Table 2): There was a 70–percentage point decrease in the number of stores where flavored products were available (from 77.3% to 7.3%, $p < 0.001$). By comparison, in Malden, no significant change was observed in the

Table 2. Impact of Flavored Tobacco Restriction on Flavored Tobacco Availability

Variable	Lowell (case)			Malden (comparison)		
	Baseline, % (n=111)	Follow-up, % (n=111)	p-value ^a	Baseline, % (n=47)	Follow-up, % (n=47)	p-value ^a
How many flavored products does your store sell?						
0	22.7	92.7	<0.01	23.4	21.3	0.54
1–5	26.4	5.5		27.7	21.3	
6–20	40.9	1.8		38.3	34.0	
21–30	5.4	0		8.5	21.3	
31–50+	4.6	0		2.1	2.1	

Note: Boldface indicates statistical significance ($p < 0.05$).

^aChi-squared tests used to test for significance between baseline and follow-up.

number of flavored products sold per retailer over the same time frame (from 76.6% to 78.7%, $p = 0.537$).

Some differences were detected between students surveyed in Lowell and Malden, including differences in age, gender, and race/ethnicity (Table 3). However, in

both communities, students were similar between baseline and follow-up, with the exception of age. At follow-up, students in Lowell were slightly younger, whereas students in Malden were slightly older. To control for residual demographic differences between and within

Table 3. Demographic Characteristics of Participants With Comparisons Between Baseline and 6-Month Follow-up

Variable	Overall			Lowell (case)			Malden (comparison)		
	Lowell, %	Malden, %	p-value ^a	Baseline, % (n=593)	Follow-up, % (n=524)	p-value ^a	Baseline, % (n=636)	Follow-up, % (n=646)	p-value ^a
Age, years									
≤13	0.1	0.1	<0.01	0.2	0.0	<0.01	0.2	0.0	<0.01
14	11.8	10.2		14.2	9.0		14.5	5.9	
15	17.8	20.7		13.0	23.3		23.6	17.9	
16	22.3	25.4		20.1	24.8		25.1	25.7	
17	24.4	27.5		31.5	16.4		28.2	26.8	
18	21.1	13.6		17.9	24.6		6.8	20.3	
≥19	2.5	2.5		3.1	1.9		1.6	3.4	
Grade									
9	21.1	17.3	<0.01	18.1	24.6	<0.01	16.7	17.8	0.92
10	22.0	26.4		16.1	28.6		26.1	26.8	
11	17.5	26.4		20.0	14.7		26.7	26.2	
12	39.4	29.9		45.8	32.1		30.5	29.2	
Gender									
Female	53.5	52.5	0.03	52.6	54.5	0.35	52.1	52.9	0.68
Male	46.3	46.5		47.0	45.5		47.1	45.9	
Other	0.2	1.0		0.4	0.0		0.8	1.2	
Transgender									
Yes	1.2	1.4	0.57	1.6	0.8	0.47	1.3	1.6	
No	95.7	96.1		95.5	95.9		95.6	96.5	
Do not know	3.1	2.5		2.9	3.3		3.1	1.9	
Race									
Asian	30.6	27.0	<0.01	30.6	30.7	0.73	27.8	26.1	0.49
Black	11.1	17.1		10.8	11.5		18.1	16.2	
Hispanic	23.8	21.3		22.8	25.0		20.6	21.9	
Other	10.7	11.0		10.5	10.9		11.6	10.4	
White	23.8	23.6		25.3	21.9		21.9	25.4	

Note: Boldface indicates statistical significance ($p < 0.05$).

^aChi-squared tests used to test for significance between groups.

Table 4. Impact of Flavored Tobacco Restriction on Flavored Tobacco Access and Use, and Non-flavored Tobacco Use

Variable	Lowell (case) Estimate % (95% CI) ^a	Malden (comparison) Estimate % (95% CI) ^a	Difference Estimate % (95% CI)
Difficult to access flavor product ^b	-3.8 (-15.1, 7.4)	-13.1 (-25.7, -0.5)	9.3 (-7.1, 25.7)
First use tobacco product was flavored ^b	4.6 (-7.3, 16.6)	4.3 (-9.8, 18.4)	0.3 (-17.7, 18.3)
Still use tobacco if not available in flavors ^c	2.9 (-17.9, 23.8)	30.0 (4.6, 55.4)	-27.1 (-60.7, 6.6)
Ever use (flavored products)			
Any tobacco use	-4.0 (-8.8, 0.9)	2.1 (-2.6, 6.7)	-6.1 (-12.5, 0.4)
Cigarette	-1.0 (-3.2, 1.2)	1.1 (-1.0, 3.2)	-2.0 (-5.0, 0.9)
Cigar	-2.0 (-4.8, 0.8)	0.7 (-2.0, 3.4)	-2.7 (-6.5, 1.0)
Blunt	-2.1 (-6.2, 2.1)	2.5 (-1.5, 6.5)	-4.6 (-10.1, 1.0)
Smokeless	-0.9 (-2.8, 1.0)	0.8 (-1.0, 2.6)	-1.7 (-4.3, 0.8)
E-cigarette	-1.7 (-6.2, 2.7)	1.9 (-2.4, 6.2)	-3.6 (-9.6, 2.4)
Current use (flavored products)			
Any tobacco use	-2.4 (-6.2, 1.3)	3.3 (-0.3, 6.9)	-5.7 (-10.7, -0.7)
Cigarette	-0.5 (-1.8, 0.8)	0.7 (-0.6, 1.9)	-1.2 (-2.9, 0.6)
Cigar	-1.0 (-3.0, 0.9)	0.2 (-1.6, 2.1)	-1.2 (-3.8, 1.4)
Blunt	-1.8 (-5.0, 1.4)	2.2 (-0.9, 5.3)	-4.0 (-8.3, 0.3)
Smokeless	-0.8 (-2.2, 0.7)	0.4 (-0.9, 1.8)	-1.2 (-3.1, 0.7)
E-cigarette	-1.3 (-4.2, 1.6)	1.8 (-0.9, 4.6)	-3.1 (-6.9, 0.7)
Ever use (non-flavored products)			
Any tobacco use	-5.0 (-9.8, -0.2)	3.6 (-1.0, 8.2)	-8.6 (-15.0, -2.2)
Cigarette	-2.4 (-5.5, 0.8)	-1.0 (-4.1, 2.0)	-1.3 (-5.5, 2.9)
Cigar	0.7 (-2.1, 3.4)	0.9 (-1.7, 3.5)	-0.2 (-3.9, 3.4)
Blunt	-3.5 (-7.7, 0.6)	4.5 (0.6, 8.5)	-8.1 (-13.6, -2.5)
Smokeless	0.3 (-1.7, 2.2)	1.0 (-0.9, 2.9)	-0.8 (-3.4, 1.9)
E-cigarette	-0.6 (-4.8, 3.5)	2.5 (-1.5, 6.4)	-3.1 (-8.6, 2.5)
Current use (non-flavored products)			
Any tobacco use	-1.9 (-5.5, 1.7)	4.3 (0.9, 7.8)	-6.2 (-11.0, -1.4)
Cigarette	-1.5 (-3.2, 0.3)	-0.2 (-1.9, 1.5)	-1.3 (-3.7, 1.0)
Cigar	-0.9 (-2.7, 0.9)	0.8 (-0.9, 2.6)	-1.7 (-4.1, 0.7)
Blunt	-2.1 (-5.3, 1.0)	3.5 (0.5, 6.6)	-5.7 (-9.9, -1.5)
Smokeless	0.0 (-1.4, 1.5)	0.9 (-0.5, 2.3)	-0.9 (-2.9, 1.1)
E-cigarette	1.4 (-1.1, 4.0)	2.5 (0.1, 5.0)	-1.1 (-4.5, 2.3)

Note: Boldface indicates statistical significance ($p < 0.05$).

^aPercent change from baseline to follow-up, estimated from difference-in-difference models adjusting for age, gender, and race/ethnicity.

^bRestricted to students who reported ever trying a tobacco product.

^cRestricted to students who currently use (use in the past 30 days) flavored tobacco products.

communities, all multivariate models controlled for age, gender, and race.

Among tobacco ever users, after controlling for covariates, there were no significant differences in the change in the percentage of students reporting that it was difficult to obtain flavored products in their town from baseline to follow-up between Lowell and Malden (Table 4; unadjusted baseline and follow-up estimates are in Appendix Table 1, available online).

There were no significant differences in change in likelihood that a student initiated on flavored tobacco from baseline to follow-up between Lowell and Malden (Table 4). However, significant differences between Lowell and Malden were found in changes in flavored tobacco use from baseline to follow-up. Changes in

ever and current use of flavored tobacco from baseline to follow-up were in opposite directions in Lowell and Malden: Use of any flavored tobacco product decreased from baseline to follow-up in Lowell, whereas use of any flavored tobacco product increased in Malden (Figure 1). Difference-in-difference models found a marginally significant difference between the 2 communities in change in ever use of any flavored tobacco product (-6.1% , $p=0.07$) and a significant difference in change in current use of any flavored tobacco product (-5.7% , $p=0.03$) (Table 4). When looking at flavored tobacco products individually, the greatest differences between Lowell and Malden were seen in changes in ever use (-4.6% , $p=0.10$) and current use (-4.0% , $p=0.07$) of blunt wraps.

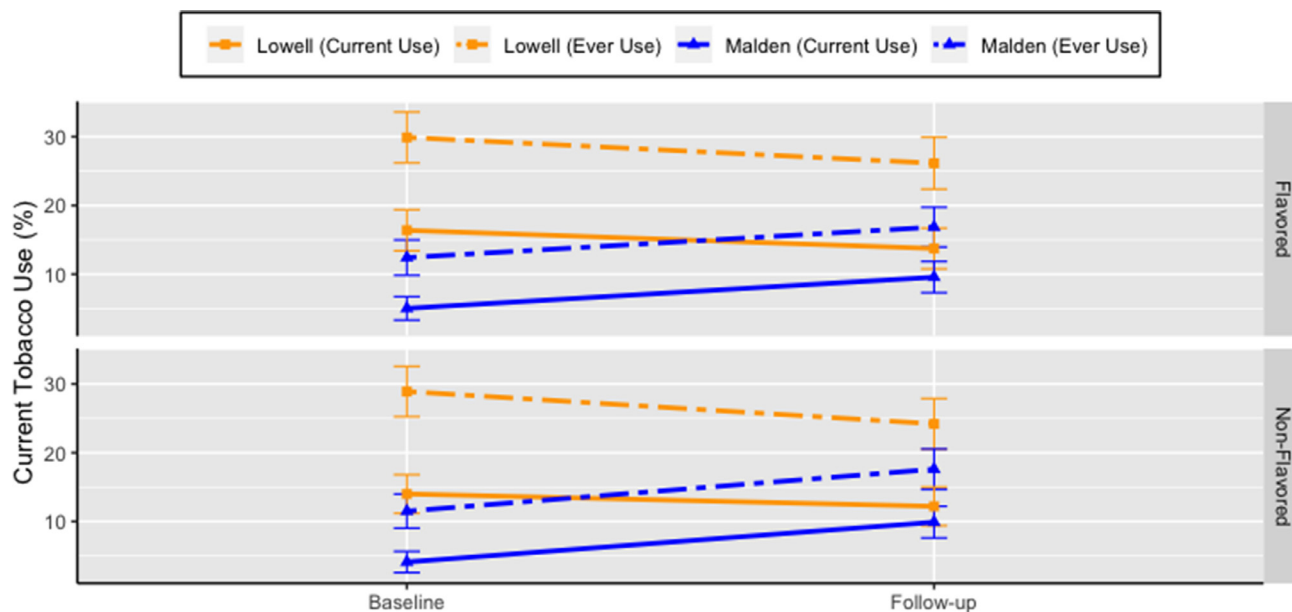


Figure 1. Changes in any flavored and non-flavored tobacco use between baseline and 6-month follow-up: Lowell and Malden, 2016 and 2017.

Note: Any tobacco use includes use of the following products: cigarettes, cigars/cigarillos, e-cigarettes, blunts/blunt wraps, and smokeless tobacco.

Significant differences between Lowell and Malden were also found in changes in non-flavored tobacco use from baseline to follow-up. Use of any non-flavored tobacco product decreased in Lowell from baseline to follow-up, whereas use of any non-flavored tobacco product increased in Malden (Figure 1). Difference-in-difference models found significant differences between the 2 communities in changes in ever use (-8.6% , $p=0.01$) and current use (-6.2% , $p=0.01$) of any non-flavored tobacco product (Table 4). The greatest differences between Lowell and Malden were again seen in changes in the use of blunt wraps: Significant differences were found in changes in ever use (-8.1% , $p<0.01$) and current use (-5.7% , $p=0.01$) of non-flavored blunt wraps (Table 4).

DISCUSSION

This study is one of the first to assess the impact of a flavored tobacco restriction on both the retail environment and youth tobacco use. It builds on previous research to include a comprehensive assessment of all tobacco products in retailers and is the first study to look at the short-term impact of the restriction on youth tobacco use.

This study has 2 main findings with public health significance. First, consistent with previous research, there are greater reductions in availability of flavored products in a community with a flavored product restriction versus one without.^{12,13,17} Retailer compliance with the restriction in Lowell was likely aided by MTCP's

rigorous enforcement infrastructure, which included multiple education visits and education materials, such as the flavored product list.

Second, this study expands on the findings of the New York City flavored product restriction evaluation to show that flavored tobacco restrictions begin to have an impact on youth tobacco use shortly after policy implementation, not only in the long term. The policy was found to be associated with reduced tobacco use 6 months after implementation and was associated with greater reductions in ever and current use of both flavored and non-flavored tobacco than in a community without the policy. In fact, in Malden, increases (though not all statistically significant) were seen in ever and current use of flavored and non-flavored tobacco. These differences between Lowell and Malden were even seen in blunt wraps, which had the highest current use rates in both communities at baseline. This suggests the policy helps curb use of tobacco products popular among youth and does not necessarily drive youth to switch to non-flavored tobacco, even for flavored tobacco products with high baseline use. The decreases seen in non-flavored tobacco use in Lowell may have been due in part to changes in social norms, which have been found to impact youth smoking rates.¹⁸ Prior research in Massachusetts found that youth residing in communities with strong regulations addressing both clean air and youth tobacco access perceived their communities to be significantly more “anti-smoking” compared with youth in communities without strong regulations in these areas.¹⁹

Even so, the greater reductions in tobacco use in Lowell than Malden may have been aided, in addition to decreased availability of flavored products, by the geographic layout of Lowell. Lowell has a high Walk Score,²⁰ suggesting that students may have limited access to cars, and in turn, limited access to neighboring communities without a policy. Unfortunately, sample sizes were too small to assess whether Lowell students are more likely to obtain flavored products in communities other than their own compared with Malden students.

Significant differences between communities in change in perceived ease of access to flavored products or initiation with a flavored product, were not found. This could be attributed partially to the short follow-up time, as reducing exposure to flavored tobacco may take more time than reducing retail availability (e.g., owing to remaining advertising, non-compliant retailers, other sources of access).

This study has many strengths. Both retailer and youth data were collected in a community in which the policy was passed with large sample sizes (almost 100% of retailers, and close to 600 students, were surveyed in Lowell). Data were collected both before and after policy implementation. Finally, a rigorous matching method was used to select Malden as the comparison community.

Limitations

Student data collected at baseline and follow-up were cross-sectional, so the authors cannot assess whether tobacco-related behaviors of individuals changed over time. However, as surveys were conducted in the same school and classrooms at both time points, the survey cohort likely remained relatively stable. Regarding matching, Lowell was only matched to 1 community, and some differences existed between the 2 communities. Differences in tobacco-related characteristics most likely to impact youth tobacco rates (e.g., smoking rate, retail density, baseline availability of flavored tobacco) were all < 20%, and difference-in-difference models controlled for time-invariant characteristics with baseline differences between communities (however, these models cannot control for any time-varying change in youth tobacco use that might occur). Additional methodologic limitations include that baseline youth surveys were conducted in Lowell 1–3 months after policy implementation, at which point retailers may have started to remove flavored tobacco from shelves, so the actual impact of the policy could have been greater than observed results. In addition, sample sizes for some survey questions, such as source and location of flavored product acquisition and intention to smoke in the future (among noncigarette users), were too small to assess differences between Lowell and Malden. However, because of the promising findings of the impact

of the policy on tobacco use, these additional outcomes are areas that future studies could consider assessing.

CONCLUSIONS

With rigorous enforcement, the flavored restriction policy has promising potential to curb youth tobacco use, even within 6 months after implementation. With a longer follow-up time, the authors expect these trends will continue, and the policy may begin to impact and reduce flavored tobacco initiation, as exposure to flavored tobacco among younger students continues to decline. Future considerations for improving policy impact include encouraging surrounding communities to adopt this policy and adding menthol flavoring into the restriction because tobacco companies have historically targeted menthol cigarettes to youth.²¹

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SUPPLEMENTAL MATERIAL

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REFERENCES

1. U.S. Food and Drug Administration. Family Smoking Prevention and Tobacco Control Act—An Overview. www.fda.gov/tobacco-products/rules-regulations-and-guidance/family-smoking-prevention-and-tobacco-control-act-overview. Updated January 17, 2018. Accessed June 26, 2019.
2. Harrell MB, Loukas A, Jackson CD, Marti CN, Perry CL. Flavored tobacco product use among youth and young adults: what if flavors didn't exist? *Tob Regul Sci*. 2017;3(2):168–173. <https://doi.org/10.18001/trs.3.2.4>.

3. Corey CG, Ambrose BK, Apelberg BJ, King BA. Flavored tobacco product use among middle and high school students—United States, 2014. *MMWR Morb Mortal Wkly Rep*. 2015;64(38):1066–1070. <https://doi.org/10.15585/mmwr.mm6438a2>.
4. Dai H. Changes in flavored tobacco use among current youth tobacco users in the United States, 2014–2017. *JAMA Pediatr*. 2019;173(3):282–284. <https://doi.org/10.1001/jamapediatrics.2018.4595>.
5. Villanti AC, Johnson AL, Ambrose BK, et al. Flavored tobacco product use in youth and adults: findings from the first wave of the PATH Study (2013–2014). *Am J Prev Med*. 2017;53(2):139–151. <https://doi.org/10.1016/j.amepre.2017.01.026>.
6. Dai H, Hao J. Flavored electronic cigarette use and smoking among youth. *Pediatrics*. 2016;138(6):e20162513. <https://doi.org/10.1542/peds.2016-2513>.
7. Ribsil KM, D'Angelo H, Schleicher NC, et al. Disparities in tobacco marketing and product availability at the point of sale: results of national study. *J Prev Med*. 2017;105:381–388. <https://doi.org/10.1016/j.ypmed.2017.04.010>.
8. Sanders-Jackson A, Parikh NM, Schleicher NC, Fortmann SP, Henriksen L. Convenience store visits by US adolescents: rationale for healthier retail environments. *Health Place*. 2015;34:63–66. <https://doi.org/10.1016/j.healthplace.2015.03.011>.
9. Adams ML, Jason LA, Pokorny S, Hunt Y. Exploration of the link between tobacco retailers in school neighborhoods and student smoking. *J Sch Health*. 2013;83(2):112–118. <https://doi.org/10.1111/josh.12006>.
10. Massachusetts Department of Public Health. Youth tobacco use in Massachusetts: survey results from 1995 to 2017. www.mass.gov/files/documents/2019/04/03/MA-Youth-Tobacco-Report-2017.pdf.
11. Wilson DJ. *Local policies restricting flavored 'other tobacco products' (OTP) to adult-only retailers*. Massachusetts Municipal Association; 2019. <http://mhoa.com/wp-content/uploads/2019/04/Muni-List-Flavored-OTP-Restriction-C754e.pdf>. Published 2019. Accessed June 26, 2019.
12. Kingsley M, Song G, Robertson J, P Henley, WWS Ursprung. Impact of flavoured tobacco restriction policies on flavoured product availability in Massachusetts. *Tob Control*. In press. Online February 18, 2019. <https://doi.org/10.1136/tobaccocontrol-2018-054703>.
13. Farley SM, Johns M. New York City flavoured tobacco product sales ban evaluation. *Tob Control*. 2017;26(1):78–84. <https://doi.org/10.1136/tobaccocontrol-2015-052418>.
14. CounterTools. Counter store audit center. <https://assess.countertools.org/>. Accessed December 10, 2018.
15. Dean AG, Sullivan KM, Soe MM. *OpenEpi: Open Source Epidemiologic Statistics for Public Health*, Version 3.01. www.OpenEpi.com. Accessed August 28, 2018; Updated 2013.
16. HHS. *The Epidemiology of Tobacco Use Among Young People in the United States and Worldwide*. Preventing Tobacco Use Among Youth and Young Adults: a Report of the Surgeon General. Atlanta, GA: HHS, CDC, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2012.
17. Brock B, Carlson SC, Leizinger A, et al. A tale of two cities: exploring the retail impact of flavoured tobacco restrictions in the twin cities of Minneapolis and Saint Paul, Minnesota. *Tob Control*. 2019;28(2):176–180. <https://doi.org/10.1136/tobaccocontrol-2017-054154>.
18. Eisenberg ME, Forster JL. Adolescent smoking behavior: measures of social norms. *Am J Prev Med*. 2003;25(2):165–166. [https://doi.org/10.1016/S0749-3797\(03\)00116-8](https://doi.org/10.1016/S0749-3797(03)00116-8).
19. Hamilton WL, Biener L, Brennan RT. Do local tobacco regulations influence perceived social norms? Evidence from adult and youth surveys in Massachusetts. *Health Educ Res*. 2008;23(4):709–722. <https://doi.org/10.1093/her/cym054>.
20. Lowell walk Score®. www.walkscore.com/MA/Lowell. Published 2019. Accessed June 26, 2019.
21. Lee YO, Glantz SA. Menthol: putting the pieces together. *Tob Control*. 2011;20(suppl 2):iii1–ii7. <https://doi.org/10.1136/tc.2011.043604>.