Effect of tobacco sales bans on retail sales in Beverly Hills and Manhattan Beach, California, USA: a synthetic difference-in-differences analysis

Nita H Mukand ,[1] Wendy B Max ,[2] Rafael Colonna ,[3] Elizabeth Andersen-Rodgers ,[3] Justin S White [1,4]

► Additional supplemental material is published online only. To view, please visit the journal online (https://doi.org/10.1136/tc-2024-059184).

[1]Department of Epidemiology and Biostatistics, University of California San Francisco, San Francisco, California, USA
[2]Institute for Health and Aging, University of California San Francisco, San Francisco, California, USA
[3]California Tobacco Prevention Program, California Department of Public Health, Sacramento, California, USA
[4]Department of Health Law, Policy and Management, Boston University School of Public Health, Boston, Massachusetts, USA

Correspondence to
Dr Justin S White;
juswhite@bu.edu

Received 26 November 2024
Accepted 28 October 2025

To cite: Mukand NH, Max WB, Colonna R, *et al*. *Tob Control* Epub ahead of print: [*please include* Day Month Year]. doi:10.1136/tc-2024-059184

ABSTRACT

Background On 1 January 2021, Beverly Hills and Manhattan Beach, California, became the first cities in the USA to ban tobacco product sales. We evaluated the effects of these policies on the sale of tobacco products and non-tobacco products by store in each city and its neighbouring area.

Methods We used custom NielsenIQ retail scanner data by product and store to estimate actual and counterfactual sales trends for a set of convenience, grocery and drug stores in Beverly Hills and Manhattan Beach and their border areas using synthetic difference-in-differences models. Tobacco product unit sales were estimated overall and by tobacco product category. We also estimated changes in dollar sales of total non-tobacco products to evaluate broader economic impacts.

Results Tobacco sales in included stores ceased within 3 months of the policy going into effect in Beverly Hills and nearly ceased by December 2021 in Manhattan Beach. A shift in cross-border shopping was detected for cigars only. Non-tobacco product sales did not significantly change in either city or the border area.

Conclusion The tobacco sales bans in Beverly Hills and Manhattan Beach nearly eliminated local tobacco sales in the included stores, without prompting substantial cross-border shopping. Stability of non-tobacco product sales for included stores suggests these policies did not adversely affect local retail economies. These results suggest the viability of tobacco sales bans as an effective tobacco control strategy.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Studies have shown that retailers in Beverly Hills and Manhattan Beach had high compliance with the local tobacco sales bans and felt it was easy to comply with them, but expressed concern about losing business to retailers in nearby cities.

WHAT THIS STUDY ADDS

⇒ This study provides the first evidence on the impact of tobacco sales bans in Beverly Hills and Manhattan Beach on the sale of tobacco products, cross-border shopping and non-tobacco products.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Our findings show that local tobacco sales bans led to the near cessation of tobacco sales in a set of convenience, grocery and drug stores, with the displacement of sales to border areas limited to cigars and with limited harm to the sale of non-tobacco products.

⇒ Our findings suggest the importance of continuing to monitor cross-border shopping and economic impacts on retailers as additional jurisdictions adopt tobacco sales bans.

INTRODUCTION

On 1 January 2021, Beverly Hills and Manhattan Beach in California became the first two cities in the USA to end tobacco sales.[1 2] Both cities provided retailers with temporary exemptions for economic hardship that expired by December 2021, and Beverly Hills provided permanent exemptions for hotel concierges and existing cigar bars. To date, studies have assessed retailers' perceptions of the laws, observed changes in tobacco products and marketing in stores, and have attempted to buy tobacco from retailers in the cities. In a phone survey of tobacco retailers in both cities in the month following the policy going into effect, 8 of 11 non-exempt retailers who were willing to participate reported that compliance was easy or very easy. Of the three who said compliance was difficult, all cited fear of going out of business as a reason.[3] Interviews with retailers in Beverly Hills and Manhattan Beach in October 2022 found that small retailers in these cities reported lost business to neighbouring cities.[4] Henriksen and colleagues documented high compliance using a secret shopper study fielded in both cities, in which 88% of retailers were not selling tobacco within 6–12 months of implementation.[5] The same study estimated that Marlboro cigarette prices were 7% higher on average in cross-border stores compared with stores farther away, but discounts did not change. There has not yet been a comprehensive study using retail sales data to directly assess the extent to which the policies achieved their intended impact of ending tobacco sales and whether business was displaced to neighbouring communities.

In this study, our objective was to estimate the impact of the tobacco sales bans on tobacco purchases in the two cities with sales bans and their surrounding areas. We applied recent advances in statistical methods to estimate the effects on sales of tobacco products, cross-border shopping and non-tobacco products. Our findings have implications for the potential expansion of tobacco sales bans in other jurisdictions in the USA and elsewhere.

METHODS

Data

NielsenIQ provided retail scanner data on sales of tobacco and non-tobacco products from a select group of retail chains that granted prior approval to NielsenIQ to licence their store-level data. These data are collected from point-of-sale systems at retailers that gave such approval, capturing weekly price and sales data across all major US markets. The custom data set used in this analysis included data by product and store from 524 California places, including 398 cities. Overall, the custom data included approximately 16% of California cigarette retail sales, as the use of store-level data was limited to retailers that had granted NielsenIQ prior approval to share the more granular data. Our data set had comparable coverage in California to the NielsenIQ Retail Scanner Data available via the University of Chicago's Kilts Center, commonly used in tobacco policy evaluations,[6–9] in terms of number of tobacco retailers (n=3340 versus n=3240 for our data) and total cigarette sales (US$669 million in 2020 versus US$737 million). Data were provided at the individual product level based on universal product codes and summarised as 4-week, store-level prices and unit and dollar sales, which we aggregated to quarterly sales. We used sales data from 1 April 2018 to 31 December 2022, which covers 32 months prior to and 24 months after the sales ban effective date for Beverly Hills and Manhattan Beach.

Retail environment and included stores

Prior to the sales bans, there were 29 tobacco retailers in Beverly Hills and 18 in Manhattan Beach.[5] At the time of implementation, 33 stores across both cities were subject to the sales ban. Most were convenience stores (34.4%), followed by liquor stores (18.8%), drug stores (15.6%), grocery stores (21.9%) and one tobacco speciality store (3.0%) in Manhattan Beach. Three cigar lounges in Beverly Hills (9.4%) were exempted from the ban. Prior to the sales bans, Beverly Hills and Manhattan Beach had implemented multiple ordinances to restrict the use and sale of tobacco products, including restricting the use of tobacco products in many outdoor public spaces and the sale of flavoured tobacco products.[10 11]

Selected retail chains give NielsenIQ prior approval to licence their store-level data to NielsenIQ clients. Our custom data included all retail chains that gave such approval, hereafter referred to as the included stores. This consisted of grocery stores, convenience stores (including those at gas stations) and drug stores, and excluded independent stores, liquor stores, tobacco speciality stores and cigar lounges. We excluded military stores that were only present in the control cities, because they would likely be exempt from local tobacco regulations. The data contained two stores in Beverly Hills—one grocery store (33% of all Beverly Hills licensed tobacco retailers of that type) and one drug store (33%)—and five stores in Manhattan Beach—one grocery store (25% of all Manhattan Beach licensed tobacco retailers of that type) and four convenience stores (66%).

Border areas were created using the ZIP codes within a 30-min commuting area of Beverly Hills and Manhattan Beach and encompassed all available stores within those areas (online supplemental figure S1). This is similar to the average commuting times for Beverly Hills (24.5 min) and Manhattan Beach (28.9 min) based on 2023 American Community Survey 5-year estimates. The commuting area was identified using Geoapify's Isoline application programming interface, assuming car as a mode of transport and incorporating traffic conditions.[12] The Beverly Hills border area contained 252 included stores (163 convenience stores, 43 drug stores and 46 grocery stores). The Manhattan Beach border area contained 300 included stores (180 convenience stores, 51 drug stores and 69 grocery stores). In sensitivity analyses, we defined the border area as ZIP codes contiguous with Beverly Hills and Manhattan Beach. More details are provided in the online supplemental file 1. The donor pool of potential control units consisted of more than 2738 stores from 388 cities throughout California.

Product categories

Tobacco sales were classified by NielsenIQ as (1) cigarettes, (2) cigars (including big cigars, little cigars and cigarillos), (3) smokeless tobacco, (4) electronic nicotine delivery systems (ENDS) and (5) the sum of these products grouped as an 'all tobacco' category. We also included other non-tobacco products, which are classified in the NielsenIQ data as: baby care, bakery, dairy, deli, frozen, general merchandise, grocery, health and beauty care, household care, meat, produce and seafood; the data excluded alcohol and pet supplies.

Demographic data

Data on population size, median income, and race and ethnicity for Manhattan Beach, Beverly Hills, and the greater California donor pool were drawn from the 2017–2022 American Community Survey 5-year estimates, collected by the US Census Bureau, to characterise demographic differences between the treated cities and the rest of California.

Ethics

This study followed Strengthening the Reporting of Observational Studies in Epidemiology reporting guidelines for cross-sectional studies[13] and was determined not to meet the criteria for human participant research by the institutional review board at the University of California, San Francisco.

Outcome variables

Our primary outcome measure was total units sold of all tobacco products per included store within Beverly Hills, Manhattan Beach and their border areas, compared with their synthetic controls. An alternate outcome used in sensitivity analyses was total dollar sales of tobacco products per store, to account for differential changes in volume purchased over time (eg, buying cartons instead of packs) or differences in product attributes (eg, disposable e-cigarettes versus e-liquid). The analysis of non-tobacco products used the total dollar sales across all non-tobacco departments within the store.

Statistical analyses

The analysis used the synthetic difference-in-differences (SDID) approach on store-level data.[14] SDID brings together the strengths of other leading quasi-experimental approaches, namely difference-in-differences and synthetic control methods. Similar to synthetic control analysis, SDID is a data-driven approach that applies unit weights to control units (stores) in order to construct a weighted average of all potential control (non-treated) units that best approximates the treated unit on both the pretreatment outcome and a set of prognostic factors.[15] The unit weights facilitate satisfying the parallel trends assumption by matching on control units with the most similar pretreatment outcome trends. Unlike synthetic control analysis, SDID also includes time weights that allow the model to draw more weight from pretreatment periods that are the most similar to the post-treatment periods, resulting in a more reliable

counterfactual trend. SDID thereby constructs a counterfactual outcome for what would have happened to the treated area in the absence of treatment. Furthermore, we restricted the store type (drug, grocery and convenience) used to create the synthetic control to those present in the treated unit. Consequently, only drug and grocery stores were used to create the synthetic control for Beverly Hills, and only grocery and convenience stores were used to create the synthetic control for Manhattan Beach. SDID has been shown to have excellent performance compared with synthetic control and difference-in-differences approaches in terms of bias and root-mean-squared error,[14] is feasible when the parallel trends assumption is not met in unweighted data, and does not require mean outcomes of treated units to be within the distribution of the control data as in synthetic control analysis. While synthetic control methods have been used to evaluate tobacco control programmes and policies in California, including Proposition 99 and the 2017 cigarette tax increase,[15 16] SDID has rarely been used in the tobacco control literature.

To determine the statistical significance of the SDID average treatment effects, we used a permutation-based approach. Under this approach, placebo estimates were generated for randomly selected stores in the potential pool of control stores as if those stores had been subject to a tobacco sales ban. The placebo estimate factors in the unit and time weights used to construct the synthetic control.[14] We repeated this procedure for 100 iterations to generate 95% CIs from the variance around the placebo estimates. Further details are included in the online supplemental file 1.

We also conducted an 'event study' that plotted the difference between the included stores in the treated cities and their synthetic controls in each year-quarter.[17] This allowed for visual inspection and quantification of the change in the treatment effect over time. The significance of the prepolicy coefficients provided a diagnostic of parallel pre-event outcome trends, an indicator of whether the parallel trends assumption may be satisfied.[18] Further, to assess pretreatment fit, we computed the root mean squared prediction error (RMSPE) between the treated units and their synthetic controls in the prepolicy period.

As a sensitivity analysis, we conducted a leave-one-out SDID analysis—sequentially re-estimating the model while excluding each donor city and recording the change in policy effects—to assess whether the results were driven by any single locality or poor pretreatment fit.

Statistical analyses were conducted using Stata (V.18.0, StataCorp).

Tobacco product sales

Our primary analyses focused on sales of tobacco products in the included stores in Beverly Hills and Manhattan Beach overall and stratified by each of the four product categories, compared with sales in their respective synthetic controls. Our SDID

Table 1 Tobacco sales preban for included stores, and demographic and store characteristics for Beverly Hills, Manhattan Beach, and potential and estimated synthetic controls

	Beverly Hills	Manhattan Beach	All potential control stores	'Synthetic' Beverly Hills	'Synthetic' Manhattan Beach
A. Tobacco sales per store, quarterly					
Total unit sales, all tobacco	285.9	776.4	469.9	254.8	801.2
Total unit sales, by category					
Cigarettes	202.4	264.0	243.4	177.1	272.3
Cigars (big, little)	71.0	120.2	109.9	52.5	150.6
Smokeless tobacco	6.5	459.4	126.3	24.5	467.0
ENDS	44.7	48.7	48.2	44.6	72.4
B. Demographic characteristics					
Population	32 585	35 506	35 782	41 038	44 653
Race/ethnicity (%)					
Non-Hispanic White	77.4	71.4	40.1	47.6	36.3
Non-Hispanic Black	2.0	0.9	3.6	4.0	5.0
Hispanic	6.9	8.7	37.8	28.6	38.0
Asian and Pacific Islander	7.6	11.3	13.2	13.8	15.2
Other race, 2+ races	6.1	7.7	5.3	6.0	5.5
Median household income (US$)	70 766	100 283	44 780	50 695	45 924
C. Included store information					
Number of products	351	784	3718	1259	3596
Number of stores	2	5	2679	1279	2182
Convenience stores	0	4	1380	0	1309
Drug stores	1	0	393	384	0
Grocery stores	1	1	906	895	873
Number of cities	1	1	387	350	352

Tobacco sales are reported as the city-level average of total quarterly sales per store prior to the local tobacco sales bans being in effect. Data included the set of convenience, grocery and drug stores in the NielsenIQ data. The pool of potential control stores excludes those in Beverly Hills, Manhattan Beach and their commuting border areas, and its population estimate is a mean value across all potential control cities. The synthetic controls in the last two columns correspond to weighted store-level mean sales and weighted ZCTA-level demographic characteristics, using the unit-specific weights derived from our primary synthetic difference-in-differences estimates. Demographic data, reported at the city level in the first three columns and ZCTA level in the last two, is from the 2020 Decennial Census for race and ethnicity and from the 2017–2022 American Community Survey 5-year estimates for median household income.
ENDS, electronic nicotine delivery systems; ZCTA, ZIP code tabulation areas.

model included store type (drug, grocery and convenience) and presence of a local flavoured tobacco sales restriction (via the Policy Evaluation Tracking System)[19] as covariates and store and quarter-year fixed effects to adjust for city characteristics that did not vary over time and secular trends. For ease of interpretation, we expressed the estimates as per cent changes compared with the prepolicy outcome for included stores in the treated cities. In exploratory analyses, we estimated the SDID models by store type.

Cross-border sales

To fully quantify changes following the tobacco sales bans, we explored whether tobacco product sales changed in adjacent border areas. Border areas were created using commuting areas around and the ZIP codes contiguous with Beverly Hills and Manhattan Beach, as described above. The same SDID procedure was used, with the border areas considered the 'treated' areas and omitting Manhattan Beach and Beverly Hills.

Non-tobacco product sales

An analysis of total dollar sales of non-tobacco products provided an assessment of whether retailers were negatively impacted by the sales ban beyond any change in tobacco sales. This analysis used the same SDID procedure as detailed above, except it included the sum of all non-tobacco product dollar sales as the outcome variable. In exploratory analyses, we estimated the SDID models by store type and by store department.

RESULTS

Descriptive statistics

The characteristics of the treated cities, each city's synthetic control and the pool of all potential control stores are shown in table 1. There were large differences in the mean weekly tobacco sales and demographics between the treated cities and potential control stores in the unadjusted data. This supports the empirical strategy of forgoing the entire donor pool of California stores as a control group in favour of a synthetic control-like approach that might better match the treated units. Compared with the entire donor pool, the characteristics of each city's synthetic control were more similar to those of the treated cities, both for tobacco sales that were used to construct the synthetic control as well as for demographic characteristics that were not.

The pool of all potential control units included more than 2600 stores with over 3700 different tobacco products from 387 cities in California.

Analyses of unit sales of tobacco products in treated cities

The SDID procedure constructs a weighted average of potential controls to match each treated unit. The five control units that received the most weight for each treated city are listed in online supplemental table S1. No single store contributed more than 7% to the synthetic control for Beverly Hills or more than 4% for Manhattan Beach. A total of 1279 stores from 350 cities contributed to the synthetic control for Beverly Hills, and 2182 stores from 352 cities contributed to the synthetic control for Manhattan Beach for the analysis of unit sales of all tobacco products.

The outcome trends for all tobacco products between each treated city and its synthetic control are shown in figure 1. The SDID procedure produced a synthetic control with a relatively close match to the preban outcome trends for the included stores in each treated city.

Beverly Hills and Manhattan Beach each experienced large reductions in tobacco sales in the included convenience, grocery and drug stores. Sales started to decline just prior to the ban in Beverly Hills. Tobacco sales in the Beverly Hills stores ceased within the first 3 months after its policy took effect. Total tobacco sales in the Manhattan Beach stores decreased to <1% of preban sales by the end of 2021; our study included one convenience store that had received a temporary hardship exemption and continued to sell a small number of tobacco units for 6 months postban (online supplemental table S2). With the exception of the exempt store, tobacco sales in the other Manhattan Beach stores reached zero by the end of March 2021.

In table 2, we quantify the policy effect following the effective date in the included convenience, grocery and drug stores in Beverly Hills and Manhattan Beach and their border areas using the SDID analysis. In Beverly Hills, all tobacco sales decreased significantly by 44.8% (–127.9 units per store-quarter (95% CI –65.1% to –24.4%), p<0.001) postban, compared with the trend in its synthetic control. In Manhattan Beach, all tobacco sales decreased significantly by 63.9% (–496.1 units per store-quarter (95% CI –82.0% to –45.8%), p<0.001) postban, compared with the trend in its synthetic control. The event study plots of how sales changed quarter by quarter in Beverly Hills and Manhattan Beach are shown in figure 2. Sales declined steeply immediately after the policy took effect and persisted through the end of the study period. Similar declines appear for most product categories (online supplemental figure S3–S6, S8–S10). Before the policy, sales in the comparison (synthetic control) group closely tracked those in the treated cities, and

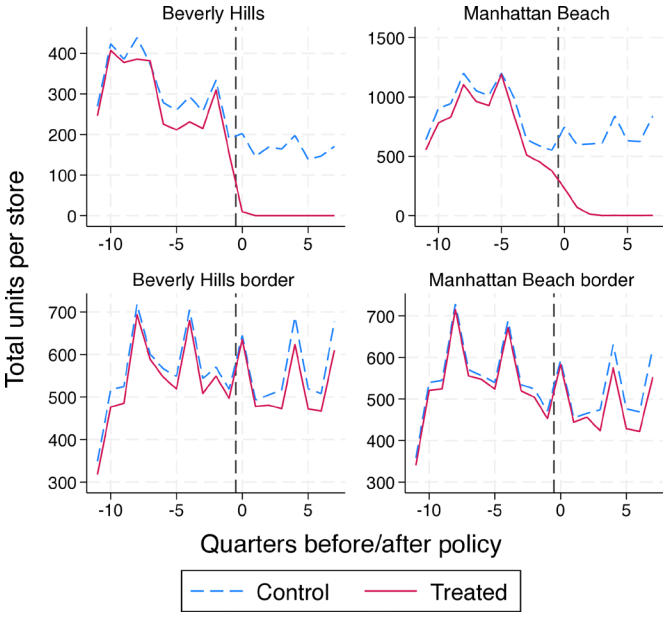

Figure 1 Trends in quarterly unit sales of all tobacco products between treated and border areas with their synthetic control before and after the local tobacco sales bans in effect. Note: this figure shows trends over time in quarterly total unit sales of all tobacco products (including electronic nicotine delivery systems) per store for the treated or border area and its synthetic control. Estimates are derived from synthetic difference-in-differences models that include covariates for store type (convenience, grocery and drug) and whether the city had a flavour policy implemented during the study period. The model also includes store and quarter-year fixed effects. Data were analysed at the store-quarter level and included a set of convenience, grocery and drug stores.

Table 2 Effect of tobacco sales bans on store-level quarterly unit sales in treated and border areas, by tobacco product category

	Unit sales by product category				
	All tobacco	**Cigarettes**	**Cigars**	**SLT**	**ENDS**
A. Beverly Hills					
ATT	−127.9***	−98.6***	−53.3***	−1.3	1.2
	(−186.1 to −69.8)	(−133.0 to −64.3)	(−72.7 to −33.9)	(−17.4 to 14.8)	(−1.8 to 4.3)
Number of observations	24 434	23 845	16 378	13 699	7999
Mean outcome	285.9	202.4	71.0	6.6	42.0
ATT as % change	−44.8	−48.7	−75.0	−19.8	2.9
	(−65.1 to −24.4)	(−65.7 to −31.8)	(−102.3 to −47.7)	(−266.2 to 226.6)	(−4.4 to 10.2)
B. Manhattan Beach					
ATT	−496.1***	−175.9***	−118.2***	−251.9***	−11.7
	−636.7 to −355.6)	(−221.6 to −130.3)	(−180.7 to −55.7)	(−348.5 to −155.3)	(−33.7 to 10.2)
Number of observations	41 686	41 097	33 972	31 312	32 718
Mean outcome	776.4	264.0	120.2	459.4	48.7
ATT as % change	−63.9	−66.6	−98.3	−54.8	−24.1
	(−82.0 to −45.8)	(−83.9 to −49.4)	(−150.3 to −46.3)	(−75.9 to −33.8)	(−69.1 to 21.0)
C. Beverly Hills border					
ATT	−17.1*	−2.5	13.8***	−18.3***	−9.8***
	(−35.9 to 1.8)	(−10.1 to 5.2)	(5.6 to 22.0)	(−30.6 to −6.0)	(−13.7 to −5.9)
Number of observations	57 323	56 715	48 925	45 809	38 988
Mean outcome	532.9	265.9	125.9	105.6	69.5
ATT as % change	−3.2	−0.9	11.0	−17.3	−14.1
	(−6.7 to 0.3)	(−3.8 to 1.9)	(4.4 to 17.5)	(−29.0 to −5.7)	(−19.7 to −8.4)
D. Manhattan Beach border					
ATT	−20.0**	−3.4	9.3**	−21.1***	−12.2***
	(−37.1 to −2.9)	(−10.2 to 3.3)	(2.0 to 16.7)	(−34.2 to −8.0)	(−15.8 to −8.7)
Number of observations	58 235	57 627	49 476	46 379	39 558
Mean outcome	534.3	266.8	144.3	112.6	57.9
ATT as % change	−3.7	−1.3	6.5	−18.7	−21.1
	(−7.0 to −0.5)	(−3.8 to 1.2)	(1.4 to 11.6)	(−30.4 to −7.1)	(−27.3 to −14.9)

This table shows estimates from synthetic difference-in-differences models of the change in total units sold per store for each product category by geographic area. 95% CIs, derived from permutation-based inference, are provided in parentheses. Data were analysed at the store-quarter level and included a set of convenience, grocery and drug stores. Stores used in creating the synthetic controls for Beverly Hills were restricted to the channels present in Beverly Hills: grocery and drug stores. Stores used in creating the synthetic controls for Manhattan Beach were restricted to the channels present in Manhattan Beach: grocery and convenience stores. Mean outcome = mean outcome measure of the treated group during the prepolicy period. ATT as % change = theATT expressed as a per cent change relative to the mean baseline outcome variable.
Significance: *p<0.10, **p<0.05, ***p<0.01.
ATT, average treatment effect on the treated; ENDS, electronic nicotine delivery systems; SLT, smokeless tobacco.

statistical checks found no meaningful differences in the quarters leading up to the policy (online supplemental table S2). For Beverly Hills, prepolicy coefficients were small and statistically indistinguishable from zero, and the prepolicy match was tight by RMSPE (7.5% of the preban mean, 0.12 preperiod SDs). In Manhattan Beach, some prepolicy quarterly coefficients were statistically significant; however, their magnitudes were small, and the overall prepolicy match was tight (RMSPE 7.6% of the preban mean, 0.102 preperiod SDs), consistent with no meaningful pretrend.

In sensitivity analyses, estimates were similar when using dollar sales instead of unit sales as the outcome (online supplemental table S3 and figure S11). In the leave-one-out sensitivity analysis, dropping each donor unit in turn produced changes in policy effects centred near zero (mean change <0.1%), with no single donor shifting the estimate by more than 1.5% in Beverly Hills and Manhattan Beach (online supplemental table S4).

Analyses of cross-border shopping

The average treatment effect estimates for cross-border shopping are presented in Panels C and D of table 2. Sales of all tobacco products among the included stores in the area surrounding Beverly Hills did not significantly change (−3.2%, or −17.1 units per store-quarter (95% CI −6.7% to 0.3%), p=0.08); this implies sales did not shift to included stores in the Beverly Hills border area. Individual tobacco product categories in the included Beverly Hills border stores also showed no increase across all product categories, except for cigars, which increased by 11.0% (95% CI 4.4% to 17.5%), p=0.001.

Sales of all tobacco products in the included stores in the Manhattan Beach border area decreased by 3.7% (95% CI −7.0% to −0.5%), p=0.02, compared with its counterfactual trend following implementation of the Manhattan Beach policy. Individual tobacco product categories also showed no increase in the included Manhattan Beach border stores, again except for cigars (6.5% (95% CI 1.4% to 11.6%), p=0.01).

The cross-border estimates were robust to define the border area as adjacent ZIP codes, although ENDS sales increased in the adjacent Beverly Hills border area (online supplemental table S5 and figure S12).

Analyses of dollar sales of non-tobacco products

We investigated the effect of the local tobacco sales bans on dollar sales of all non-tobacco products sold at included convenience,

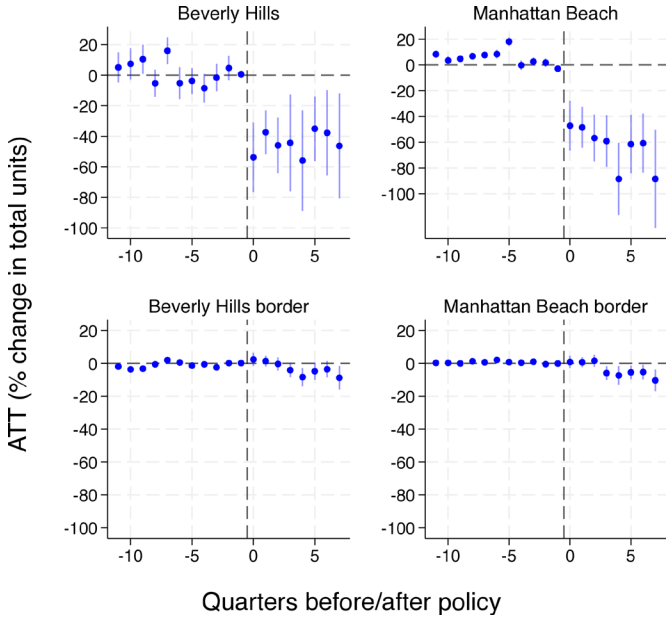

Figure 2 Change over time in the effects of tobacco sales bans on quarterly unit sales of all tobacco products in treated and border areas. Note: this figure displays event-study coefficients and 95% CIs for the effects of local tobacco sales bans relative to the quarter when the policy went into effect, indicated by the vertical dotted line. The vertical axis displays the ATT, representing the difference in total unit sales per store between the treated or commuting border area and its synthetic control, expressed as a per cent change relative to the outcome in the prepolicy period. Estimates are derived from synthetic difference-in-differences models that include covariates for store type (convenience, grocery and drug) and whether the city had a flavour policy implemented during the study period, as well as store and quarter-year fixed effects. Data were analysed at the store-quarter level and included a set of convenience, grocery and drug stores. ATT, average treatment effect on the treated.

grocery and drug stores within the treated cities as well as within the border areas (table 3, online supplemental figure S13–S15, online supplemental table S6–S7). Estimates are provided in thousands of dollars (k). In Beverly Hills, non-tobacco purchases did not significantly increase (9.6%, or US$150k per store-quarter (95% CI –6.8% to 26.0%), p=0.25) following implementation of its policy. The tobacco sales ban did not appear to negatively impact retailers' revenues from non-tobacco products there, and it is possible that a small number of tobacco consumers shifted their purchases away from tobacco products and toward other types of products. There is also no observed displacement in sales to the included stores in the Beverly Hills border area; the coefficient is negative, indicating no increase in sales in the border area on average (–0.6%, or –US$5k per store-quarter (95% CI –2.9% to 1.8%), p=0.63).

Manhattan Beach stores experienced no significant change in non-tobacco sales, although the CIs were wide (–13.0%, or –US$43k per store-quarter (95% CI –56.2% to 30.2%), p=0.56). The Manhattan Beach border area's included stores had no change in sales of non-tobacco products (1.0% (95% CI: –1.2% to 3.1%), p=0.38).

DISCUSSION

The analysis of tobacco sales bans in Beverly Hills and Manhattan Beach revealed a dramatic reduction in tobacco product sales in the included grocery, drug and convenience stores. With the exception of one convenience store in Manhattan Beach that had a limited-time hardship exemption, tobacco product sales among the included stores decreased to zero units within 3 months of the policies going into effect. This decrease aligns with the high compliance rates observed in these areas during a recent purchase attempt study.[5] These results reinforce the potential of tobacco sales bans as effective tools in achieving communities that eliminate tobacco sales.

The analysis of cross-border shopping effects revealed no significant change in overall tobacco sales among included stores in either border area, though with an increase in cigar sales. This suggests that any displacement of sales that occurred was limited in magnitude. We would also anticipate that the risk of cross-border shopping would diminish if tobacco sales bans were adopted across larger geographic areas (eg, clusters of contiguous cities or at the state level).

Concerning the economic impacts on retailers, our analysis shows that non-tobacco sales in the included stores were not adversely affected by the sales bans. This is an important finding for policymakers, as it counters arguments against tobacco sales bans based on the potential negative economic impacts on local businesses. It is consistent with prior work finding that only four tobacco retailers closed following implementation of the sales ban, three in Beverly Hills (a gas station, a large chain pharmacy and a hotel gift shop) and one in Manhattan Beach (a small grocery store).[4] However, the wide CIs for our Manhattan Beach estimate suggest a small geographical redistribution of consumer spending could have occurred, which may necessitate supportive measures for local businesses during the transition phase of such policies. These results also suggest the potential for local variations in the impacts of tobacco sales bans, which will be important to monitor.

Strengths and limitations

This study has notable strengths. It uses a unique data set of store-level retail sales data from a large group of retailers statewide and advanced econometric methods to evaluate the policy impacts. Findings from the tobacco sales ban analyses offer a

Table 3 Estimates of change in store-level quarterly dollar sales, in thousands, of non-tobacco products following the tobacco sales ban effective date

	Beverly Hills	Manhattan Beach	Beverly Hills border	Manhattan Beach border
ATT	150	–43	–5	9
	(–106 to 405)	(–186 to 100)	(–27 to 16)	(–10 to 28)
Number of observations	28 956	42 104	57 437	58 653
Mean outcome	1561	330	916	891
ATT as % change	9.6	–13.0	–0.6	1.0
	(–6.8 to 26.0)	(–56.2 to 30.2)	(–2.9 to 1.8)	(–1.2 to 3.1)

This table shows changes in dollar sales, measured in thousands, of all non-tobacco products following local tobacco sales bans going into effect, based on synthetic difference-in-differences estimates. 95% CIs, derived from permutation-based inference, are in parentheses. Mean outcome = mean outcome measure of the treated group during the prepolicy period. ATT as % change = the ATT expressed as a per cent change relative to the mean baseline outcome variable. Data were analysed at the store-quarter level and included a set of convenience, grocery and drug stores.
Significance: *p<0.10, **p<0.05, ***p<0.01.
ATT, average treatment effect on the treated.

first look at the local economic effects of an innovative policy approach being considered by other California localities.

This study has several limitations. The retail sales data only indicate purchasing behaviour and not direct consumption. It is possible that policy-affected populations consumed a different share of purchased tobacco products—for example, by instead relying on social sources of tobacco—than did policy-unaffected control populations. Moreover, the sales data are appropriate for analysing aggregate consumer behaviour but not the behaviour of any individuals, such as differences by consumers with different demographic profiles. In addition, the retail sales data contain only a subset of grocery, convenience and drug stores in each city, and thus do not include all sales. Due to data limitations, our study included only two stores in Beverly Hills (13% of stores), consisting of one drug and one grocery store and five in Manhattan Beach (29%), consisting of one drug store, two grocery stores and four convenience stores. The incomplete sales coverage, while comparable to the commonly used NielsenIQ Retail Scanner Data as noted above, could introduce bias into our estimates to the extent that excluded stores experienced different customer responses than included stores or to the extent that sales shifted differentially over time from included stores to excluded stores in treated versus control cities. Moreover, given that the sales data were primarily drawn from a set of large chain stores, these results may not extend to independent stores, smaller retailers, tobacco speciality stores or online sellers. This may be an important omission because smaller retailers in Beverly Hills and Manhattan Beach had self-reported larger revenue losses following the sales ban.[4] Generalisability is also limited by heterogeneity in sociodemographic profiles, tobacco retail landscapes and policy environments between the treated cities and other cities that might implement a tobacco sales ban. Another limitation is that the sales data would overstate compliance if retailers continue to sell tobacco products without scanning them after the ban, as has been found for some other tobacco regulations.[20 21] However, our finding of high retailer compliance with the sales bans is consistent with findings from a secret shopper study.[5] Our primary outcomes were measured as unit sales. If consumers switched package sizes over time, this may be missed by a count of unit sales, as opposed to volume sales. However, our findings were robust to using dollar sales as an outcome, suggesting that this is unlikely to be a major concern. Finally, border areas include stores that are varying distances from the treated areas.

CONCLUSION

This study details the effectiveness of local tobacco sales bans in achieving significant reductions in tobacco product sales among the included grocery, drug and convenience stores. The evidence suggests that these policies can be implemented without substantial economic harm to local retailers, bolstering the case for broader adoption of this tobacco prevention strategy. As additional jurisdictions with different sociodemographic profiles, tobacco retail environments and policy environments follow the lead of Beverly Hills and Manhattan Beach, future studies might be able to uncover factors that contribute to local variations in the economic impacts.

Contributors Conceptualisation: JSW. Data curation: NHM, RC, EA-R and JSW. Formal analysis: NHM and JSW. Funding acquisition: JSW. Methodology: JSW. Supervision: JSW. Visualisation: NM and JSW. Writing—original draft: NHM and JSW. Writing—review and editing: NHM, WBM, RC, EA-R and JSW. All authors approved the final version. JSW is the guarantor.

Funding This work is supported by a contract from the California Department of Public Health's California Tobacco Prevention Programme (contract No 21-10222). NHM was supported by a grant from the National Institutes of Health (T32AG049663).

Disclaimer Researchers' own analyses and calculations are based in part on data reported by NielsenIQ. The conclusions drawn from the NielsenIQ data are those of the researchers and do not reflect the views of NielsenIQ. NielsenIQ is not responsible for, had no role in, and was not involved in analysing and preparing the results reported herein. The findings and conclusions in this article are those of the authors and do not necessarily represent the views or opinions of the California Department of Public Health or the California Health and Human Services Agency.

Map disclaimer The depiction of boundaries on this map does not imply the expression of any opinion whatsoever on the part of BMJ (or any member of its group) concerning the legal status of any country, territory, jurisdiction or area or of its authorities. This map is provided without any warranty of any kind, either express or implied.

Competing interests The California Department of Public Health was involved in the study design, data collection, analysis, interpretation and writing. CDPH did not influence the results or outcomes of the study despite author affiliations with the funder. CDPH reviewed the text prior to submission and did not influence whether and where to submit for publication.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data may be obtained from a third party and are not publicly available. Retail sales data from NielsenIQ are proprietary and subject to the terms of NielsenIQ's data use agreement with UCSF. The data may be licensed from NielsenIQ by contacting Zach Point. Statistical code to replicate the analyses is available at: https://doi.org/10.17605/OSF.IO/DUCF5.

ORCID iDs
Nita H Mukand https://orcid.org/0000-0001-8467-5731
Wendy B Max https://orcid.org/0000-0002-4040-1592
Rafael Colonna https://orcid.org/0009-0003-2456-0598
Elizabeth Andersen-Rodgers https://orcid.org/0000-0002-4126-6564
Justin S White https://orcid.org/0000-0002-3388-9569

REFERENCES

1 City of Manhattan Beach. An ordinance of the city of manhattan beach amending manhattan beach municipal code chapter 4.118 to prohibit the sale of all tobacco products and electronic smoking devices, and making a finding of exemption under the california environmental quality act. In: *Ordinance No 20-0007*. 2020.
2 City of Beverly Hills. An ordinance of the city of beverly hills amending article 21 of chapter 2 of title 4 of the beverly hills municipal code to prohibit the retail sale of tobacco products and electronic cigarette paraphernalia, and making a finding of exemption under the california environmental quality act. In: *Ordinance No 19-O-2783*. 2019.
3 Welwean RA, Stupplebeen DA, Vuong TD, *et al*. Perspectives of licensed tobacco retailers on tobacco sales bans in Manhattan Beach and Beverly Hills, California. *Tob Control* 2022;31:e213–4.
4 McDaniel PA, Smith EA, Malone RE. Retailer experiences with tobacco sales bans: lessons from two early adopter jurisdictions. *Tob Control* 2024;33:tc-2023-057944:739–44:.
5 Henriksen L, Andersen-Rodgers E, Voelker DH, *et al*. Evaluations of Compliance With California's First Tobacco Sales Bans and Tobacco Marketing in Restricted and Cross-Border Stores. *Nicotine Tob Res* 2024;26:1159–65.
6 Cotti C, Courtemanche C, Maclean JC, *et al*. The effects of e-cigarette taxes on e-cigarette prices and tobacco product sales: Evidence from retail panel data. *J Health Econ* 2022;86:102676.

7 Pesko MF, Courtemanche CJ, Catherine Maclean J. The effects of traditional cigarette and e-cigarette tax rates on adult tobacco product use. *J Risk Uncertain* 2020;60:229–58.
8 Goli A, Mummalaneni S, Chintagunta PK. Making a Smooth Exit? Menthol Bans and Cigarette Sales in Massachusetts. *Marketing Science* 2024;43:564–89.
9 White JS, Atherwood S, Apollonio DE. Effect of a minimum floor price law for tobacco products on tobacco sales in Oakland. *Tob Control* 2025.
10 Phasing out the sale of tobacco products case study beverly hills. Action on smoking and health; 2021.
11 Phasing out the sale of tobacco products case study manhattan beach action on smoking and health. 2021.
12 Geoapify. Isoline API playground 2025. 2025. Available: https://commutetimemap.com [Accessed 15 Apr 2025].
13 von Elm E, Altman DG, Egger M, *et al*. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *The Lancet* 2007;370:1453–7.
14 Arkhangelsky D, Athey S, Hirshberg DA, *et al*. Synthetic Difference-in-Differences. *American Economic Review* 2021;111:4088–118.
15 Abadie A, Diamond A, Hainmueller J. Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program. *J Am Stat Assoc* 2010;105:493–505.
16 Boettiger DC, White JS. Cigarette Pack Prices and Sales Following Policy Changes in California, 2011-2018. *Am J Public Health* 2020;110:1002–5.
17 Ciccia D. A short note on event-study synthetic difference-in-differences estimators. Statistical Software Components S459354, Boston College Department of Economics; 2024.
18 Freyaldenhoven S, Hansen C, Shapiro JM. Pre-Event Trends in the Panel Event-Study Design. *American Economic Review* 2019;109:3307–38.
19 American Nonsmokers' Rights Foundation. Policy evaluation tracking system (PETS). 2023. Available: https://pets.tcspartners.org
20 Vyas P, Ling P, Gordon B, *et al*. Compliance with San Francisco's flavoured tobacco sales prohibition. *Tob Control* 2021;30:227–30.
21 Roberts ME, Klein EG, Ferketich AK, *et al*. Beyond Strong Enforcement: Understanding the Factors Related to Retailer Compliance With Tobacco 21. *Nicotine Tob Res* 2021;23:2084–90.