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### Title

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### Authors

Timberlake, David S

Rhee, Joshua

Silver, Lynn D

et al.

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## Impact of California's tobacco and cannabis policies on the retail availability of little cigars/cigarillos and blunt wraps

David S. Timberlake<sup>a,\*</sup>, Joshua Rhee<sup>a</sup>, Lynn D. Silver<sup>b</sup>, Alisa A. Padon<sup>b</sup>, Robert O. Vos<sup>c</sup>, Jennifer B. Unger<sup>d</sup>, Elizabeth Andersen-Rodgers<sup>e</sup>

<sup>a</sup> Program in Public Health, College of Health Sciences, University of California, Irvine, Anteater Instruction & Research Building, Irvine, CA 92697, United States

<sup>b</sup> Public Health Institute, Oakland, CA, United States

<sup>c</sup> Spatial Sciences Institute, University of Southern California, Los Angeles, CA, United States

<sup>d</sup> Preventive Medicine, University of Southern California, Los Angeles, CA, United States

<sup>e</sup> California Tobacco Control Program, Sacramento, CA, United States

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### ABSTRACT

**Background:** Recent changes in California's tobacco and cannabis policies could impact the retail availability of little cigars/cigarillos (LCCs) and blunt wraps that are used for blunt smoking. This study was intended to test whether tobacco flavor bans and minimum pack sizes of LCCs have reduced tobacco availability in California jurisdictions, whereas, permissive policies on sales and marketing of cannabis increased availability.

**Methods:** Measures of retail availability of LCCs and blunt wraps were obtained from the 2016–2019 longitudinal sample of licensed tobacco retailers (LTRs,  $n = 4062$ ) from California's Healthy Stores for Healthy Communities campaign. Additional data sources included the California Cannabis Local Laws database and geographic location of 1063 cannabis retailers used for constructing a spatial index of accessibility to the LTRs. Two-level generalized structural equation models were developed to assess effects of store- and jurisdiction-level predictors of change in tobacco availability (+, -, no change).

**Results:** Neither permissive cannabis policies nor accessibility to cannabis retailers were associated with an increase in retail availability of the tobacco products. Enactment of a tobacco flavor ban, however, was associated with reduced availability of LCCs and blunt wraps, which was more pronounced in jurisdictions that had permissive cannabis policies (i.e. policy interaction).

**Conclusions:** A tobacco flavor ban may be an effective strategy to reduce retail availability of LCCs, blunt wraps and possibly other tobacco in California jurisdictions. This finding is of particular relevance as the tobacco industry has successfully petitioned for a referendum vote on California's statewide flavor ban in the 2022 election.

### 1. Introduction

Smoking a blunt, a cigar whose tobacco is replaced with cannabis, emerged in response to the need for a less stigmatized form of drug use and an improved way of delivering cannabis (Soller and Lee, 2010). The practice initially became popular among urban African-Americans in the early 1990s (Golub and Johnson, 1999), and subsequently expanded to other demographic groups (e.g., Hispanics) (Schauer et al., 2016; Timberlake, 2013). Coinciding with this expansion was the growth in market share of little cigars/cigarillos (LCCs), facilitated by low taxes, flavors, and small pack sizes (Delnevo et al., 2015; Delnevo et al., 2017; Kostygina et al., 2016). Cigarillo manufacturers used marketing

strategies that appealed to cannabis users, such as suggestive brand names (e.g., Splitarillos) (Kostygina et al., 2017); cannabis-associated flavors (e.g., Pineapple Express); re-sealable foil pouches for storing cannabis (Giovenco et al., 2017); and marketing terms that directly imply use of the tobacco product for blunt smoking (e.g., blunt wrap). Unlike an LCC, which has a tobacco filler, a blunt wrap consists of rolling paper made from tobacco leaf. While the blunt wrap composed only 2.8% of the U.S. cigarillo market in 2016 (Giovenco et al., 2018), the product was sold by more than half of the tobacco retailers in California who carried LCCs (Henriksen et al., 2018).

The availability of LCCs in the retail environment is a useful measure of neighborhood exposure to the tobacco products that are used for

\* Corresponding author.

E-mail address: [dtimberl@uci.edu](mailto:dtimberl@uci.edu) (D.S. Timberlake).

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blunt smoking (Cantrell et al., 2013; Henriksen et al., 2018; Kong et al., 2020). Cantrell et al. (2013) reported a strong dose-response association between retail availability of LCCs and the percentage of African Americans residing in census block groups in Washington, D.C. It is also important to consider the effects of policy on the retail availability of these tobacco products, particularly in the State of California where several tobacco and cannabis laws have recently been enacted (Silver et al., 2020; The Center for Tobacco Policy & Organizing, May, 2019; Truth Initiative, 2019). Since 2010, numerous California communities have restricted the sales of flavored tobacco, and some have required a minimum pack size of LCCs. These ordinances could substantially reduce the availability of flavored LCCs and blunt wraps in California, as compliance to the laws has been relatively high in other U.S. states (Brock et al., 2019; Farley and Johns, 2017; Sbarra et al., 2017).

The State of California passed a ballot initiative in 2016 (Proposition 64) that legalized sales of cannabis for adult recreational use, which became effective on January 1, 2018. Passage of the initiative preserved broad local discretion to regulate commerce of cannabis, resulting in 38% of jurisdictions that allowed cannabis sales for adult use in the first year of legalization. Silver et al. (2020) reported that jurisdictions regulated a host of other practices ranging from health warnings to advertising restrictions on cannabis. Variability in cannabis regulation across jurisdictions is relevant to the current study because both large and small tobacco retailers have discretion to carry inventory that meets local needs (Han et al., 2014). Retailers often use empirical data or customer feedback in managing product categories (e.g., LCCs) on a store-by-store basis. Thus, if a jurisdiction allows cannabis sales for adult use, a tobacco retailer might carry and promote LCCs and blunt wraps to satisfy customer needs. A similar argument can be made for the greater demand for cannabis and the cannabis-related tobacco products in jurisdictions that permit cannabis marketing.

There are only two studies to our knowledge, both cross-sectional, that have investigated the association between cannabis laws and the retail sales or availability of tobacco products used for blunt smoking (Giovenco et al., 2018; Lipperman-Kreda et al., 2014). Lipperman-Kreda et al. (2014) reported a positive association between tobacco availability and laws permitting medical cannabis dispensaries in California jurisdictions. Giovenco et al. (2018) observed that the market share of Swisher, the most popular brand of cigarillo for blunt smoking, was considerably higher in regions with legalized cannabis markets (e.g., 59% in Seattle) compared to the total U.S. (28%). The current investigation is intended to complement the two studies by testing whether local ordinances and proximity to adult-use cannabis outlets in California have led to changes in retail availability of LCCs and blunt wraps. It is anticipated that the ordinances permitting marketing and sales of cannabis for adult use have increased the retail availability of LCCs and blunt wraps, but, not in jurisdictions that have banned flavored products that account for a majority of U.S. cigarillo sales (Giovenco et al., 2018).

## 2. Materials and methods

### 2.1. Selection of licensed tobacco retailers

The Healthy Stores for Healthy Communities (HSHC) campaign commenced in 2013 under the auspices of the California Department of Public Health's Tobacco Control Program and other governmental agencies (California Tobacco Control Program, June, 2020; Henriksen et al., 2017). The selection of licensed tobacco retailers (LTRs) first entailed stratification of the population of stores in California by 61 lead local agencies (LLAs), comprised of health departments in 58 counties and three municipalities (Berkeley, Long Beach, Pasadena). The sampling frame of zip codes in each stratum contained at least one LTR licensed by the California Department of Tax and Fee Administration (CDTFA). Among the ~700 zip codes that were randomly selected, a census of all eligible LTRs yielded more than 7000 stores surveyed in 2013, 2016 and 2019. Eligible LTRs included those that were youth

accessible and did not require a membership or fee to enter the facility. The LTRs were surveyed by volunteers, health inspectors, and staff from health departments who received standardized training and a pocket guide with instructions on data collection. The 2019 cross-sectional survey ( $n = 7896$  stores) was used in the current study to estimate the proportion of stores selling LCCs and blunt wraps. The primary analyses were based on 2016–2019 longitudinal data ( $n = 4062$  LTRs) because numerous jurisdictions enacted local tobacco and cannabis ordinances between the two survey years. The high attrition of LTRs from 2016 to 2019 (42%) was attributed to tobacco retailers who were no longer operating at the time of the 2019 survey; thus, the 2019 sample was supplemented with LTRs from the randomly selected zip codes.

### 2.2. Measures

Measures of retail availability of LCCs and blunt wraps (yes/no) served as binary dependent variables for the 2019 cross-sectional analysis. For the longitudinal analyses, measures from the 2016 and 2019 surveys were combined to form a multinomial dependent variable with the following three categories: 1) discontinued carrying the product since the 2016 survey; 2) no change in product availability; 3) added the product since the 2016 survey. Independent variables for the multilevel models were store-level measures (type of LTR, accessibility potential) and jurisdictional-level measures that included tobacco policies, cannabis policies, and demographics from the 2013–2017 American Community Survey (see Table 2) (California Community Health Assessment Tool).

#### 2.2.1. Cannabis retailers and accessibility potential

The locations of cannabis retailers throughout California were obtained by co-authors (JBU, ROV) who collected the data in October, 2018 as part of another study (Unger et al., 2020). Unger et al. (2020) identified licensed retailers ( $n = 448$ ) from the Bureau of Cannabis Control and unlicensed retailers ( $n = 662$ ) from a comprehensive search of the websites weedmaps.com and leafly.com. Among the 1110 cannabis businesses with a retail location, 47 were excluded because they only sold cannabis for medicinal purposes, yielding 1063 cannabis retailers for the analysis.

The accessibility potential (AP), a spatial index of the accessibility of LTRs to cannabis retailers, was calculated for each LTR using the equation  $AP_i = \sum (1/d_{ij})/P_i$  (Pirie, 1979; Weibull, 1980), where  $P$  is the total number of persons in the service area;  $i$  is the LTR;  $j$  is a cannabis retailer located within a 10-minute drive of the LTR (i.e. the service area); and  $d$  is the Manhattan distance between the LTR and cannabis retailer. The latter, which is the distance between points along axes at 90° angles, was used instead of the Euclidean distance to estimate more accurately the distance traveled via roadways. A service area was estimated using traffic data incorporated in ArcGIS Online (ArcGIS Online). The population of a service area,  $P$ , was used to normalize AP by population density due to variability in rural and urban service areas. The population was obtained by summing the multiplicative of the population of census tracts and the percent overlap of the census tracts and the given service area. For several LTRs, AP could not be calculated because a single cannabis retailer was not located within the service area. Thus, the measure for AP was categorized into LTRs without a nearby cannabis retailer (46.8%) and LTRs with a low AP (46.9th–75th percentile) and high AP (>75th percentile). Using a larger service area (e.g., 30-minute drive) presented computational challenges and was deemed unnecessary because cannabis retailers located far from an LTR may have had a diminished influence on retailer behavior.

#### 2.2.2. Tobacco and cannabis ordinances

The ordinances were identified from the 258 incorporated municipalities and 56 unincorporated county areas that had at least one LTR sampled in the 2019 HSHC campaign ( $n = 314$  jurisdictions). The California Department of Public Health provided a list of ordinances

pertaining to flavored tobacco restrictions and minimum pack sizes of LCCs. The ordinances restricting the sales of flavored tobacco applied to most tobacco products and most locations; exemptions in some jurisdictions were sales of mentholated tobacco, sales in adult-only stores, and sales in stores that were distant from youth-populated areas (e.g., >500 ft. from schools). Due to a limited number of jurisdictions with a flavor ban (see Table 1), jurisdictions with comprehensive and non-comprehensive flavor bans were combined in the analyses. Some of the ordinances restricting flavored tobacco also required a minimum pack size of five, ten or twenty LCCs. Thus, a nominal variable for the tobacco control ordinances was constructed with the following three categories: 1) no restriction, 2) any tobacco flavor ban, and 3) any tobacco flavor ban and a minimum pack size of LCCs. Jurisdictions whose ordinances became effective between 8/01/16 and 4/17/19 were coded as having implemented the policies as most of the 2016 and 2019 surveys were administered prior to and following the aforementioned dates.

Cannabis ordinances were selected from the California Cannabis Local Laws database maintained by the Public Health Institute (Silver et al., 2020). The most relevant ordinances were any ban on storefront sales and any restriction on cannabis marketing that could impact the demand for LCCs and blunt wraps. The marketing restrictions included bans on outdoor advertising (e.g., billboards), business signage, and advertising on television, radio, Internet or print media. A nominal variable for the cannabis control ordinances was constructed with the following three categories: 1) ban on storefront sales for recreational use, 2) marketing restriction(s) in jurisdictions that allow storefront sales, 3) neither of the two restrictions. Policies pertaining only to sales of medicinal cannabis were not evaluated because the cannabis was less likely than recreational cannabis to be used with LCCs or blunt wraps. This decision was supported in part by a Canadian study reporting that approximately 50% of tobacco users had reduced or quit their use of tobacco upon initiating medicinal cannabis (Lucas et al., 2021).

2.3. Statistical analyses

The first set of two-level generalized structural equation models were developed for estimating intra-class correlation coefficients (i.e. unconditional models). All subsequent models included the store-level measures (level I) and demographic and policy predictors (level II)

Table 1

Licensed tobacco retailers (LTRs) sampled in the 2019 and 2016–2019 HSHC by tobacco and cannabis policies and accessibility to cannabis retailers.

	% LTRs (No. of Jurisdictions)		% LTRs within a 10-minute drive of a cannabis retailer			
	2019	2016–2019	2019		2016–2019	
			%	$\chi^2$ (df) <sup>4</sup>	%	$\chi^2$ (df) <sup>4</sup>
<b>No. of LTRs (Jurisdictions)</b>	7896 (314)	4062 (269)	53.1%		50.4%	
<b>Cannabis Policy</b>						
No restriction	24.3% (48)	19.7% (40)	79.5%		76.0%	
Advertising restriction (only) <sup>1</sup>	18.2% (42)	19.7% (39)	81.2%		84.5%	
No storefront retail <sup>2</sup>	57.5% (221)	60.6% (188)	33.1%	49.0 <sub>(2)</sub> <sup>€</sup>	31.0%	55.6 <sub>(2)</sub> <sup>€</sup>
<b>Tobacco Policy</b>						
No restriction	90.7% (293)	94.4% (251)	50.8%		49.4%	
Flavor ban (only)	6.9% (14)	4.0% (12)	80.4%		69.9%	
Flavor ban & min. pack size <sup>3</sup>	2.4% (7)	1.6% (6)	60.4%	4.1 <sub>(2)</sub>	63.1%	1.8 <sub>(2)</sub>
<b>Cannabis &amp; Tobacco Policies</b>						
No restrictions	18.0% (41)	16.5% (34)	76.0%		72.0%	
Any cannabis restriction (only)	72.7% (249)	77.8% (215)	44.6%		44.6%	
Any tobacco restriction (only)	6.3% (7)	3.2% (6)	89.6%		96.9%	
Any cannabis & tobacco restr.	3.0% (14)	2.4% (12)	45.1%	16.8 <sub>(3)</sub> <sup>€</sup>	29.6%	20.3 <sub>(3)</sub> <sup>€</sup>

\*p < .05;

<sup>€</sup> p < .001;

<sup>€</sup> p < .0001;

<sup>1</sup> Any restriction on outdoor advertising, business signage or advertising placement (TV, radio, print, Internet) of cannabis;

<sup>2</sup> includes some LTRs in jurisdictions that also restrict cannabis advertising;

<sup>3</sup> minimum pack size of five, ten or twenty LCCs;

<sup>4</sup> Wald  $\chi^2$  test of association accounts for the clustering of LTRs within jurisdictions.

that were described previously. Likelihood ratio tests were conducted to determine whether models include random intercepts only or random intercepts and random slopes. Models were subsequently tested for the inclusion of a level-II interaction term for tobacco and cannabis policies, as well as a term for the cross-level interaction between cannabis policies (level II) and accessibility of LTRs to cannabis retailers (level I). For descriptive analyses, tests of independence between a given dependent variable and a series of independent variables (i.e. Wald  $\chi^2$  test) were based on cluster-robust variance estimates that allowed for correlations within California jurisdictions. Regression methods, which accounted for spatial autocorrelation, were not utilized because Global Moran's I Indices indicated that the distribution of observations for LCCs ( $z = -1.26, p = .21$ ) and blunt wraps ( $z = 1.23, p = .22$ ) were the result of random spatial processes. The statistical software package STATA v16 was used in developing the generalized structural equation models (gsem) (StataCorp., 2021).

3. Results

3.1. Distribution of LTRs and cannabis retailers

Most of the 314 jurisdictions permitted sales of flavored tobacco ( $n = 293$ ), but not sales of cannabis for adult use ( $n = 221$ ). The uneven distribution of cannabis and tobacco retailers (Fig. 1) was highlighted by the five Southern California counties (L.A., Orange, Riverside, San Bernardino, San Diego) that accounted for 73% of cannabis retailers in the State. Approximately 50% of LTRs in the cross-sectional and longitudinal samples were within a 10-minute drive of a cannabis retailer (Table 1). Less accessibility to a cannabis retailer was observed for LTRs located in jurisdictions that banned storefront cannabis sales. One-third of such LTRs were still proximal to a cannabis retailer because of the presence of unlicensed cannabis retailers ( $n = 255$ ) or adjacency to a jurisdiction that permitted cannabis sales. Accounting for clustering effects, a negative association was observed between having any tobacco flavor ban and a restriction on marketing or storefront sales of cannabis (OR=0.12(0.03,.53);  $p = .005$ ). As indicated in Table 1, this inverse association was further evidenced by the accessibility potential to cannabis retailers, which was greater for LTRs located in jurisdictions that banned flavored tobacco.

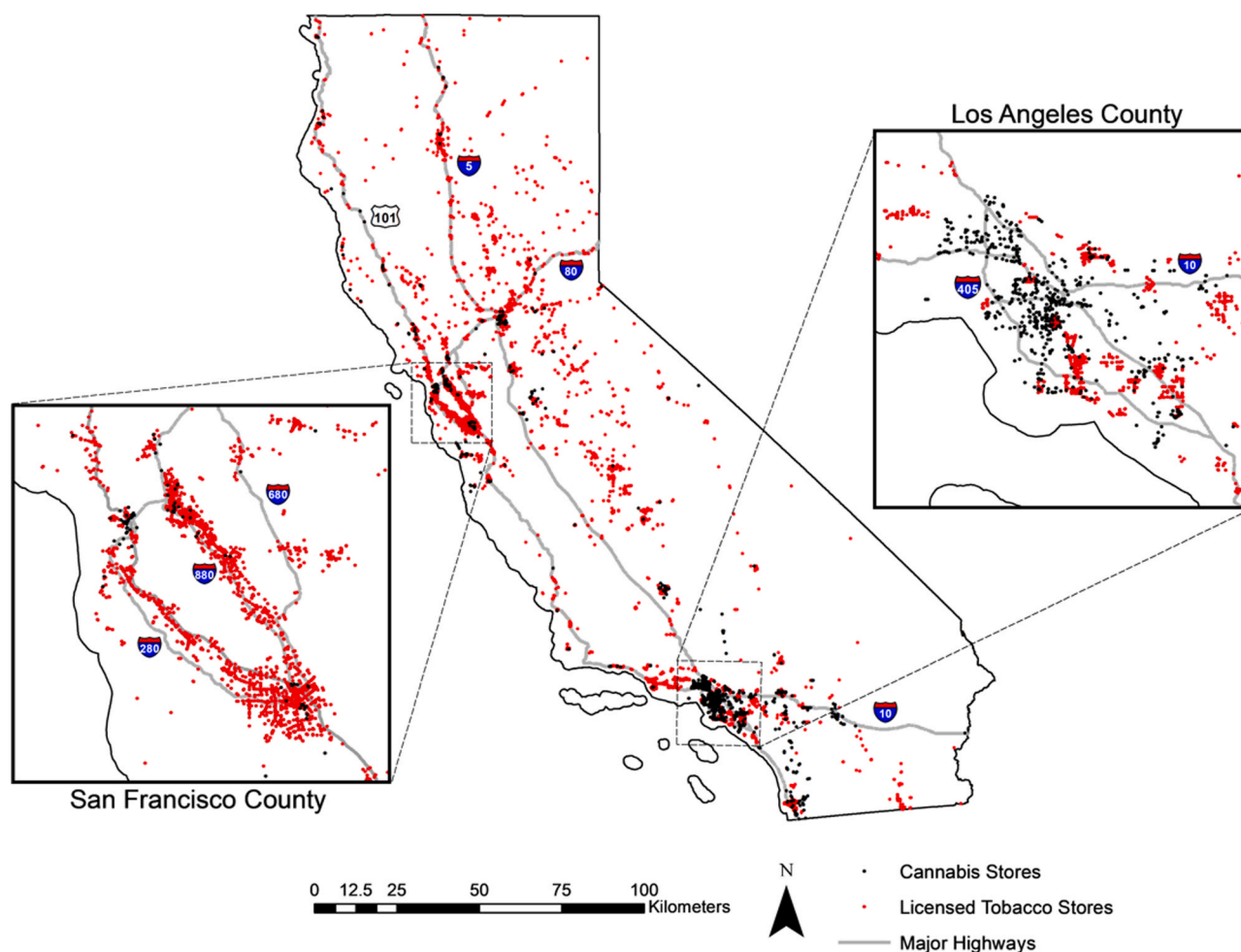


Fig. 1. Distribution of cannabis and licensed tobacco stores located throughout California.

### 3.2. Changes in retail availability of tobacco

A 7.3% increase in retail availability of blunt wraps occurred between 2016 and 2019; in contrast, no such change was observed for the LCCs. Considerable variability in the availability and change in availability of these tobacco products occurred by type of LTR (see Table 2). While most convenience stores carried LCCs (> 90%), they experienced the smallest percent change in availability of LCCs between survey years. Significant variation in change in availability of LCCs, but not blunt wraps, was observed by the demographic composition of jurisdictions. Increases in availability of LCCs were observed for LTRs located in jurisdictions that had the highest tertile of young residents (i.e. <21 years) and households receiving SNAP benefits (Supplemental Nutrition Assistance Program). Statistically significant declines in the availability of LCCs and blunt wraps occurred in jurisdictions that enacted tobacco flavor bans, but not in jurisdictions that restricted cannabis advertising or sales.

### 3.3. Estimates from multilevel models (2016–2019 HSHC)

The intraclass correlation coefficient (ICC) for product availability in the unconditional model was considerably larger for LCCs (0.144) compared to blunt wraps (0.038). Likelihood ratio tests comparing models that included and excluded random effects on change in availability of LCCs suggested the retention of random intercepts ( $\chi^2_{(1)}=65.2$ ;  $p < .00001$ ), but not random slopes ( $\chi^2_{(2)}=1.2$ ;  $p = .56$ ). Similar findings were observed for blunt wraps, leading to the inclusion of random intercepts in the multilevel models.

Model estimates indicated that small markets/supermarkets, pharmacies/discount stores, and gas station booths had significantly greater odds than convenience stores of making any change to the sales of tobacco products between survey years (i.e. adding or discontinuing the product) (see Table 3). Jurisdictions with the highest tertile of nonwhites (vs. lowest tertile) had greater odds of experiencing an increase in availability of LCCs. Similar to the descriptive results in Table 2, accessibility to a cannabis retailer had minimal impact on the retail availability of the tobacco products. Unlike the two cannabis restrictions, a tobacco flavor ban was significantly associated with the discontinued sales of LCCs and blunt wraps. The same finding was observed for the two tobacco products upon recoding the dependent variable into two categories, discontinued sales versus no change/addition of product. A post-estimation test indicated no difference between the regression coefficients, corresponding to discontinued sales of LCCs (Table 3), for jurisdictions that only banned flavored tobacco and jurisdictions that banned flavored tobacco and enacted a minimum pack size ( $\chi^2_{(1)}=0.16$ ;  $p = .69$ ). A similar finding was observed for the coefficients corresponding to restrictions on cannabis marketing and sales ( $\chi^2_{(1)}=0.42$ ;  $p = .52$ ). Based on these results, the two tobacco restrictions and two cannabis restrictions were grouped together for testing a tobacco x cannabis policy interaction.

#### 3.3.1. Intra- and cross-level policy interactions

A significant interaction between the tobacco and cannabis policies was observed for LCCs (OR=0.29(0.09,.97);  $p = .04$ ), such that the effect of a tobacco flavor ban on the decline in the availability of LCCs was more pronounced for LTRs located in jurisdictions that only banned



**Table 2**

Retail availability of LCCs and blunt wraps by store-level variables, demographic characteristics, and cannabis and tobacco policies in the 2019 and 2016–2019 HSHC campaign.

Independent Variable	No. LTRs	% Retail Availability (2019) (n = 7896)		% Change in Availability 2016–2019 (n = 4062)			
		LCC	Blunt Wraps	+ /- %LCC <sup>5</sup>	χ <sup>2</sup> (df) <sup>7</sup>	+ /- %Wrap <sup>6</sup>	χ <sup>2</sup> (df) <sup>7</sup>
All Stores	7896	81.9%	59.7%	-0.3%		+ 7.3%	
<b>Type of Store</b>							
Convenience store	3356	92.8%	67.2%	+ 1.3%		+ 8.3%	
Small/Super market	1660	61.5%	40.8%	-4.4%		+ 3.7%	
Discount/Drug store	581	86.4%	56.2%	+ 2.5%		+ 12.5%	
Liquor store	982	90.5%	77.3%	+ 2.5%		+ 10.9%	
Gas station booth	669	86.0%	49.6%	-2.5%		+ 4.3%	
Other (e.g., restaurant)	648	66.8%	60.0%	-3.6%	67.0 <sup>ε</sup>	+ 1.5%	121 <sup>ε</sup>
<b>AP<sup>1</sup> (10-minute drive)</b>							
No cannabis retailer	3703	83.3%	58.0%	+ 0.4%		+ 8.5%	
46.9th-75th percentile	2218	82.0%	59.9%	-1.7%		+ 9.9%	
>75th percentile	1975	80.6%	60.9%	-0.4%	1.4	+ 2.3%	4.2
<b>% Population Size<sup>2</sup></b>							
1st Tertile	2643	81.2%	57.0%	-1.0%		+ 10.2%	
2nd Tertile	2688	83.0%	61.1%	+ 0.6%		+ 9.4%	
3rd Tertile	2565	81.7%	60.4%	-0.5%	5.2	+ 2.2%	5.3
<b>% Non-White</b>							
1st Tertile	2679	81.6%	57.4%	-3.3%		+ 9.4%	
2nd Tertile	2801	82.9%	59.1%	-0.3%		+ 5.7%	
3rd Tertile	2416	81.0%	61.7%	+ 2.8%	8.8	+ 6.8%	2.8
<b>% Under 21 Years</b>							
1st Tertile	2642	77.0%	55.2%	-1.5%		+ 6.3%	
2nd Tertile	2624	81.4%	60.8%	-3.0%		+ 9.3%	
3rd Tertile	2630	86.0%	62.1%	+ 3.5%	17.7 <sup>ε</sup>	+ 6.3%	4.4
<b>% Receives SNAP<sup>3</sup></b>							
1st Tertile	2655	76.8%	53.5%	-1.9%		+ 10.2%	
2nd Tertile	2652	82.2%	62.8%	-1.0%		+ 7.2%	
3rd Tertile	2589	86.2%	62.5%	+ 2.0%	10.4 <sup>*</sup>	+ 4.2%	4.2
<b>Cannabis Policy</b>							
No restriction	1921	78.7%	57.2%	-4.4%		+ 2.9%	
Advertising restriction	1432	84.0%	58.5%	+ 2.0%		+ 7.9%	
No storefront retail <sup>4</sup>	4534	81.8%	61.1%	+ 0.3%	6.5	+ 8.4%	5.2
<b>Tobacco Policy</b>							
No restriction	7163	83.0%	61.0%	+ 0.5%		+ 8.4%	
Flavor ban (only)	546	64.0%	Combined <sup>8</sup> 36.7%	-11.7%		Combined <sup>8</sup> -11.8%	
Flavor ban & min. pack <sup>5</sup>	187	58.3%		-18.5%	26.7 <sup>ε</sup>		12.3 <sup>ε</sup>

\* p < .05;

ε p < .01;

ε p < .0001;

<sup>1</sup> Accessibility Potential;

<sup>2</sup> population size was used instead of population density because the latter could not be determined for unincorporated areas of a jurisdiction that are non-contiguous;

<sup>3</sup> percent households receiving Supplemental Nutrition Assistance Program (SNAP) benefits;

<sup>4</sup> includes some LTRs in jurisdictions that also restricted cannabis advertising (n = 202);

<sup>5</sup> minimum pack size of five, ten or twenty LCCs;

<sup>6</sup> percent difference in the increase (+) and decrease (-) in retail availability from 2016 to 2019;

<sup>7</sup> Wald χ<sup>2</sup> test of association of the addition, deletion, or no change in availability;

<sup>8</sup> only one estimate because a minimum pack size of LCCs does not pertain to blunt wraps.

flavored tobacco (OR=5.20(2.11,12.84); p < .001), versus the jurisdictions that banned flavored tobacco and restricted cannabis sales or marketing (OR=1.54(0.71,3.35); p = .27). A similar policy interaction (OR=0.39(0.15,.98); p = .04) was observed for tobacco retailers' discontinuation of blunt wraps. In a separate model, a cross-level interaction (OR=3.51(1.32, 9.35); p = .01) indicated that a tobacco flavor ban was more strongly associated with reduced availability of blunt wraps in LTRs located within a 10-minute drive of a cannabis retailer.

#### 4. Discussion

Our prevalence estimate of the availability of LCCs in retail stores in 2019 (81.9%), which did not differ appreciably from 2016, was strikingly similar to estimates reported in California in 2011 (82.7%) (Schleicher et al., 2015) and Washington D.C. in 2011–2012 (80%) (Cantrell et al., 2013). This stability over time could be partly attributed to the convenience stores that accounted for the largest percentage of

LTRs in California in 2019 (39.2%). In a series of focus groups, patrons of tobacco retailers perceived tobacco sales to be indispensable to and part of the identity of convenience stores (McDaniel and Malone, 2014). These sentiments are consistent with our observation that convenience stores had significantly lower odds than other retailers (e.g. small/super markets) of making any changes to LCCs, particularly the discontinuation of products. Similar to the type of LTR, demographic characteristics of jurisdictions were associated with change in availability of LCCs. Our adjusted estimate, which indicated that availability increased over time in more non-white jurisdictions, is consistent with other studies reporting that LCCs are available and marketed to a greater degree in neighborhoods with a higher percentage of African Americans (Cantrell et al., 2013; Smiley et al., 2019). In contrast, neither our univariate results nor those published from mid-sized communities in California (Lipperman-Kreda et al., 2014) indicated that availability of blunt wraps was associated with demographic characteristics.

The estimates of our two cannabis measures, policy and accessibility, were inconsistent with findings on sales of blunt wraps in legalized

**Table 3**

Estimates from the generalized structural equation models of the change in retail availability of LCCs and blunt wraps in the 2016–2019 HSHC campaign (n = 4056).

Variables	Little Cigars/Cigarillos AOR (95% C.I.) <sup>1</sup>		Blunt Wraps AOR (95% C.I.) <sup>1</sup>	
	Discontinued	Added Product	Discontinued	Added Product
<b>Type of Store</b>				
Convenience store	Reference		Reference	
Small/Super market	2.82(2.10,3.78) <sup>f</sup>	1.52(1.12,2.06) <sup>e</sup>	.60(0.47,.77) <sup>e</sup>	.51(0.41,.64) <sup>e</sup>
Discount/Drug store	2.35(1.57,3.53) <sup>e</sup>	2.23(1.54,3.22) <sup>e</sup>	1.37(1.01,1.86) <sup>*</sup>	1.42(1.10,1.84) <sup>e</sup>
Liquor store	1.12(0.70,1.79)	1.25(0.83,1.88)	.76(0.54,1.06)	.89(0.68,1.16)
Gas station booth	2.31(1.53,3.50) <sup>e</sup>	1.56(1.01,2.40) <sup>*</sup>	1.15(0.82,1.60)	.87(0.64,1.17)
Other (e.g., restaurant)	1.18(0.63,2.19)	.44(0.19,1.03)	.27(0.15,.50) <sup>e</sup>	.22(0.13,.38)
<b>AP<sup>2</sup> (10-minute drive)</b>				
No cannabis retailer	Reference		Reference	
46.9th-75th percentile	1.19(0.84,1.69)	.88(0.62,1.26)	.85(0.65,1.12)	1.00(0.80,1.26)
>75th percentile	.99(0.66,1.47)	.88(0.59,1.31)	.91(0.68,1.23)	.76(0.58,.99) <sup>*</sup>
<b>% Population Size<sup>3</sup></b>				
2nd Tertile	.58(0.40,.84) <sup>e</sup>	.79(0.54,1.14)	1.08(0.82,1.42)	.89(0.71,1.13)
3rd Tertile	.61(0.38,.96) <sup>*</sup>	.61(0.38,.96) <sup>*</sup>	1.47(1.08,2.01) <sup>*</sup>	.79(0.60,1.05)
<b>% Non-White<sup>3</sup></b>				
2nd Tertile	.90(0.60,1.35)	1.26(0.82,1.91)	1.05(0.78,1.42)	1.09(0.84,1.42)
3rd Tertile	1.10(0.69,1.73)	2.39(1.52,3.77) <sup>e</sup>	1.10(0.80,1.53)	1.28(0.96,1.69)
<b>% Under 21 Years<sup>3</sup></b>				
2nd Tertile	1.18(0.80,1.73)	.82(0.54,1.24)	.89(0.66,1.18)	1.22(0.95,1.56)
3rd Tertile	.76(0.45,1.27)	.99(0.60,1.65)	1.09(0.76,1.58)	1.39(1.01,1.91) <sup>*</sup>
<b>% Receives SNAP<sup>3</sup></b>				
2nd Tertile	.69(0.46,1.01)	.68(0.45,1.02)	.94(0.71,1.26)	.71(0.55,.91) <sup>e</sup>
3rd Tertile	.70(0.43,1.15)	.63(0.38,1.04)	1.10(0.77,1.58)	.58(0.43,.79) <sup>e</sup>
<b>Cannabis Policy</b>				
No restriction	Reference		Reference	
Advertising restriction	1.02 (0.60,1.74)	1.82 (1.05,3.15) <sup>*</sup>	1.08(0.74,1.56)	1.35(0.96,1.90)
No storefront retail	.87 (0.56,1.36)	1.15(0.71,1.85)	.89(0.65,1.22)	.95(0.71,1.27)
<b>Tobacco Policy<sup>3</sup></b>				
No restriction	Reference		Reference	
Flavor ban (only)	2.87(1.43,5.74) <sup>e</sup>	1.38(0.61,3.12)	2.15 (1.40,3.32) <sup>e</sup>	.74 (0.46,1.19)
Flavor ban & min. pack	2.28(0.92,5.69)	.49(0.10,2.39)		

\* p < .05;

<sup>e</sup> p < .01;

<sup>f</sup> p < .0001;

<sup>1</sup> The adjusted odds ratios corresponding to the two categories, discontinuation and addition of the product since the 2016 survey, are relative to the category representing no change in product availability between the two survey years;

<sup>2</sup> Accessibility Potential;

<sup>3</sup> first tertile of the distribution is the reference category for each of the four demographic variables;

<sup>4</sup> only one estimate for blunt wraps because a minimum pack size does not apply.

cannabis markets (Giovenco et al., 2018) and locations of cannabis retailers in California (Unger et al., 2020). Unger et al. (2020) reported that among geographic service areas in California (2.5 mile radius), a higher percentage of those with a cannabis retailer were below the federal poverty line (18.1% vs. 12.9%, p < .001); LTRs in such areas frequently market and sell cigarillos. One might surmise that our unexpected finding was a function of the negative correlation between tobacco and cannabis restrictions in the jurisdictions where LTRs were sampled. But, upon adjusting the models for a tobacco flavor ban, the restrictive cannabis policies were not associated with a decline in the retail availability of the tobacco products. While there is no apparent explanation for this finding, Lipperman-Kreda et al. (2014) reported that retail availability of the tobacco products (e.g., blunt wraps) was negatively associated with density of cannabis medical dispensaries in California.

The main effect of a tobacco flavor ban on retailers' discontinued sales of LCCs and blunt wraps in California was consistent with policy effects in other parts of the country (Brock et al., 2019; Farley and Johns, 2017). Farley and Johns (2017) reported an 86.2% decline in sales of flavored cigars following enforcement of New York City's ban on flavored tobacco in November, 2010. Although the flavored tobacco products could not be differentiated from the non-flavored products in our longitudinal sample, it is highly likely that the flavor bans reduced availability of LCCs/blunt wraps because flavored cigarillos accounted for 56% of U.S. cigarillo sales in 2016 (Giovenco et al., 2018). It is unlikely that the enactment of a minimum pack size accounted for the

decline in availability of LCCs because our regression estimates did not differ significantly for the California jurisdictions that had and had not adopted the policy.

The significant interaction of policies, which indicated a stronger effect of tobacco flavor bans in jurisdictions that permitted cannabis, could be attributed to three factors. First, the jurisdictions that banned flavored tobacco, but not cannabis, are widely known for their progressivity in tobacco control (e.g., San Francisco, Berkeley, Oakland) (Katz, 2008). The community norms of these jurisdictions may have contributed to reduction of the retail availability of flavored blunt wraps. Further, the San Francisco Department of Public Health took an active role in educating tobacco retailers about the flavor ban, resulting in a substantial increase in compliance (17%–77%) over a one-month period (Vyas et al., 2021). The second factor was the recent advent of non-tobacco wraps (e.g., hemp wraps) that are being marketed and sold by cannabis retailers as an alternative to tobacco blunts (hempwraps.com, 2017). Since most LTRs do not carry these new products, the switch to the non-tobacco alternative was probably occurring in the progressive jurisdictions where storefront cannabis sales are permitted. A third factor accounting for the interaction was the variety of options for administering cannabis (e.g., edibles, tinctures) that may be more readily available to residents of cities with progressive tobacco control and legalized cannabis. It is plausible that more access to the cannabis products has diminished the demand for tobacco to be used as blunts. Public health officials should carefully monitor any adverse outcomes associated with the alternative cannabis products, which could be an

unintended consequence of policies allowing cannabis sales.

#### 4.1. Study limitations

Our study benefited from a longitudinal statewide survey of tobacco retailers that was conducted during an optimal time for assessing the impact of tobacco and cannabis ordinances in California. Yet, there are study limitations that may have affected our estimates, which include a high attrition of LTRs between 2016 and 2019 (42%); lack of prevalence estimates of cannabis use for the multilevel analyses; lack of measures of flavored LCCs/blunt wraps in the longitudinal sample; the potential impact of other policies, such as tobacco retailer density, on availability of the tobacco products; and assessment of demographic data in jurisdictions rather than neighborhoods (Henriksen et al., 2017; Lipperman-Kreda et al., 2014). Initial analyses specified multilevel cross-classified models with demographic data of census tracts. These models failed to converge due to their complexity, resulting in our use of the two-level generalized structural equation models. Yet, the modeling of jurisdictions rather than census tracts still revealed minority communities' increased access to LCCs, a finding observed in other studies (Cantrell et al., 2013; Kong et al., 2020). Such an inequity was not as evident for the blunt wraps, which could reflect the high degree of variability of retailers who sell blunt wraps within jurisdictions (i.e. low clustering). Lipperman-Kreda et al. (2014) similarly reported that demographics of census block groups were not associated with availability of blunt wraps (Lipperman-Kreda et al., 2014). Despite these findings, blunt wraps should be closely monitored because unlike the LCCs, their availability increased between the years 2016 and 2019. In the coming years, the non-tobacco wraps are likely to compete with the blunt wraps (and LCCs) because they can be sold in a variety of flavors in any California jurisdiction, and may be perceived as a less harmful option for smoking blunts.

#### 4.2. Conclusions

The enactment of tobacco flavor bans in California jurisdictions was associated with significant reductions in retail availability of LCCs and blunt wraps. These reductions were moderated by cannabis policy such that the strongest effect of a tobacco flavor ban occurred in jurisdictions that did not restrict cannabis advertising or sales. Passage of tobacco flavor bans in California jurisdictions, as well as jurisdictions in other U. S. states, may be an effective strategy to reduce retail availability of LCCs, blunt wraps, and possibly other tobacco at the local level. This finding is of particular relevance as the tobacco industry has successfully petitioned for a referendum vote to attempt to overturn California's 2020 statewide flavor ban.

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#### CRedit authorship contribution statement

DST designed the study, conducted analyses, and wrote most of manuscript. JR mapped the cannabis and tobacco retailers, developed the AP index, and assisted with analyses. LDS, AAP, ROS, JBU and EAR provided material support and consultation pertaining to cannabis laws and cannabis retailers. All authors reviewed and edited the manuscript.

#### Declaration of Competing Interest

No conflict of interest is declared

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