



Brief report

Evaluating a Real World Ban on Menthol Cigarettes: An Interrupted Time-Series Analysis of Sales

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Abstract

Background: Menthol in cigarettes has been shown to increase regular cigarette smoking and nicotine dependence, and decrease success in smoking cessation. Owing to these reasons, in May 2015, the province of Ontario introduced a menthol ban on tobacco products that came into effect in January 2017 prior to a Federal Canadian Ban in October 2017. The objective of this article was to assess the effect of a provincial menthol ban on cigarette wholesale sales in Ontario.

Methods: Wholesale data submitted by tobacco manufacturers to Health Canada pursuant to the federal *Tobacco Reporting Regulations* from October 2012 to September 2017 were analyzed using interrupted time-series analysis. Changes in sales of cigarettes with and without menthol were estimated, using the province of British Columbia as a comparison. Analyses were seasonally adjusted.

Results: Sales of menthol and nonmenthol cigarettes increased from 2013 until the implementation of the 2017 provincial ban. Subsequently, a sharp decline of 55 million menthol cigarettes and 128 million total cigarettes was observed in Ontario. As a comparison, no significant changes were observed in British Columbia.

Conclusion: This study supports the conclusion that implementation of a menthol ban in Ontario was associated with significant reduction of menthol cigarette sales and total cigarettes sales, compared to British Columbia where there was no provincial menthol ban. This suggests that menthol regulations in jurisdictions with a larger percentage of menthol smokers are likely to be highly effective.

Implications: The 2017 menthol ban was associated with significant reduction of menthol cigarette sales and total cigarette sales suggesting that menthol regulations will have important effects on cigarette consumption.

Background

Menthol in cigarettes has been shown to increase regular cigarette smoking and nicotine dependence, and decrease success in smoking cessation.^{1,2} On January 1, 2017, the province of Ontario implemented a ban on all use of menthol in tobacco products.³

A Canada-wide federal menthol ban was then implemented in October 2017, banning the use of menthol in cigarettes, blunt wraps, and most cigars sold in Canada.⁴ Menthol sales comprised approximately 5% of cigarette sales in Canada in 2015,^{5–7} in comparison,

menthol sales are estimated to be about 25% of tobacco products⁸ and 30% of the cigarette market in the United States.^{1,9}

In the United States, the US Food and Drug Administration is currently assessing the potential benefits of regulating menthol in cigarettes, and their advisory committee concluded that the “removal of menthol cigarettes from the marketplace would benefit public health.”^{1,9} Other countries, including Brazil, Ethiopia, Turkey, and the European Union, have introduced menthol cigarette bans and restrictions along with partial bans in the city of Chicago, San Francisco, and potentially New Jersey among other jurisdictions.^{10–12}

There are very little data looking at the effectiveness of menthol bans.¹³ Therefore, to investigate the impact of the 2017 menthol ban in Ontario, this study uses wholesale sales data to examine trends in menthol sales in Ontario and uses the province of British Columbia, which did not implement menthol legislation, as a comparator during the period of October 2012 to September 2017. British Columbia (2016 population of 4.6 million) is the province with the lowest smoking prevalence in Canada (10.2% in 2015 compared to 11.3% in Canada for ages ≥ 15 years) but shares some similar demographic characteristics with Ontario (2016 population of 14.0 million) such as high immigrant population and a robust economy and have a similar age distribution in the 16–65 years age range.¹⁴

Methods

Data Source

The data used for this study are from wholesale sales data that are reported to Health Canada. Manufacturers are required to report by province, each brand of tobacco product, the number of units sold, package sizes, as well as the value of the units sold pursuant to the *Tobacco Reporting Regulations* (SOR/2000–273). Cigarette sales are reported on a monthly basis and returns to companies from wholesalers and retailers are reported as negative values. All data are subject to future review as a result of resubmissions by companies and audits by Health Canada.

Statistical Analysis

Sales data were merged into a master database using Stata, version 14. For each month, net unit sales by product type (menthol, nonmenthol, and all cigarettes) in Ontario and British Columbia were calculated for the period October 1, 2012, to September 30, 2017—a total of 80 monthly periods. To provide comparability between the provinces, the wholesale sales were centered at baseline in October 2012 and divided by 1 000 000. Starting values in October 2012 were 300 million nonmenthol and 17 million menthol cigarettes sold per month in British Columbia, and 1 billion nonmenthol cigarettes and 44 million menthol cigarettes sold per month in Ontario.

This study uses an interrupted time-series design to assess the 2017 regulations using aggregate monthly sales using the program ITSA.^{15,16}

The basic model was

$$Y_t = \beta_0 + \beta_1 T_t + \beta_2 X_t + \beta_3 X_t T_t + \beta_4 Z + \beta_5 Z T_t + \beta_6 Z X_t + \beta_7 Z X_t T_t + \varepsilon_t$$

where t is the time since October 2012, X_t is an indicator variable representing the intervention, β_0 represents the starting level of cigarette sales in British Columbia, $\beta_1 T_t$ is the slope or trajectory of sales until the introduction of regulations in British Columbia, $\beta_2 X_t$ represents the change in the level of sales that occurs in the

month immediately following the regulations (compared to the counterfactual without regulations) in British Columbia, and $\beta_3 X_t T_t$ represents the difference between the pre- and post-intervention slopes or trajectories in British Columbia. Z is an indicator for Ontario, so that $\beta_4 Z$ and $\beta_5 Z T_t$ represent the difference in level and trend between Ontario and British Columbia at baseline, and $\beta_6 Z X_t$ and $\beta_7 Z X_t T_t$ represent the differences in Ontario post-intervention. The magnitude and confidence intervals of β_6 estimate the immediate association of the regulation in Ontario, and β_7 for the treatment effect over time. Dummy variables representing each month were added to control for seasonality. Newey–West robust standard errors were used to control for autocorrelation.

Results

Figure 1 displays trends in unit sales of menthol, nonmenthol, and all cigarettes in Ontario, and in British Columbia for comparison. Data are displayed as raw unit sales for each month from 2012 to 2017. Sales of menthol cigarettes increased from 2013 until the implementation of the 2017 provincial ban with sharp increases in sales over the period of 2016. Sales of menthol cigarettes (decline of 15%; $\beta = -17.9$; 95% CI = -35.2 to 71.0); nonmenthol cigarettes (increase of 1%; $\beta = 7.5$; 95% CI = -49.8 to 64.7); and overall sales (1% decline; $\beta = -17.9$; 95% CI = -35.2 to 71.0) are consistent with the absence of an intervention in the control province British Columbia.

In contrast, a sudden decline was observed in menthol sales in Ontario with the model attributing a decline of 55.0 million cigarettes (95% CI = -78.5 to -31.5) (see Table 1) as sales of menthol cigarettes fell to approximately 0 after the ban. The model-based estimate suggests a nonsignificant decline of 4% of nonmenthol sales associated with the implementation of the ban in Ontario ($\beta = -72.8$; 95% CI = -155.6 to 10.0); Figure 1 and Table 1). Overall, sales of all cigarettes fell by 127.8 million cigarettes (95% CI = -208.2 to -47.4) or 11% of all sales. However, there was a significant increase in the sales of all cigarette and nonmenthol cigarettes in Ontario after the ban, suggesting a slight rebound effect.

Discussion

This study supports the conclusion that implementation of a ban restricting the sale of menthol cigarettes in Ontario was associated with significant reduction of menthol cigarette sales and total cigarettes sales, using British Columbia as a comparator. As expected, the ban was successful at eliminating legal sales of menthol cigarettes; furthermore, the ban was associated with an overall change on sales of cigarettes in Ontario. This change was consistent with the levels of sales of menthol cigarettes prior to the ban but may have also affected smokers who did not use menthol or used menthol rarely.

The increase in sales of menthol prior to the ban may have been due to the introduction of cigarettes brands that contained a novel menthol breakable “capsule.”¹⁷ These products were advertised in at least one instance to be used to help smokers transition from menthol to regular cigarettes. These results are consistent with Chaiton et al.¹³ which show that 29% of menthol smokers made quit attempts in Ontario after the ban. The observed decrease in menthol cigarette sales after the ban and the evidence of some rebound effect is consistent with high levels of quitting behavior followed by some level of relapse.

Other aspects of the model support the hypothesis that the menthol cigarette ban affected cigarette sales. The lack of a significant

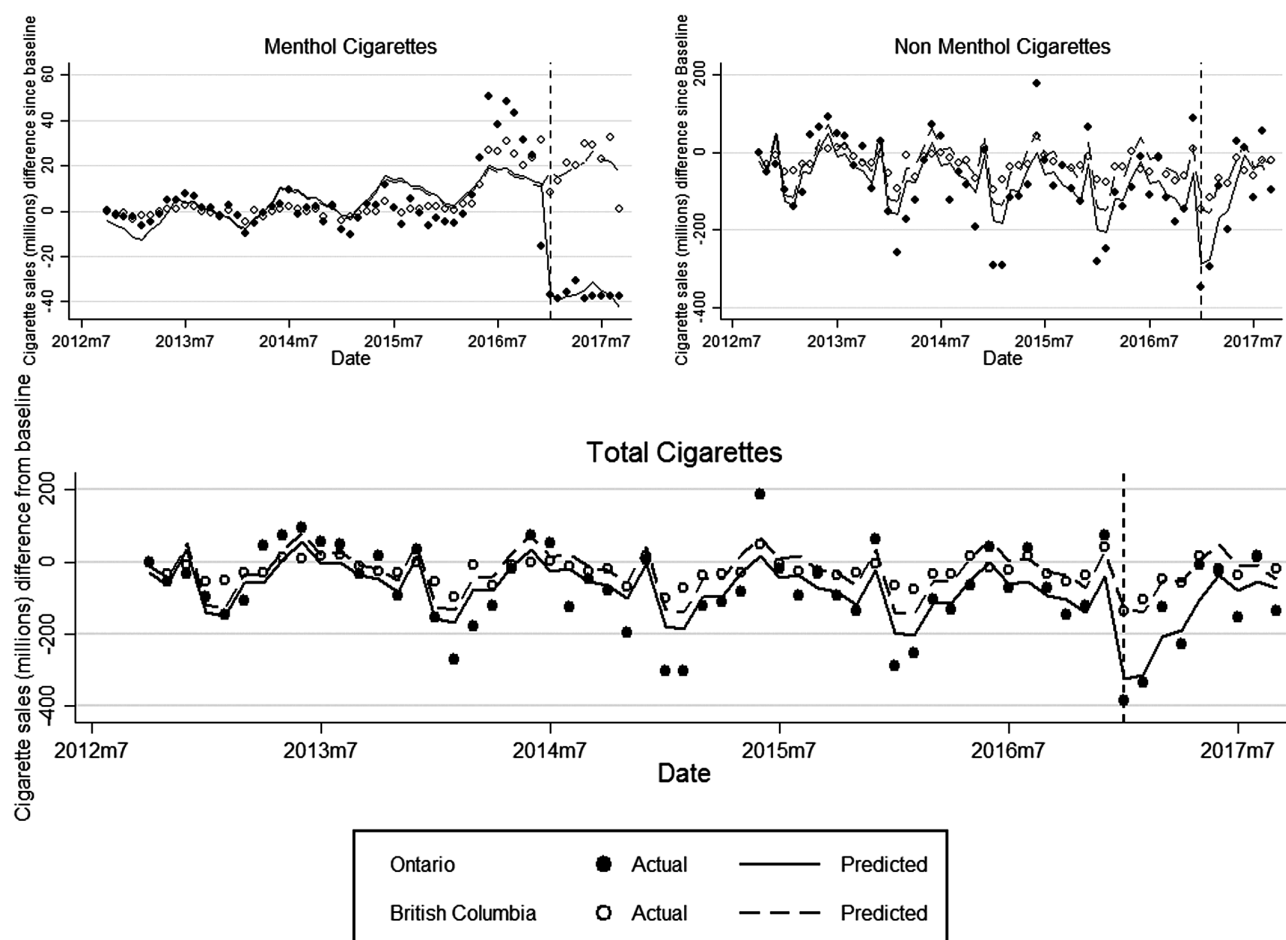


Figure 1. Menthol, nonmenthol, and cigarette sales in net wholesale per quarter Ontario and British Columbia, October 2012 to October 2017 with model predicted sales. Intervention date is January 1, 2017. All analyses control for seasonality by month. Sales are wholesales sales difference from wholesale sales in October 2012. Sales levels centered on October 2012 baseline.

Table 1. Interrupted Time-Series Regression Results for the 2017 Menthol Ban in Canada. Outcome Wholesale Sales of Cigarettes (Millions of Units) per Month, Total and by Brands With or Without Menthol Descriptors. Sales Levels Centered on October 2012 Baseline. $N = 160$

	All cigarettes β (95% CI)	Nonmenthol cigarettes β (95% CI)	Menthol cigarettes β (95% CI)
BC initial level (2012 October) β_0	-32 (-65.7 to 1.8)	-24.6 (-57.3 to 8.0)	-7.9 (-15.9 to 0.1)
BC pre Intervention trend $\beta_1 T_t$	-0.5 (-1.3 to 0.3)	-0.9* (-1.7 to -0.1)	0.4* (0.1 to 0.7)
ON difference in baseline level vs. BC	-15.9 (-63.8 to 31.9)	-14.6 (-58.8 to 29.6)	-0.1 (-11.2 to 10.9)
ON difference in baseline trend vs. BC	-1.0 (-2.5 to 0.4)	-1.1 (-2.5 to 0.3)	0 (-0.5 to 0.6)
BC post-intervention level change $\beta_2 X_t$	17.9 (-35.2 to 71.0)	7.5 (-49.8 to 64.7)	10.5 (-4.4 to 25.3)
BC post-intervention change in trend $\beta_3 X_t T_t$	-4.3 (-14.0 to 5.3)	-2.8 (-13.1 to 7.5)	-1.6 (-4.0 to 0.8)
ON difference in post-intervention level vs. BC	-127.8** (-208.2 to -47.4)	-72.8 (-155.6 to 10.0)	-55.0*** (-78.5 to -31.5)
ON difference in post-intervention change in trend vs. BC	23.0*** (10.3 to 35.6)	23.8*** (10.2 to 37.4)	-0.8 (-2.9 to 1.3)

BC = British Columbia, ON = Ontario. Implementation date of regulation: January 1, 2017. All analyses control for seasonality by month.

* $p < .05$, ** $p < .01$, *** $p < 0.001$.

effect, among nonmenthol cigarettes post-intervention suggests that the impact was menthol specific. There was also no effect on level or trend post-intervention in British Columbia suggesting that the effect was Ontario-specific. Similarity in baseline trends between Ontario and British Columbia suggests comparability between the two provinces.

Contraband sales are not included in these figures. Estimates suggest that approximately 11.5% of Canadians had purchased tax-evaded cigarettes.¹⁴ Smoking behavior studies suggest that the smokers who were purchasing menthol cigarettes from contraband sources after the implementation of the ban had been previously purchasing from these sources.¹³ A tax increase in Ontario

effective April 28, 2017, may have influenced tobacco use during the period of the study. Furthermore, a temporary decline may be due to retailers and smokers stockpiling menthol cigarettes in advance of the ban. In addition, a limitation of this study is that the menthol smoking population in Canada differs from that in the United States as menthol smoking is much less prevalent than in the United States, most menthol smokers in Canada are white, and that most smokers who use menthol do so only occasionally rather than using menthol as their primary brand.⁷ Because of the greater percentage of menthol cigarette use in the United States, it is expected that a ban would have a greater effect.

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Declarations of Interests

RN and GT are employed by Health Canada who is responsible for the administration of the menthol cigarette regulations.

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