



# **Review of Studies Assessing the Potential Impact of Prohibiting Menthol as a Characterizing Flavor in Cigarettes**

**Center for Tobacco Products  
Food and Drug Administration  
U.S. Department of Health and Human Services**

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# Review of Studies Assessing the Potential Impact of Prohibiting Menthol as a Characterizing Flavor in Cigarettes

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## Section 1:

### Summary of the Policy Evaluation Evidence on the Impact of Flavored Tobacco Sales Restrictions or Bans: A Reproducible, Transparent, Documented (RTD) Literature Review

## Summary of the Policy Evaluation Evidence on the Impact of Flavored Tobacco Sales Restrictions or Bans: A Reproducible, Transparent, Documented (RTD) Literature Review

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## Abbreviations

CI	confidence interval
IARC	International Agency for Research on Cancer
ITC	International Tobacco Control
MTurk	Amazon Mechanical Turk
NASEM	National Academies of Sciences, Engineering, and Medicine
NSDUH	National Survey on Drug Use and Health
NYTS	National Youth Tobacco Survey
OR	odds ratio
RR	rate ratio
RR2	relative rate
RTD	reproducible, transparent, and documented
RYO	roll-your-own
US	United States
USDA	US Department of Agriculture
YES	Youth Experience Survey
YHS	Youth Health Survey
YRBS	Youth Risk Behavior Surveys

## Purpose

This document provides a reproducible, transparent, and documented (RTD) review of evaluation studies that examine the impact of flavored tobacco sales restrictions or bans on tobacco use behaviors, sales of tobacco products, and unintended consequences. The specific research questions addressed by this review are:

1. What is the impact of flavored tobacco sales restrictions or bans on tobacco use behaviors of young people?
2. What is the impact of flavored tobacco sales restrictions or bans on tobacco use behaviors of adults?
3. What is the impact of flavored tobacco sales restrictions or bans on the sales of tobacco products?
4. What is the impact of flavored tobacco sales restrictions or bans on illicit sales of tobacco products?
5. What is the impact of flavored tobacco sales restrictions or bans on user modification of tobacco products?

Three electronic databases – PubMed, Web of Science, and Embase – were searched to identify articles describing studies appropriate for inclusion in this review. Additional articles identified during the external peer review process that met the article selection criteria were also included in this review. A total of 28 articles were included in this final literature review.

## Methods

### Eligibility Criteria

The following eligibility criteria were used to search for and identify scientific articles for inclusion in this review:

- Years considered: All
- Language: English
- Publication status: Peer-reviewed published or in-press journal articles, full-text available (including commentaries, research letters, letters to the editor, and review articles); conference proceedings; book chapters
  - Conference abstracts, presentations, and reports were excluded
- Studies conducted in any geographic location
- Studies in any demographic population (e.g., youth, adults)
- All study designs (e.g., cohort, cross-sectional)
- Studies of implemented flavored (e.g., menthol and/or other flavors) tobacco sales restrictions or bans covering cigarette and/or cigar tobacco products
- Focus on the following outcomes in response to the policy:
  - Behavior (such as initiation, prevalence, cessation, switching to other tobacco products);
  - Legal sales of tobacco products;
  - Illicit sales of tobacco products; and/or
  - User modification of tobacco products

## Information Sources and Search Strategy

On July 15, 2021, three electronic databases were searched for scientific publications – PubMed, Web of Science, and Embase that fit the eligibility criteria outlined above. Search strings were tailored to each respective database based on the requirements for that database. **Table 1** displays the search terms used and the number of results retrieved for each database. No additional restrictions were placed on electronic searches (e.g., article publication date).

*Table 1: Search Strings Employed on July 15, 2021 to Identify Evaluation Literature Relevant to Flavored Tobacco Product Sales Restrictions, by Database*

Database	Search String	Results
PubMed	"Flavoring Agents"[Mesh] OR Menthol[Mesh] OR Menthol*[TIAB] OR Flavor*[TI] OR Flavour*[TI] OR Flavoring*[TI] OR additive*[TI] AND "Tobacco Products"[Major] OR smoking[Mesh] OR Cigarette[TIAB] OR Cigarettes[TIAB] OR bidi[TIAB] OR Bidis[TIAB] OR "roll your own"[TIAB] OR tobacco*[TIAB] OR smoking[TIAB] OR smoker[TIAB] OR smokers[TIAB] OR cigar[TIAB] OR cigars[TIAB] OR cartridge*[TIAB] OR cigarillo[TIAB] OR cigarillos[TIAB] AND policy[TI] OR policies[TI] OR ban[TI] OR bans[TI] OR banning[TI] OR banned[TI] OR restriction[TI] OR restrict*[TI] OR prohibit*[TI] OR standard[TI] OR standards[TI] OR regulat*[TI] OR withdraw*[TI] OR eliminat*[TI] OR prohibit*[TI] OR remov*[TI] OR law[TI] OR laws[TI]	165
Web of Science	TS=("tobacco product*" OR cigarette* OR bidi OR bidis OR smoking OR smoker OR smokers OR cigar OR cigars OR cigarillo OR cigarillos OR cheroot OR cheroots OR stumphen OR stumpens OR cartridge*) NOT TI=("cigar-shape" OR "cigar-shaped" OR "cigar body" OR "cigar-bodies" OR "cigar roll" OR "cigar rolls" OR "cigar-like") AND TI=(flavor* OR flavour* OR additive* OR menthol) OR (TS=menthol) AND TI=(policy OR policies OR ban OR bans OR banning OR banned OR law OR laws OR restrict* OR prohibit* OR standard* OR regulat* OR withdraw* OR eliminat* OR remov*)	153

Database	Search String	Results
Embase	(smoking:ti,ab OR smoker:ti,ab OR smokers:ti,ab OR bidi:ti,ab OR bidis:ti,ab OR cigarette*:ti,ab OR cigar:ti,ab OR cigars:ti,ab OR cigarillo:ti,ab OR cigarillos:ti,ab OR cheroot:ti,ab OR cheroots:ti,ab OR stumpen:ti,ab OR stumpens:ti,ab) NOT ("cigar-shape":ti OR "cigar-shaped":ti OR "cigar body":ti OR "cigar-bodies":ti OR "cigar roll":ti OR "cigar rolls":ti OR "cigar-like":ti) OR ("tobacco products":ti AND (cigar:ti,ab OR cigars:ti,ab OR cigarillo:ti,ab OR cigarillos:ti,ab OR bidi:ti,ab OR bidis:ti,ab)) AND 'flavoring agent'/exp OR flavor*:ti OR flavour*:ti OR additive*:ti OR menthol*:ti,ab AND policy:ti OR policies:ti OR ban:ti OR bans:ti OR restrict*:ti OR regulat*:ti OR prohibit*:ti OR standard*:ti OR law:ti OR laws:ti OR withdraw*:ti OR eliminat*:ti OR banning:ti OR banned:ti OR remov*:ti	141

## Article Selection

Prior to excluding duplicates, the searches of PubMed, Web of Science, and Embase yielded 165, 153, and 141 citations, respectively. After de-duplication, 230 unique citations remained. Two independent reviewers conducted an initial screening of title and abstracts to determine inclusion or exclusion of each publication in this review. The reviewers then discussed and reconciled their decisions, resulting in the exclusion of 204 citations for the following reasons: newly identified duplicate (1); not in English (2); conference abstract (18); not peer reviewed – e.g., report, news item (15); study was not an evaluation of an implemented flavored tobacco sales restriction or ban - e.g., anticipated responses to a hypothetical policy, evaluation of a different type of policy (148); and study reported on outcomes in response to a policy other than behavior, legal sales of tobacco products, illicit sales of tobacco products, or user modification of tobacco products – e.g., retailer inventory of tobacco products, retailer compliance with a policy, legal challenges to implementation of a policy, public opinion related to a policy (20).

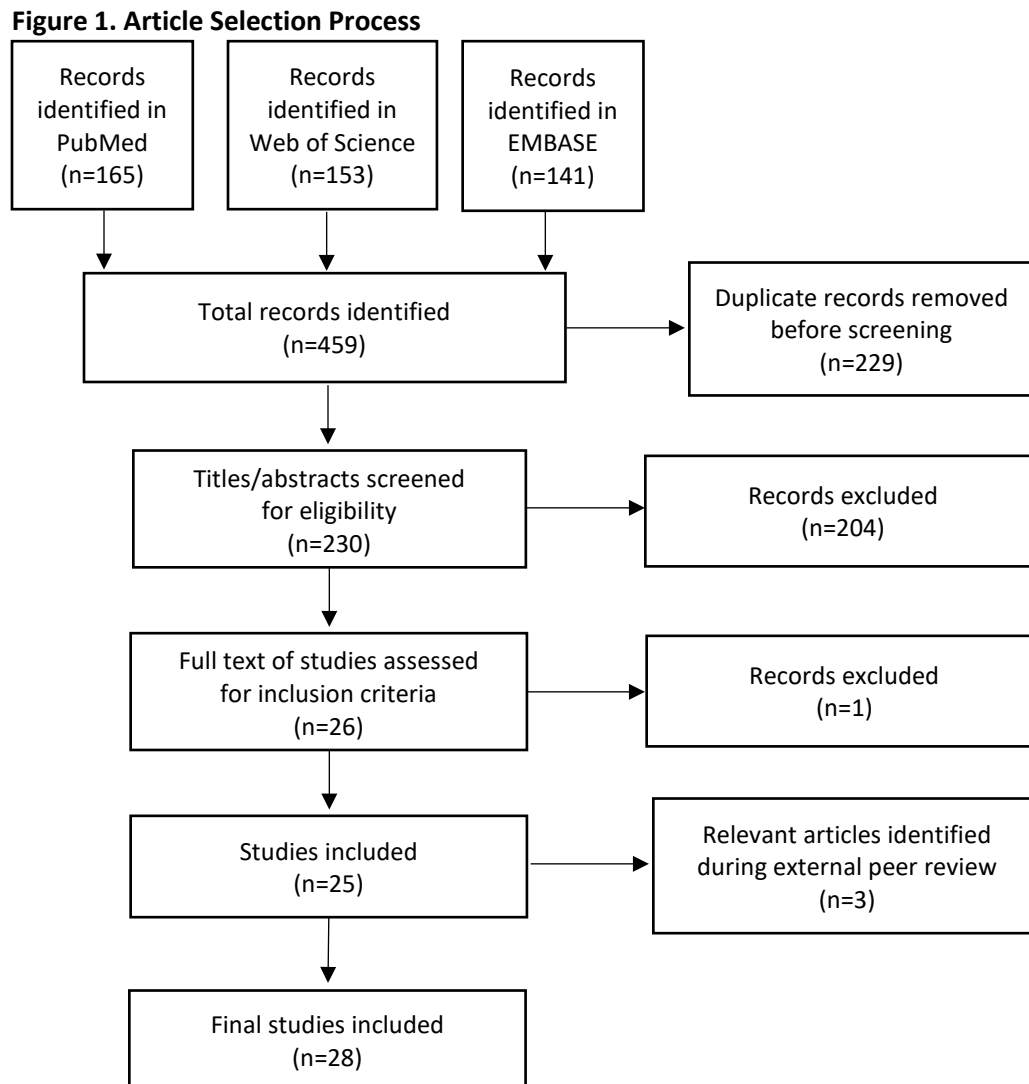
When articles were being reviewed for data extraction and analysis one additional article was identified for exclusion – a literature review covering existing articles identified for the review that did not report any new data or information (Cadham et al., 2020). During the external peer review process, 3 additional peer reviewed articles that met the article selection criteria were identified and added to this review (Chaiton, Schwartz, Kundu, Houston, & Nugent, 2021; Kock et al., 2021; Zatoński et al., 2020). In the end, a total of 28 publications were selected for inclusion in this review (Brown et al., 2021; Chaiton et al., 2018; Chaiton et al., 2019; Chaiton, Nicolau, Schwartz, Cohen, Soule, Zhang, & Eissenberg, 2020; Chaiton, Papadhima, Schwartz, Cohen, Soule, Zhang, & Eissenberg, 2020; Chaiton, Schwartz, Shuldiner, Tremblay, & Nugent, 2020; Chaiton, Schwartz, Cohen, Soule, Zhang, & Eissenberg, 2020; Chaiton, Schwartz, Cohen, et al. g, 2021; Chaiton, Schwartz, Kundu, et al., 2021; Chung-Hall et al., 2021; Courtemanche et al., 2017; Delnevo & Hrywna, 2015; Farley & Johns, 2017; Friedman, 2021; Gammon et



al., 2021; Guydish et al., 2020; Hawkins et al., 2021; Kingsley et al., 2019; Kingsley et al., 2021; Kock et al., 2021; Pearlman et al., 2019; Rogers et al., 2017; Rogers et al., 2020; Rossheim et al., 2020; Soule et al., 2019; Stoklosa, 2019; Yang et al., 2020; Zatoński et al., 2020).

## Results of Article Selection

A diagram of the article selection process is presented in **Figure 1**.



## Data Extraction and Analysis

Appendices A, B, C, and D were developed to support a consistent approach to data extraction and analysis. **Appendix A Table** "Summary of Flavored Tobacco Sales Restrictions or Bans Included in RTD Evaluation Studies" describes the flavored tobacco policies examined in the studies included in the RTD; dates the policy was effective and/or enforced; tobacco products included and excluded from the policy; tobacco product flavors excluded from the policy; any retailer exemptions; and citations for the evaluation studies included in the RTD that examined that policy.

To inform assessment of the strength of evidence, **Appendix B Table** “Summary of RTD Evaluation Studies on the Impact of Flavored Tobacco Sales Restrictions or Bans,” which describes characteristics and findings of each study included in the RTD organized by outcome of interest (i.e., tobacco use behaviors of young people, tobacco use behaviors of adults, sales of tobacco products, illicit sales of tobacco products, user modification of tobacco products), was developed. For each study included in the RTD, the following information (as relevant and appropriate) was included: policy location, study design, sample characteristics, key findings related to that outcome, and key strengths and limitations. This RTD focuses on reporting key findings for each study that are statistically significant at alpha level of 0.05 if significance testing was conducted.

To describe study design, the following components were assessed and indicated in **Appendix B Table**: 1) whether the design included data collection prior to the policy (pre-design), after the policy (post-design), or both prior to and after the policy (pre/post design); 2) whether the design was a one-group design only consisting of data from the policy intervention group or area (i.e., no control or comparison); whether the design included data from a control group or area (i.e., data from outside the policy jurisdiction area and presumably unaffected by the policy studied or similar policies); and whether the design included data from a comparison group or area (i.e., data from outside the policy jurisdiction area but could potentially include participants who live in areas with policies similar to the policy in the intervention area); 3) whether frequency of data collection was at one point-in-time or repeated (more than one point-in-time); and 4) whether data collection with participations was cross-sectional or longitudinal.

To assess strengths and limitations, consistent with the approach employed in multiple rigorous systematic literature reviews, we considered the study design, study population, sample selection, sample size, setting, data collection, study measures, and data analysis (National Academies of Sciences, Engineering, and Medicine [NASEM], 2018; Guyatt, Oxman, Vist, Kunz, Falck-Ytter, Alonso-Coello, & Schunemann, 2008; Schünemann, Brożek, Guyatt, Oxman, 2013; Porta, 2008; International Agency for Research on Cancer [IARC] Handbooks of Cancer Prevention, 2008). Each study included in the RTD was qualitatively assessed by the review team for risk of bias, specifically threats to internal and external validity/generalizability. Internal validity refers to the degree to which a study is free from bias or systematic error and can draw conclusions about cause-and-effect relationships (Porta, 2008; IARC Handbooks of Cancer Prevention, 2008). External validity refers to the degree to which study findings can be generalized to other settings or populations (Porta, 2008; IARC Handbooks of Cancer Prevention, 2008). For example, studies using a pre/post quasi-experimental design with a control/comparison were considered to have higher internal validity than a single group post-design because of their longitudinal and between-group components (IARC Handbooks of Cancer Prevention, 2008). Furthermore, studies that collect data at multiple time points before and after a policy intervention have enhanced internal validity because they allow for assessing the impact of time related trends in outcomes unrelated to the policy (IARC Handbooks of Cancer Prevention, 2008). When assessing the internal validity of studies with a control/comparison group or area, reviewers also evaluated the extent to which the control/comparison group or area is similar to the policy intervention group at baseline (e.g., similar levels of economic development, tobacco use prevalence, tobacco control efforts prior to the policy intervention) (IARC Handbooks of Cancer Prevention, 2008). Another important consideration for assessing internal validity of evaluation studies was temporal precedence (i.e., whether the policy preceded the change in outcome) (IARC Handbooks of Cancer Prevention, 2008). For the purposes of

this RTD, the strongest evaluation study designs are those that are quasi-experimental and include pre/post designs with data collected at multiple timepoints from both the control group or area and from the policy intervention group or area. In addition to the use of a control/comparison group or area, studies that statistically controlled for potential confounders, increasing specificity<sup>1</sup> of the observed relationship and confidence in a specific effect, were considered to have higher internal validity than studies that did not control for potential confounders or use a control/comparison group or area. Additionally, reviewers evaluated the degree to which study findings can be generalized to making inferences about the possible impact of a ban on menthol cigarettes in the United States (US). Studies evaluating policies restricting the sale of menthol cigarettes were considered to have higher external validity than studies evaluating policies restricting the sale of other flavored tobacco products. Studies that use probability-based sampling (e.g., multi-stage, simple random, stratified random) were also considered to have higher external validity than studies that use purposive or convenience sampling (Better Evaluation, 2020). **Appendix C Table** “Risk of Bias Assessment for Evaluation Studies” lists the potential biases that were considered.

Next, we synthesized the body of evidence for each outcome as a whole. When evaluating the strength of the body of evidence, the review team followed the level of evidence framework and approach used in NASEM’s Public Health Consequences of E-Cigarettes report (NASEM, 2018). In addition to considering the strengths and limitations of each study, described above, we considered consistency of findings across studies related to associations between the policy intervention and the outcome(s) of interest, directionality of study findings, magnitude of the observed effects (where appropriate), and the extent to which findings have been replicated in other studies of different policies in different locations using different study designs and populations (triangulation). Each conclusion by the review team was assigned a level of evidence category rating using the following framework (language was adapted slightly as shown below in italics to be appropriate for a review of evaluation studies):

- **Conclusive evidence:** There are many supportive findings from good-quality controlled studies (*including quasi-experimental studies that included pre-test and post-test data collected at multiple timepoints from both the control group/area and from the policy intervention group/area*) with no credible opposing findings. A firm conclusion can be made, and the limitations to the evidence, including chance, bias, and confounding factors, can be ruled out with reasonable confidence.
- **Substantial evidence:** There are several supportive findings from good-quality *studies* with few or no credible opposing findings. A firm conclusion can be made, but minor limitations, including chance, bias, and confounding factors, cannot be ruled out with reasonable confidence.
- **Moderate evidence:** There are several supportive findings from fair-quality studies with few or no credible opposing findings. A general conclusion can be made, but limitations including chance, bias, and confounding factors, cannot be ruled out with reasonable confidence.

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<sup>1</sup> In this context specificity is defined as whether association is unique to the exposure; for example, for observational studies, statistically controlling for potential confounders increases confidence in a specific effect (NASEM, 2018).

- **Limited evidence:** There are supportive findings from fair-quality studies or mixed findings with most favoring one conclusion. A conclusion can be made, but there is significant uncertainty due to chance, bias, and confounding factors.
- **Insufficient evidence:** There are mixed findings or a single poor study. No conclusion can be made because of substantial uncertainty due to chance, bias, and confounding factors.
- **No available evidence:** *Outcome of interest* has not been studied at all. No conclusion can be made.

**Appendix Table D** “Summary of Conclusions on the Impact of Flavored Tobacco Sales Restrictions or Bans” shows the level of evidence category rating assigned to each conclusion by the review team, organized by outcome of interest. The table also shows, for each conclusion, factors that led to a higher rating of the quality of evidence, and factors that led to a lower rating of the quality of evidence. Citations of evaluation studies included in the RTD that support each conclusion are also listed in the table.

## Results

Each article was summarized with a particular focus on outcomes of interest and results relevant to each research question. These summaries are available in **Appendix E**. The body of evidence is presented below based on the outcomes in each research question: tobacco use behaviors of young people, tobacco use behaviors of adults, sales of tobacco products, illicit sales of tobacco products, and user modification of tobacco products.

### Summary of Studies on the Impact of Flavored Tobacco Sales Restrictions or Bans on Tobacco Use Behaviors of Young People

Nine studies examined the impact of flavored tobacco sales restrictions on the tobacco use behaviors of young people (Courtemanche et al., 2017; Farley & Johns, 2017; Friedman, 2021; Hawkins et al., 2021; Kingsley et al., 2019; Kingsley et al., 2021; Pearlman et al., 2019; Rossheim et al., 2020; Yang et al., 2020). Of the nine studies, two studies used a pre/post design using data from repeated cross-sectional national surveys to estimate the effects of the 2009 US federal ban on flavored cigarettes (which banned all flavored cigarettes with the exception of menthol) on youth tobacco use (Courtemanche et al., 2017; Rossheim et al., 2020). The remaining seven studies (Farley & Johns, 2017; Friedman, 2021; Hawkins et al., 2021; Kingsley et al., 2019; Kingsley et al., 2021; Pearlman et al., 2019; Yang et al., 2020) evaluated the effects of US local policies on either youth or young adult tobacco use behaviors. Of these studies, three studies examined municipal-level flavored (excluding menthol) tobacco restrictions in Massachusetts on youth tobacco use using a cross-sectional post-only design with a control group (Kingsley et al., 2019), a cross-sectional pre/post design with a control group (Kingsley et al., 2021), and repeated cross-sectional pre/post design with comparison counties (Hawkins et al., 2021); one study examined the effect of New York City’s policy restricting the sale of flavored (excluding menthol) cigars, cigarillos, little cigars, chew, snuff, snus, pipe tobacco, roll-your-own (RYO) tobacco, and dissolvables on youth tobacco use using a cross-sectional pre/post design with no control or comparison group (Farley & Johns, 2017); one study examined the effect of Providence, Rhode Island’s sales restriction on flavored (excluding menthol) tobacco products on youth tobacco use using a cross-sectional pre/post design with no control or comparison group (Pearlman 2019); and two studies examined the effect of San Francisco, California’s restriction on the sale of flavored (including menthol)

tobacco products on tobacco use in young people using pre/post design<sup>2</sup> with a comparison group and repeated cross-sectional surveys (Friedman, 2021) and a cross-sectional post-only study design with no control or comparison group (Yang et al., 2020).

*Decreases in Use of Tobacco Products among Young People After a Sales Restriction or Ban on Flavored Tobacco Products (Substantial Evidence)*

Studies evaluating restrictions on the sale of flavored tobacco products in several US localities have generally found decreases in the use of tobacco products among young people. In 2009, New York City enacted a policy prohibiting the sale of all flavored non-cigarette tobacco products (i.e., cigars, cigarillos, little cigars, chew, snuff, snus, pipe tobacco, RYO tobacco, and dissolvables), except in legally permitted tobacco bars. Products with the taste or aroma of menthol, mint, or wintergreen including menthol cigarettes were excluded from the policy. The policy was effective July 2010 and enforcement began in November 2010. Using a cross-sectional pre/post design with data from 2010 and 2013 New York City Youth Risk Behavior Surveys (YRBS), Farley and Johns (2017) found that in 2013, (after policy enforcement), youth (13-17 years) had 37% lower odds of ever trying flavored tobacco products compared to youth in 2010 (before policy enforcement) (adjusted odds ratio [OR] 0.63, 95% confidence interval [CI] 0.52-0.77,  $p \leq 0.05$ ). In 2013, youth also had 28% lower odds of using any type of tobacco product (adjusted OR 0.72, 95% CI 0.62-0.85,  $p \leq 0.05$ ) compared with youth in 2010.

Three additional studies examined the effects of local policies restricting the sale of flavored (excluding menthol) tobacco products to adult-only retailers in select municipalities within the state of Massachusetts, before Massachusetts's statewide flavored (including menthol) tobacco policy became effective in 2019. Hawkins et al. (2021) used difference-in-differences models to link changes in the proportion of county residents covered by local flavored tobacco sales restrictions over time with changes in youth tobacco use within and between counties, using data derived from the 2011-2017 biennial Massachusetts Youth Health Survey (YHS), a cross-sectional, representative survey of Massachusetts high school students. The authors noted that counties with greater proportion of county residents covered by local flavored tobacco sales restrictions were associated with a reduction in the level of cigarette use among users (difference in difference incidence rate ratio (RR) -1.56; 95% CI -2.54 – -0.58,  $p \leq 0.05$ ), with the largest reductions in level of cigarette use observed among 14- and 18-year-olds. Further, an increase in the proportion of county residents covered by local flavored tobacco sales restrictions also was associated with a reduction in youth e-cigarette use (difference in difference OR - 0.87; 95% CI -1.68 – -0.06,  $p \leq 0.05$ ).

Kingsley et al. (2019) assessed the short-term (6 month) impact of a policy in Lowell, Massachusetts that restricted the sale of flavored tobacco products (excluding menthol; including e-cigarettes) to adult-only (ages  $\geq 21$  years) retailers (effective October 2016), on youth tobacco use behaviors. The authors used a post-design with a control community (Malden, Massachusetts) matched on demographics, retailer characteristics, and point-of-sale policies, but without a flavored tobacco policy. Youth behaviors were assessed using cross-sectional surveys of high school students in each community at baseline (November 2016 – January 2017 in Lowell which was 1-3 months after policy implementation, September 2016 in Malden) and follow-up (May 2017 in Lowell, April 2017 in Malden).

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<sup>2</sup> While the author describes a pre/post design, Liu et al. (2022) found that the 2019 YRBS was conducted in Fall 2018 prior to when the flavor policy was enforced in April 2019 signifying it was a pre-only design.

Current youth use of any flavored (excluding menthol and mint) tobacco products decreased 2.4% (95% CI -6.2 – 1.3,  $p>0.05$ ) in Lowell from baseline to follow-up and increased 3.3% (95% CI -0.3 – 6.9,  $p>0.05$ ) in the control community, resulting in a significant difference of -5.7% between the communities (95% CI -10.7 – -0.7,  $p=0.03$ ). Current youth use of any non-flavored (including menthol and mint) tobacco products decreased 1.9% (95% CI -5.5 – 1.7,  $p>0.05$ ) in Lowell from baseline to follow-up and increased significantly in the control community by 4.3% (95% CI 0.9 – 7.8,  $p<0.05$ ), resulting in a significant difference of -6.2% (95% CI -11.0 – -1.4,  $p=0.01$ ) between the communities.

Pearlman et al. (2019) evaluated the impact of Providence, Rhode Island's sales restriction on flavored (excluding menthol) non-cigarette tobacco products (cigars, smokeless tobacco, loose tobacco, and e-cigarettes with nicotine) (effective January 2013) using a pre/post design with no control or comparison. Tobacco price discounting and multipack offers were also restricted. Active enforcement of the policy began in 2017. Self-reported data on youth current use of tobacco products were obtained from the 2012 (pre-policy;  $n=2,150$ ), 2016 (post-policy;  $n=2,062$ ), and 2018 (post-policy;  $n=2,223$ ) Annie E. Casey Evidence2Success Providence Youth Experience Survey (YES), a cross-sectional census survey that collects information in classrooms from all 10th and 12th grade students in Providence. Current cigarette smoking prevalence was 3.2% (95% CI 2.4-4.0) in 2012 (pre-policy). After enforcement of the policy, current cigarette smoking prevalence decreased from 7.6% (95% CI 6.3 – 9.0) in 2016 to 3.0% (95% CI 2.1 – 3.8) in 2018, current use of any tobacco product decreased from 22.2% (95% CI 20.0 – 23.3) in 2016 to 12.1% (95% CI 10.5 – 13.7) in 2018; cigars and cigarillos use decreased from 7.1% (95% CI 5.7 – 8.5) to 1.9% (95% CI 1.2 – 2.6); e-cigarettes use decreased from 13.3% (95% CI 11.4 – 15.1) to 6.6% (95% CI 5.3 – 7.8); and hookah use decreased from 13.5% (95% CI 11.6 – 15.3) to 7.7% (95% CI 6.4 – 9.2).

In July 2018, San Francisco, California implemented a comprehensive restriction on the sale of all flavored e-cigarettes (other than tobacco flavor), menthol cigarettes, and other non-tobacco flavored tobacco products with no retailer exemptions. The San Francisco Department of Public Health announced that enforcement would begin January 2019 and enforcement with routine retailer compliance inspections began April 2019. Yang et al. (2020) used Amazon Mechanical Turk (MTurk) to collect data post-policy (November 2019) from a convenience sample of young adult (age 18-34,  $n=247$ ) ever users of tobacco products who lived, worked or studied in San Francisco as of December 2018. Among the 18-24 age group ( $n=62$ ), use of any tobacco products decreased by 17.7 percentage points (95% CI -27.5 – -8.0,  $p<0.01$ ) from 100% to 82.3%; flavored cigar use decreased by 12.9 percentage points (95% CI 23.7 – -2.1,  $p<0.05$ ) from 19.4% to 6.5%.

Using repeated cross-sectional, nationally representative data from the 1999-2013 National Youth Tobacco Survey (NYTS), Courtemanche et al. (2017) examined the effect of the 2009 US federal ban on flavored cigarettes (excluding menthol) on youth tobacco use behaviors. Data from 1999-2009 NYTS represented pre-ban, and data from 2011-2013 NYTS represented post-ban. Courtemanche et al. (2017) found the percent of students who reported smoking cigarettes in the past 30 days decreased by 34% from 14.0% pre-ban to 9.3% post-ban ( $p=0.003$ ), and that the percent who reported any tobacco use (i.e., cigarette, cigars, smokeless tobacco or pipe) in the past 30 days decreased by 19.6%, from 17.9% to 14.4% ( $p=0.011$ ). Adjusting for demographic variables, national-level tax inclusive price indices for cigarettes and non-cigarette tobacco products, youth unemployment rate, and time trends, there was a 17.1% reduction in the probability of youth being a cigarette smoker (OR=0.829,  $p<0.001$ ) and a 6.1% reduction in the probability of youth reporting any tobacco use (i.e., cigarette, cigars, smokeless

tobacco, or pipe tobacco) in the past 30 days (OR=0.939,  $p<0.001$ ) after the flavored cigarette ban. It is important to note that the US federal ban on flavored cigarettes (excluding menthol) coincided with an increase in the federal excise tax for cigarettes, which may have contributed to the decrease in cigarette use and any tobacco use.

*Immediate Increases Followed by Decreases -- in Use of Cigarettes and Menthol Cigarettes among Young People After US Flavored Cigarette Ban (Excluding Menthol) (Limited Evidence)*

Using repeated cross-sectional, nationally representative quarterly data from the 2002-2017 National Survey on Drug Use and Health (NSDUH) where the 31 quarters before September 22, 2009 represented pre-ban and the 33 quarters after September 22, 2009 represented post-ban, Rossheim et al. (2020) found that overall, the US flavored cigarette ban was associated with significant immediate increases and then reductions over time in use of any cigarettes and menthol cigarettes among youth (12-17 years) and young adults (18-25 years). Among youth, Rossheim et al. (2020) found a 17% increase in the odds of reporting any cigarette smoking in the past 30 days immediately after the flavor ban (OR=1.17, 95% CI 1.07 – 1.29,  $p<0.001$ ) compared to the pre-ban period. However, there was a 2.2% reduction in the odds of youth reporting any cigarette smoking each quarter thereafter (OR=0.98, 95% CI 0.97 – 0.98,  $p<0.001$ ) over the pre-ban trend. Similarly, there was an immediate 33% increase in the odds of youth reporting menthol cigarette smoking in the past 30 days (OR=1.33, 95% CI 1.15 – 1.54,  $p<0.001$ ), suggesting initial substitution of menthol, followed by an additional 3.6% reduction in the odds each quarter (OR=0.96, 95% CI 0.96 – 0.97,  $p<0.001$ ) over the pre-ban trend. Findings among young adults are similar to youth. Among young adults, there was a 9% immediate increase in the odds of reporting any cigarette smoking in the past 30 days (OR=1.09, 95% CI 1.03 – 1.16,  $p=0.0047$ ), followed by an additional 1.2% reduction in the odds of cigarette smoking each quarter thereafter (OR=0.99, 95% CI 0.99 – 0.99,  $p<0.001$ ) over the pre-policy trend. Additionally, there was an immediate increase of 29% in the odds of young adults reporting any menthol cigarette smoking in the past 30 days (OR=1.29, 95% CI 1.19 – 1.41,  $p<0.001$ ), followed by a 2.6% reduction in the odds of menthol cigarettes smoking each quarter (OR=0.97, 95% CI 0.97 – 0.98,  $p<0.001$ ) over the pre-policy trend. Overall, in 2017, the predicted probability of youth and young adult cigarette smoking was reduced by 43% and 27%, respectively, compared to the model predicted probabilities in absence of the policy. The predicted probability of menthol use was reduced by 60% and 55% for youth and young adults, respectively.

*Increases in Use of Tobacco Products among Young People After a Sales Restriction or Ban on Flavored Tobacco Products (Limited Evidence)*

Courtemanche et al. (2017) examined the effect of the 2009 US federal ban on flavored cigarettes (excluding menthol) on youth tobacco use behaviors. Using repeated cross-sectional, nationally representative data from the 1999-2013 NYTS, Courtemanche et al. (2017) found a 15.9% increase in the proportion of smokers who typically smoked menthol cigarettes (45.3% pre to 52.5% post,  $p=0.006$ ), suggesting potential migration from flavored cigarettes to mentholated cigarettes, which were allowed under the policy. Further, increases in the probability of youth reporting use of cigars (34.4%,  $p<0.001$ ) and pipe (54.6%,  $p<0.001$ ) after the flavored cigarette ban were reported, potentially suggesting substitution to other flavored products allowed under the policy.

Kingsley et al. (2021) assessed the impact of policies restricting the sale of flavored (excluding menthol) tobacco products (including e-cigarettes) to adult-only retailers in two Massachusetts municipalities, Attleboro (effective January 2016) and Salem (effective March 2017), on youth tobacco

use. The municipality of Gloucester, Massachusetts served as a control, a municipality without a flavored tobacco policy at the time of the study. The three Massachusetts municipalities were matched on geographic and population size, demographics, retailer characteristics, and all three had a cigar pricing and packaging restriction in place. Cross-sectional surveys were administered at baseline (December 2015) to students in randomly selected classrooms in the sole public high school in each municipality; and at follow-up (January/February 2018) to a census of students in each school. Current use of flavored (excluding menthol) and nonflavored (including menthol) tobacco increased from baseline to follow-up in all three municipalities, although increases from baseline to follow-up were significantly smaller in the combined municipalities with flavored tobacco restrictions than in the control municipality (flavored [excluding menthol] tobacco use difference in difference estimates:  $-9.4\%$ , 95% CI  $-14.2\% - -4.6\%$ ,  $p=0.000$ ; nonflavored [including menthol] tobacco use difference in difference estimates:  $-6.3\%$ , 95% CI  $-10.8\% - -1.8\%$ ,  $p=0.006$ ). There were significantly smaller increases in current use of flavored (excluding menthol) e-cigarettes and flavored (excluding menthol) smokeless tobacco in both municipalities with flavored (excluding menthol) tobacco restrictions relative to the control municipality.

Friedman (2021) used a difference-in-differences analysis to examine the association between San Francisco's comprehensive restriction on the sale of all flavored e-cigarettes (other than tobacco flavor), menthol cigarettes, and other non-tobacco flavored tobacco products and youth (high school students younger than 18) cigarette smoking. Using data derived from the 2011-2019 cross-sectional YRBS, Friedman used a pre/post design<sup>3</sup> and limited the sample to districts with representative data (response rate greater than or equal to 60%) and high school students with non-missing data for past 30-day cigarette smoking. The author reported a significant increase in cigarette use among high school students in the San Francisco school district relative to other school districts. Specifically, they reported that San Francisco policy was associated with 2.24 times the odds of recent smoking among high school students relative to concurrent changes in other districts (adjusted OR; 95% CI 1.42 – 3.53,  $p=.001$ ). In the 2019 YRBS, cigarette smoking prevalence was 6.2% (95% CI 5.2 – 7.1) in San Francisco and 5.6% (95% CI 5.3 – 5.9) in other districts. However, another study reported a methodological mistake with these findings: data collection for the 2019 YRBS in San Francisco occurred in Fall 2018, prior to when the San Francisco flavor restriction was enforced in April 2019 (Liu et al., 2022). Since data collection occurred before formal enforcement of the policy, findings from Friedman (2021) do not reflect the impact of San Francisco flavored tobacco sales restriction on youth cigarette use.

### Summary and Conclusion

Overall, we conclude that following a flavored tobacco product sales restriction or ban, use of tobacco products among young people decreases. Additionally, we conclude that there may be increases in use of tobacco products not restricted by the policy.

There is substantial evidence of decreases in use of tobacco products among young people after a sales restriction or ban on flavored tobacco products. Six studies reported decreases in the use of tobacco products among young people after a sales restriction or ban on flavored tobacco products (Farley & Johns, 2017; Hawkins et al., 2021; Kingsley et al., 2019; Pearlman et al., 2019; Yang et al., 2020;

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<sup>3</sup> While the author describes a pre-post design, Liu et al. (2022) found that the 2019 YRBS was conducted in Fall 2018 prior to when the flavor policy was enforced in April 2019 signifying it was a pre-only design.



Courtemanche et al., 2017). Almost all of these studies were designed to establish temporality, all addressed specificity through statistical controls or control/comparison groups, and almost all showed substantial effects. Additionally, findings were consistent across studies of different policies in different locations using different study designs and data sources.

There is limited evidence of increases in use of tobacco products among young people after a sales restriction or ban on flavored tobacco products (Courtemanche et al., 2017; Kingsley et al., 2021; Friedman, 2021). Although Kingsley et al. (2021) found increases in flavored (excluding menthol) and nonflavored (including menthol) tobacco use before and after sales restrictions, these increases were significantly smaller in municipalities with policies versus municipalities without policies, suggesting that the policy may have prevented increases in tobacco use. Additionally, another study (Liu et al., 2022) reported that Friedman (2021) was not sufficiently designed to establish temporality. There is also limited evidence of immediate increases followed by decreases in use of cigarettes and menthol cigarettes among young people after the US flavored cigarette ban (excluding menthol). Only one study reported this finding (Rosshem et al., 2020).

Flavored tobacco policies that cover tobacco products that are potential substitutes and more flavor categories (e.g., menthol) as well as policies that minimize exemptions for retailer types (e.g., adult-only stores) are likely to have a much greater impact on the tobacco use behaviors of young people. It is also likely that federal policies that cover the US as a whole, as compared to state or local policies, would increase the impact of flavored tobacco restrictions on tobacco use among young people by reducing the extent of available and accessible restricted tobacco products in nearby jurisdictions where they are not restricted. In addition, a flavored tobacco product standard, like the US 2009 flavored cigarette ban, would apply to tobacco product manufacturers and retailers and be accompanied with strong enforcement at the federal level, unlike local flavored tobacco product sales restrictions that apply only to retailers.

### Summary of Studies on the Impact of Flavored Tobacco Sales Restrictions or Bans on Tobacco Use Behaviors of Adults

Eight studies examined the impact of policies restricting the sale of menthol cigarettes on adult quitting and switching behaviors (Chaiton et al., 2018; Chaiton, Nicolau, Schwartz, et al., 2020; Chaiton, Papadhima, Schwartz, et al., 2020; Chaiton, Schwartz, Cohen, et al., 2021; Chung-Hall et al., 2021; Guydish et al., 2020; Yang et al., 2020; Zatoński et al., 2020). Five of these studies used a pre/post longitudinal cohort design to examine Canadian tobacco users' responses to provincial and federal menthol cigarette sales restrictions following policy implementation (Chaiton et al., 2018; Chaiton, Nicolau, Schwartz, et al., 2020; Chaiton, Papadhima, Schwartz, et al., 2020; Chaiton, Schwartz, Cohen, et al., 2021; Chung-Hall et al., 2021). One study examined the prevalence of menthol and other flavored cigarette smoking associated with the European Union's Tobacco Products Directive 2016 ban on characterizing flavors in cigarettes and RYO before the ban on menthol cigarettes was in effect using a pre/post longitudinal design (Zatoński et al., 2020). Two studies examined outcomes associated with San Francisco, California's policy restricting the sale of flavored tobacco products, including menthol cigarettes. Yang et al. (2020) used a post-design to assess young adult ever tobacco users' response to the San Francisco policy, and Guydish et al. (2020) used a pre/post design with repeated cross-sectional surveys of clients in residential substance use disorder treatment facilities to assess the responses of current smokers in that vulnerable population to the San Francisco policy.

## **Quitting Behaviors**

### *Increases in Quit Attempts and Quitting by Adult Smokers After a Menthol Cigarette Sales Restriction (Substantial Evidence)*

Studies have found increased quitting behaviors by menthol cigarette smokers after a menthol cigarette sales restriction (Chaiton et al., 2018; Chaiton, Nicolau, Schwartz, et al., 2020; Chaiton, Schwartz, Cohen, et al., 2021; Chung-Hall et al., 2021; Yang et al., 2020). The province of Ontario, Canada implemented a menthol cigarette sales restriction on January 1, 2017. Three pre/post longitudinal cohort studies using probability-based samples supplemented with a convenience sample led by Chaiton et al. report on cessation behaviors of Ontario residents 16 years and older who were current smokers before the policy was implemented at one month, one year, and two years following policy implementation (Chaiton et al., 2018; Chaiton, Nicolau, Schwartz, et al., 2020; Chaiton, Schwartz, Cohen, et al., 2021).

At one month after implementation of the sales restriction, Chaiton et al. (2018) found that 29.1% (n=60, 95% CI 23.3-35.8) of participants (i.e., baseline current menthol smokers) who responded quit cigarette smoking or had made a serious quit attempt; of those who had attempted to quit cigarette smoking, 12.1% (n=25, 95% CI 8.3-17.4) reported not smoking. One year following policy implementation, baseline daily menthol smokers were more likely to report having quit (adjusted RR 1.62; 95% CI 1.08-2.42, p<0.05) or having made a quit attempt (adjusted RR 1.25; 95% CI 1.03-1.50, p<0.05) than baseline non-menthol smokers (Chaiton, Nicolau, Schwartz, et al., 2020). Similarly, two years post-policy, baseline daily menthol smokers had significantly higher likelihood of reporting having quit smoking compared to baseline non-menthol smokers (adjusted RR 2.08; 95% CI 1.20–3.61; p<0.01) (Chaiton, Schwartz, Cohen, et al., 2021). There was a significant increase in probability of reporting more quit attempts for baseline daily (adjusted RR 1.45; 95% CI 1.15-1.82, p<0.01) and occasional menthol smokers (adjusted RR 1.27; 95% CI 1.03-1.56, p<0.05) compared to baseline non-menthol smokers (Chaiton, Schwartz, Cohen, et al., 2021).

Chung-Hall et al. (2021) assessed the impact of menthol cigarette sales restrictions in seven Canadian provinces using longitudinal, nationally representative data from pre-policy (2016) and post-policy (2018) waves of the Canadian arm of the International Tobacco Control (ITC) Four Country Smoking and Vaping Survey. They found that of 138 baseline menthol cigarette smokers, 21.5% had quit smoking cigarettes post-policy. Baseline menthol cigarette smokers were more likely to have attempted to quit (tried to quit in past 18 months; adjusted OR=1.61; 95% CI 1.03-2.51; p<0.05) and to have remained quit (quit >6 months before nationwide menthol ban and remained quit; adjusted OR=2.30; 95% CI 1.06-5.01; p<0.05) post-policy than baseline non-menthol cigarette smokers. In addition, among pre-policy daily smokers, daily menthol smokers who quit before the nationwide menthol ban were significantly more likely than daily non-menthol smokers to have remain quit (12.7% versus 5.2%; adjusted OR=2.81, p<0.05). Non-White cigarette smokers were more likely than White cigarette smokers to make a post-policy quit attempt (adjusted OR=1.77, 95% CI 1.10-2.85, p<0.05).

Yang et al. (2020) assessed the impact of San Francisco's policy restricting the sale of all flavored e-cigarettes (other than tobacco flavor), menthol cigarettes, and other non-tobacco flavored tobacco products on adults' tobacco use behaviors using a retrospective survey with a convenience sample of young adults aged 18–34 (n=247). The San Francisco Department of Public Health announced that enforcement would begin January 2019 and enforcement with routine retailer compliance inspections

began April 2019. At the time of data collection (post-policy, November 2019), participants self-reported for each of the following tobacco products: cigarettes; e-cigarettes; cigars; hookah/waterpipe; and/or smokeless/dissolvable tobacco—a) whether or not they had used any of the aforementioned products at least once before the policy; and b) whether or not they currently used the product (i.e., during the past 30 days). The study found that among the 20 respondents who reported exclusive use of menthol cigarettes before the policy, 5% (n=1) reported having quit all tobacco use after the policy while 70% (n=14) reported having maintained exclusive use of menthol cigarettes. Furthermore, among a sample of 61 respondents who reported using menthol cigarettes in addition to other tobacco products before the policy, 3.3% (n=2) quit use of all tobacco products after the policy, while 73.8% (n=45) reported having maintained use of tobacco products (including menthol cigarettes).

*Quitting Behaviors of Adult Current Cigarette Smokers in Residential Treatment Facilities for Substance Abuse After a Sales Restriction on Flavored Tobacco Products (Including Menthol) in San Francisco, California (Insufficient Evidence)*

In a study of adult clients in residential treatment facilities for substance abuse, Guydish et al. (2020) found no evidence of increased quitting behaviors of adult current smokers following San Francisco, California's implementation of a policy restricting sale of flavored tobacco products (including menthol). The Guydish et al. (2020) study utilized cross-sectional purposive samples of participants from these facilities 6-months prior to policy enforcement (n=160), roughly 5-months post-policy enforcement (n=102), and 11-months (n=120) after enforcement, providing opportunity for pre/post analyses. Current cigarette smokers were less likely to think of quitting smoking in the next 30 days (OR=0.44, 95% CI 0.29-0.67, p<0.001) at 5-months post-policy compared to pre-policy, and less likely to have past-year quit attempts (OR=0.80, 95% CI 0.71-0.91, p<0.001) at 11-months post-policy compared to pre-policy. Current smokers were less likely to report menthol as their usual cigarette (OR=0.80, 95% CI 0.72-0.90, p=0.0002) at 5-months post-policy compared to pre-policy, and less likely to only smoke menthol cigarettes in the past month (OR=0.19, 95% 0.18-0.19, p<0.0001) at 11-months post-policy compared to pre-policy.

***Switching Behaviors***

*Some Adult Menthol Cigarette Smokers Switched to Non-Menthol Cigarettes After a Menthol Cigarette Sales Restriction (Limited Evidence)*

Studies have found that some adult menthol cigarette smokers switched to non-menthol cigarettes following implementation of a policy restricting the sales of menthol cigarettes (Chung-Hall et al., 2021; Chaiton et al., 2018; Guydish et al., 2020). Between 2015 and 2017, seven Canadian provinces, representing 83% of the total population of Canada, implemented sales restrictions on menthol cigarettes. Using a pre/post longitudinal cohort study, Chung-Hall et al. (2021) assessed the impact of these sales restrictions on cessation and smoking behaviors, including switching, among Canadian adult smokers 18 years and older (smoked at least 100 cigarettes in lifetime and currently smoked at least monthly) (n=1,236). Of 138 baseline menthol smokers who reported usual cigarette brand or last purchased brand as menthol, 59.1% (n=82) switched to non-menthol cigarettes post-policy.

Another pre/post longitudinal cohort study reported on smoking behaviors one month after Ontario's 2017 menthol cigarette sales restriction among a convenience sample of Ontario residents 16 years and older who were pre-policy menthol smokers (smoked at least 1 menthol cigarette in the past

year and were past-month smokers) (n=206) (Chaiton et al., 2018). Of participants who reported their anticipated planned reaction to the policy, approximately 28% (n=51, 95% CI 22.0-35.2) reported having actually switched to or only using non-menthol cigarettes one-month post-policy.

Using repeated cross-sectional surveys, Guydish et al. (2020) assessed cigarette use among clients in two residential substance use disorder treatment programs before and after San Francisco, California's sales restriction on flavored tobacco products (including menthol). Among pre-policy current menthol smokers who responded to a question about how the policy had impacted their cigarette smoking, 30.6% (n=11) indicated they had switched to non-menthol cigarettes post-policy.

*Some Adult Menthol Cigarette Smokers Switched to Other Tobacco Products (e.g., E-Cigarettes, Cigars) After a Menthol Cigarettes Sales Restriction (Limited Evidence)*

Studies have found that some menthol cigarette smokers switched to other tobacco products, particularly other flavored tobacco products, following implementation of a policy restricting the sales of menthol cigarettes (Chaiton, Papadhima, Schwartz, et al., 2020; Chaiton et al., 2018). One pre/post longitudinal cohort study reported on product substitution one year after Ontario's 2017 menthol sales restriction among a convenience sample of Ontario residents 16 years and older who were current (past 30-day) cigarette smokers (n=913) (Chaiton, Papadhima, Schwartz, et al., 2020). This study found that baseline daily menthol cigarette smokers (n=187) were more likely to use flavored cigar products after the policy (adjusted relative rate [RR2]=1.53, 95% CI 1.01-2.31, p=0.042) relative to baseline non-menthol cigarette smokers (n=306). Additionally, baseline occasional menthol smokers (n=420) were more likely than baseline non-menthol smokers to use other tobacco products (adjusted RR2=1.25, 95% CI 1.02-1.53, p=0.028), flavored alternative tobacco products (i.e., e-cigarettes, cigars, smokeless, hookah, bidis, kreteks) (adjusted RR2=1.56, 95% CI 1.09-2.24, p=0.016); and flavored cigars (adjusted RR2 =1.57, 95% CI 1.06-2.30, p=0.023) after the policy. Thirty-nine percent (n=23) of menthol smokers who (at baseline) predicted they would switch to another flavored tobacco product after the policy reported using flavored alternative products at follow-up.

Chaiton also conducted a pre/post longitudinal cohort study among a convenience sample of Ontario residents 16 years and older who were current (past 30-day) cigarette smokers who had smoked at least one menthol cigarette in the past year (n=206) following this same policy (Chaiton et al., 2018). Among participants who reported at baseline their anticipated planned reaction to the policy (n=206), 29.1% (n=60, 95% CI 23.3-35.8) reported switching to alternative flavored products (i.e., e-cigarettes, cigars, and other flavored tobacco products) one month after policy implementation.

*Some Menthol and Other Flavored Cigarette Smokers Switched to Unflavored Tobacco After a Sales Restriction on Flavored Cigarettes (Excluding Menthol) and Flavored RYO Tobacco (Limited Evidence)*

Zatoński et al. (2020) assessed adult smoking behavior following implementation of the European Union Tobacco Products Directive ban on flavored cigarettes. Using longitudinal data from the EUREST-PLUS ITC Europe Surveys (n=19,691 from eight EU member states) they assessed changes in 1) the prevalence of cigarette use by flavor and 2) smoking status, cessation behaviors and cigarette flavor preferences following the Tobacco Products Directive (TPD) 2016 ban on cigarettes and RYO with characterizing flavors, but before the 2020 ban on menthol cigarettes. Zatoński et al. (2020) found small but significant declines in the weighted prevalence of menthol (by 0.94%, p=0.041) and other flavored cigarette use (by 1.32%, p<0.001) following the 2016 ban, driven largely by the menthol and flavored

cigarette smokers switching to unflavored tobacco (rather than quitting). About 22.8% of menthol cigarette smokers switched to unflavored tobacco. Among other flavored cigarette smokers, about 62% switched to unflavored tobacco. About 52% of menthol cigarette smokers continued to smoke menthol cigarettes and 22.8% switched to unflavored tobacco. Among other flavored cigarette smokers, 11% continued to smoke other flavors and about 62% switched to unflavored tobacco.

### Summary and Conclusion

Overall, we conclude that following a menthol cigarette sales restriction or ban, adult menthol cigarette smokers' quit attempts and quitting increases. Some adult menthol cigarette smokers may quit cigarettes completely while others may switch to other tobacco products such as non-menthol cigarettes and flavored tobacco products.

There is substantial evidence of increases in quit attempts and quitting by adult smokers after a menthol cigarette sales restriction. Evidence from five studies evaluating the impact of local US and international menthol cigarette sales restrictions found increased quit attempts and quitting smoking following policy implementation (Chaiton et al., 2018; Chaiton, Nicolau, Schwartz, et al., 2020; Chaiton, Schwartz, Cohen, et al., 2021; Chung-Hall et al., 2021; Yang et al., 2020). Evidence from two of these studies assessing cigarette smokers' cessation behaviors at one year and two years following implementation of Ontario's 2017 menthol sales restriction found that baseline daily menthol smokers were more likely to report cigarette quit attempts and quitting cigarette smoking than baseline non-menthol cigarette smokers, suggesting increased quit attempts and quitting were attributed to the menthol sales restriction (Chaiton, Nicolau, Schwartz, et al., 2020; Chaiton, Schwartz, Cohen, et al., 2021). Almost all of these studies were designed to establish temporality, addressed specificity through statistical controls, and showed substantial effects. Additionally, findings were consistent across studies of different policies in different locations using different study designs and data sources.

One study using repeated cross-sectional surveys of clients in two residential treatment facilities in San Francisco, California found decreases in cessation behaviors post policy (Guydish et al., 2020). With a local sales restriction, some tobacco users may still find easy access to restricted tobacco products. In this study, 50% of menthol smokers reported purchasing menthol cigarettes in San Francisco after the menthol sales restriction (Guydish et al., 2020). In addition, clients in residential treatment facilities, are a vulnerable population in which tobacco cessation may be more difficult or challenging (Guydish et al., 2020). Smoking prevalence rates are substantially higher among individuals with substance use disorder compared to those in the general population (e.g., Guydish 2011; Guydish 2016), and these individuals report increased nicotine dependence levels (Parker 2018) and have less success at quitting smoking than individuals without substance use disorders (Richter 2001; Richter 2002). This population with substance use disorders may have been less sensitive to the regional menthol sales restriction compared to the general population due to their unique risk factors and pervasive patterns of tobacco use. Given this study's non-random purposive sampling, lack of control or comparison group, and the lack of additional studies assessing the impact of a comprehensive flavor restriction on current smokers in substance abuse residential treatment facilities, there is insufficient evidence of the impact of a flavored tobacco sales restriction on quitting behaviors of adult current cigarette smokers in residential treatment facilities for substance abuse.

There is limited evidence that some adult menthol cigarette smokers switched to non-menthol cigarettes or switched to other tobacco products (e.g., e-cigarettes, cigars) after a menthol cigarette

sales restriction. Studies examining switching behavior found that a majority of adult menthol cigarette smokers switched to non-menthol cigarettes (Chung-Hall et al., 2021; Chaiton et al., 2018; Guydish et al., 2020). Although these studies were designed to establish temporality, two of the studies addressed specificity through statistical controls (Chung-Hall et al., 2021; Guydish et al., 2020) and findings were consistent across studies of different policies in different locations using different study designs, none of the studies were designed with a control or comparison and as discussed previously, Guydish et al. (2020) has limited external validity. Regarding switching to other tobacco products, there were only two studies that addressed this (Chaiton, Papadhima, Schwartz, et al., 2020; Chaiton et al., 2018). While both studies were designed to establish temporality and one study addressed specificity through statistical controls (Chaiton, Papadhima, Schwartz, et al., 2020), these studies were of the same policy and population and used a similar study design (Chaiton, Papadhima, Schwartz, et al., 2020; Chaiton et al., 2018).

There is also limited evidence that some menthol and other flavored cigarette smokers switched to unflavored tobacco after a sales restriction on flavored cigarettes (excluding menthol) and flavored RYO tobacco. Only one study examined whether menthol and other flavored cigarette smokers switched to unflavored tobacco after a sales restriction on flavored cigarettes (excluding menthol) and flavored RYO tobacco (Zatoński et al., 2020). While Zatoński et al. (2020) was designed to establish temporality and addressed specificity through statistical controls, it did not assess the impact of the menthol cigarette ban.

### Summary of Studies on the Impact of Flavored Tobacco Sales Restrictions or Bans on Sales of Tobacco Products

Nine studies examined the effects of a sales restriction or ban on flavored tobacco products (Farley & Johns, 2017; Brown et al., 2021; Chaiton, Schwartz, Shuldiner, et al., 2020; Chaiton et al., 2019; Chaiton, Schwartz, Kundu, et al., 2021; Delnevo & Hrywna, 2015; Gammon et al., 2021; Rogers et al., 2017; Rogers et al., 2020) on the legal sales of tobacco products. Consistent with other economic studies (e.g., Zheng et al., 2017; Cotti et al., 2016; Zheng et al., 2016), these policy evaluation studies used sales or purchase data to measure the demand for tobacco products which can serve as a proxy for changes in levels of tobacco product consumption among existing users. Two of these studies assessed changes in tobacco product sales before and after Ontario, Canada's policy restricting the sale of menthol tobacco products (Brown et al., 2021; Chaiton, Schwartz, Shuldiner, et al., 2020). One study examined changes in cigarette sales associated with the implementation of menthol cigarette sales restrictions across Canadian provinces (Chaiton, Schwartz, Kundu, et al., 2021). One study examined the association of the 2009 federal Canadian flavored tobacco regulation banning flavor additives (except menthol) in cigarettes and all cigars under 1.4g (or with filter or non-spiral wrap) with changes in cigar sales (Chaiton et al., 2019). Delnevo & Hrywna (2015) reported on clove cigar sales after the Tobacco Control Act banned flavored (excluding menthol but including clove-flavored) cigarettes in the US. Two studies examined the impact of New York City's policy restricting the sale of non-cigarette flavored tobacco products on tobacco product sales (Rogers et al., 2017, Farley & Johns, 2017). One study (Rogers et al., 2020) focused on the impact of Providence, Rhode Island's policy restricting the sale of all flavored (except menthol, mint, and wintergreen) non-cigarette tobacco products (i.e., cigars, smokeless tobacco, loose tobacco, and e-cigarettes with nicotine) on sales of flavored non-cigarette tobacco products and flavored cigars. Gammon et al. (2021) examined the impact of San Francisco's flavored (including menthol) tobacco product (including ENDS) sales restriction on unit sales of tobacco products in San

Francisco and in two Californian cities without flavored tobacco sales restrictions (San Jose and San Diego).

A strength of using sales data is that tobacco product sales data can often be obtained for small increments of time (e.g., weekly) for multiple tobacco product and flavor categories across multiple time periods pre- and post-policy. Sales data can also be obtained for multiple geographic areas (including the policy intervention area and control or comparison areas) which can yield a strong quasi-experimental design with high internal and external validity.

*Decreases in Sales of Tobacco Products After a Sales Restriction or Ban on Flavored Tobacco Products (Conclusive Evidence)*

Most of these studies report statistically significant and meaningful reductions in the sales of tobacco products subject to the policy and/or overall tobacco product sales after a sales restriction or ban on flavored tobacco products, suggesting that such policies can be implemented effectively and reduce sales of products as intended (Chaiton et al., 2019; Brown et al., 2021; Chaiton, Schwartz, Shuldiner, et al., 2020; Farley & Johns, 2017; Rogers et al., 2017; Rogers et al., 2020; Gammon et al., 2021; Chaiton, Schwartz, Kundu, et al., 2021).

Chaiton et al. (2019) examined the association of the 2009 federal Canadian flavored tobacco regulation banning flavor additives (except menthol) in cigarettes and all cigars under 1.4g (or in any cigar that had a filter or non-spiral wrap). Using an interrupted time series analysis of quarterly wholesale unit data, they found that sales of flavored (here defined by descriptors rather than additives and includes menthol/mint) cigars significantly decreased by 59.2 million units (95% CI -86.0 - -32.4,  $p < 0.001$ ) in the quarter immediately following policy enactment (i.e., first quarter of 2010). A decrease in overall sales of cigars of 49.6 million units (95% CI -73.5 - 25.8,  $p < 0.001$ ) after the federal Canadian flavored tobacco ban was also observed in this same time period. Similarly, Chaiton, Schwartz, Kundu, et al. (2021) examined the association of menthol sales restrictions in Canadian provinces between 2010 and 2018 on sales of cigarettes. Using an interrupted time series analysis of monthly wholesale cigarette sales data, they found menthol cigarette sales decreased to zero in all provinces and overall cigarettes sales decreased by 4.6% (95% CI -8.2- -1.0,  $p = .02$ ) after the sales restrictions. Wholesale cigarette sales decreased in all 10 provinces studied after the menthol cigarette sales restrictions and was statistically significant ( $p \leq 0.05$ ) in three provinces (Alberta, New Brunswick, and Saskatchewan).

Brown et al. (2021) and Chaiton, Schwartz, Shuldiner, et al. (2020) examined the effects of Ontario's menthol cigarette sales restriction on tobacco product sales. Both studies used a pre/post interrupted time series approach; however, Chaiton, Schwartz, Shuldiner, et al. (2020) analyzed wholesale data provided to Health Canada from tobacco manufacturers, whereas Brown et al. (2021) analyzed Nielsen retail scanner data on tobacco product per capita unit sales to consumers at the retail point-of-sale. Both Brown et al. (2021) and Chaiton, Schwartz, Shuldiner, et al. (2020) reported declines in unit sales of menthol cigarettes after the Ontario policy. Brown et al. (2021) found that compared to the 6 months prior to policy implementation, menthol cigarette sales decreased by 93.2% (596 to 40 packs per capita<sup>4</sup>) in the 6 months following policy implementation and as compared to a decrease of 2.3% (696 to 679 packs per capita) in the control area (British Columbia) during this same period. Chaiton, Schwartz, Shuldiner, et al. (2020) found that in the month following policy implementation,

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<sup>4</sup> Per capita defined as per 1000 people.

there was an immediate decline of 55-million-unit sales of menthol cigarettes in Ontario relative to the control area (British Columbia) (95% CI -78.5 - -31.5,  $p < 0.001$ ), and a corresponding decline of 127.8 million of overall cigarette unit sales (95% CI -208.2 - -47.4,  $p < 0.01$ ).

Farley and Johns (2017) and Rogers et al. (2017) examined the impact of New York City's policy restricting the sale of flavored (excluding menthol, mint, or wintergreen) non-cigarette tobacco products (excluding e-cigarettes) on tobacco product sales. Farley & Johns (2017) used sales data obtained from Symphony Information Resources, Inc. for 2008-2012 in 4-week periods from a non-random sample of 922 unique stores with annual sales of over US \$2 million in New York City. Following policy enforcement, there were significant declines in the mean dollar sales of: flavored (excluding menthol or mint) non-cigarette tobacco products overall (i.e., cigars, smokeless, and pipe/RYO) (86.8% [from \$31,918.00 to \$4,227.07];  $p < 0.001$ ); flavored cigars (86.2% [\$27,403.52 to \$3,774.76];  $p < 0.001$ ); and flavored pipe/RYO tobacco (91.1% [\$3,764.03 to \$334.70];  $p < 0.001$ ). Rogers et al. (2017) used Nielsen retail scanner 4-week data from January 2010 to January 2014 to assess changes from pre- to post-policy in unit sales of flavored (i.e., fruit, chocolate, alcoholic beverage, candy, vanilla, honey, cocoa, dessert, herb, or spice) cigars, flavored smokeless tobacco, and flavored RYO tobacco in New York City and in a control area. In New York City, unit sales of all flavored tobacco products combined (-27.1%), and sales of flavored cigars (-22.3%), flavored smokeless tobacco (-97.6%), and flavored RYO tobacco (-42.5%) declined at policy implementation. Rogers et al. (2017) found that implementation of New York City's flavored tobacco product sales restriction was associated with an immediate significant 11.6% decrease in total cigar sales in New York City ( $p < 0.05$ ); a non-significant 6.4% decrease was observed in the control area; and a non-significant 2.1% increase in sales was observed nationally. Average sales of all cigars in New York City decreased by 7.4% ( $p < 0.01$ ) from pre- to post-policy while average sales of all cigars increased 9.8% ( $p < 0.01$ ) in the control area and 12% nationally ( $p \geq 0.05$ ) from pre- to post-policy. These data suggest that New York City consumers did not appear to substitute non-flavored cigars for flavored cigars.

Rogers et al. (2020) examined the impact of Providence, Rhode Island's policy restriction on flavored (excluding menthol, mint, and wintergreen) non-cigarette tobacco products (cigars, pipe tobacco, snuff, chewing tobacco, dipping tobacco, bidis, snus, dissolvable tobacco products and electronic cigarette cartridges). This paper focused on cigars, the most prevalent non-cigarette tobacco product sold in Providence. They utilized regression models to estimate pre- and post-policy cigar unit sales in Providence as well as in the rest of the state. The average weekly unit sales of flavored cigars decreased by 51% ( $p < 0.01$ ) in Providence, while it increased by 10% ( $p < 0.01$ ) in the rest of the state. The authors attribute the decline in flavored cigar sales in Providence to a 93% ( $p < 0.01$ ) reduction in sales of cigars labeled with explicit-flavor names; sales of cigars labeled with explicit-flavor names did not change significantly in the rest of the state. Overall cigar sales in Providence decreased by 31% ( $p < 0.01$ ).

Gammon et al. (2021) examined the effects of San Francisco's policy restricting the sale of flavored (including menthol-flavored) tobacco products (including e-cigarettes). The authors used Nielsen retail scanner sales data from July 2015 through December 2019 and an interrupted time-series analysis to estimate within-city changes in average weekly unit sales of tobacco by comparing three time periods: prior to policy enactment, around the time of policy enactment, and during policy enforcement. Average weekly unit sales of flavored tobacco products overall decreased 96% from pre-policy to enforcement period in San Francisco ( $p < 0.05$ ). Sales of menthol cigarettes (-96%), flavored cigars (-96%), flavored smokeless tobacco (-97%), and flavored ENDS (-100%) all significantly decreased to low levels



from pre-policy to enforcement period ( $p < 0.05$ ). In the control cities, average weekly sales of flavored tobacco products either decreased modestly or did not significantly change from pre-policy to enforcement period, with the exception of flavored ENDS (which increased in both control cities), and flavored smokeless tobacco (which increased modestly in San Diego). Gammon et al. (2021) also found that the proportion of explicit flavored (other than menthol/mint) product sales and explicit menthol/mint flavored product sales significantly decreased in San Francisco (from 6.9% to 0.3% and from 26.5% to 1.1%, respectively;  $p < 0.05$ ), whereas they significantly increased in San Jose and San Diego. The proportion of concept-named flavored product sales decreased for San Francisco (from 1.1% to 0.4%,  $p < 0.05$ ) and San Jose (1.2% to 0.7%,  $p < 0.05$ ) from the pre-policy to enforcement periods and did not change for San Diego. Furthermore, average weekly total tobacco sales in San Francisco decreased 25% from pre-policy to enforcement ( $p < 0.05$ ), suggesting that there was not complete substitution of tobacco-flavored or unflavored products for flavored or menthol/mint products.

*Increases in Sales of Tobacco Products Not Subject to Sales Restriction After a Sales Restriction or Ban on Flavored Tobacco Products (Substantial Evidence)*

Some studies have found increases in sales of tobacco products not subject to sales restrictions or bans on flavored tobacco products, indicating that at least some tobacco users may be purchasing (and presumably using) other tobacco products as a substitute for products subject to the policy (Chaiton et al., 2019; Chaiton, Schwartz, Shuldiner, et al., 2020; Brown et al., 2021; Farley & Johns, 2017; Delnevo & Hrywna, 2015).

In 2009, Canada enacted a federal regulation banning flavor additives (excluding menthol) in cigarettes and all cigars under 1.4g (or in any cigar that had a filter or non-spiral wrap). Chaiton et al. (2019) found that unit sales of cigars with menthol descriptors (products not subject to the policy) increased following enactment. Additionally, they found an increase in unit sales of cigars with no flavor descriptors after policy enactment, although this increase was not significant. The level of increase in unit sales of cigars without flavor descriptors (9.6 million units) after implementation of the federal regulation did not offset the decrease in sales of cigars with flavor descriptors (59 million units), suggesting that complete substitution with cigars without flavor descriptors did not occur.

In an evaluation of Ontario's provincial menthol cigarette sales restriction, Chaiton, Schwartz, Shuldiner, et al. (2020) found a significant decline in the overall cigarette unit sales in Ontario immediately following Ontario's menthol sales restriction; this was followed by a significant increase in the sale of non-menthol cigarettes (23.8 million units per month, 95% CI 10.2-37.4,  $p < 0.001$ ) relative to the control area (British Columbia) during the post-policy period, suggesting a slight rebound effect. Brown et al. (2021) found that sales of non-menthol cigarettes increased 0.4% (11,470 to 11,519 packs per capita) after the Ontario policy.

In New York City, Farley & Johns (2017) found statistically significant increases in dollar sales of non-flavored (but including menthol/mint) cigars (5.17%,  $p = 0.003$ ) and non-flavored (again including menthol/mint) pipe/RYO (4.3%,  $p = 0.030$ ) after New York City's sales restriction on flavored (excluding menthol, mint, or wintergreen flavor) non-cigarette tobacco products. They also found an increase in the sale of non-flavored non-cigarette tobacco products overall, but this increase was not statistically significant (18.83%,  $p = 0.066$ ).

Delnevo & Hrywna (2015) analyzed the impacts of the 2009 US flavored (excluding menthol but including other flavored including clove) cigarette ban. The authors reviewed documents from Kretek International and found that the company began planning in 2007 for the transition of their clove cigarette (a product anticipated to be restricted under the 2009 ban) to a clove cigar product (a product not anticipated to be subject to the ban). The documents suggested that the cigar product's filler was identical to the clove cigarette. The cigar product's wrapper, which was homogenized tobacco leaf, would distinguish the product as a cigar. Delnevo & Hrywna (2015) assessed unit sales trends for clove cigars following the ban using Nielsen's Convenience Track retail scanner database from 2009-2012, and 2006-2012 data on tobacco imports to the US from Indonesia (the world's top manufacturer of clove cigarettes) obtained from the US Department of Agriculture (USDA) Foreign Agricultural Service's Global Agriculture Trade System. The authors found that following the clove cigarette ban, unit sales of Djarum brand clove cigars increased from 444,192 units in 2009 to 6,750,665 units in 2012. Additionally, tobacco imports to the US from Indonesia shifted completely from clove cigarettes to cigars between 2006-2012. Cigar imports increased dramatically after 2009, increasing to over 626 million sticks by 2012. Meanwhile, imports of clove cigarettes decreased from a high of 532 million sticks in 2008 to zero in 2010. The authors argue that "failing to extend the cigarette flavor ban to cigars created an opportunity for new products to replace flavored cigarettes."

*Increases in Sales of Products with Concept Flavor Names or Products in Which Flavor Status is Ambiguous (Substantial Evidence)*

A few studies found increases in sales of products with concept flavor names or products in which flavor status is ambiguous (Chaiton et al., 2019; Brown et al., 2021; Rogers et al., 2020). Using wholesaler data, Chaiton et al. (2019) found an increase (9.6 million units) in the unit sale of cigars with descriptors other than flavors (e.g., color or ambiguous terms) after the 2009 federal Canadian flavored tobacco regulation banning flavor additives (except menthol) in cigarettes and all cigars under 1.4g (or in any cigar that had a filter or non-spiral wrap). It is possible that some of the increases in sales of cigars with color descriptors were concept-flavored products. Using retail scanner data, Brown et al. (2021) found that after Ontario, Canada implemented the sales restriction on menthol tobacco products (including cigarettes), per capita sales of cigarettes with menthol-suggestive descriptors (e.g., green) increased by 2.7% (from 4,705 to 4,829) in Ontario compared to a 2.6% decrease (4,154 to 4,044) in the comparator jurisdiction (British Columbia). Rogers et al. (2020) found that after Providence, Rhode Island's policy restricting the sale of flavored (excluding menthol/mint/wintergreen) non-cigarette tobacco products (including cigars) average estimated weekly unit sales of cigars with concept-flavor names increased by 74% ( $p < 0.01$ ) in Providence and by 119% ( $p < 0.01$ ) in the rest of the state.

Summary and Conclusion

Overall, we conclude that following a flavored tobacco sales restriction or ban, overall sales of tobacco products or specific tobacco product categories (e.g., cigarettes, cigars) decrease, suggesting that consumers did not completely substitute non-flavored tobacco products for flavored. Additionally, we conclude that sales of flavored tobacco products subject to the policy substantially decrease following a flavored tobacco sales restriction or ban. Although increases in the sales of other tobacco products not subject to the policy were observed, these increases were small.

There is conclusive evidence of decreases in sales of tobacco products after a sales restriction or ban on flavored tobacco products. Eight studies found substantial decreases in sales of tobacco products

after a sales restriction or ban on flavored tobacco products (Chaiton et al., 2019; Brown et al., 2021; Chaiton, Schwartz, Shuldiner, et al., 2020; Farley & Johns, 2017; Rogers et al., 2017; Rogers et al., 2020; Gammon et al., 2021; Chaiton, Schwartz, Kundu, et al., 2021). The decreases in sales of tobacco products were observed across studies of different policies in different locations using different study designs and data sources, and all of the studies were designed to establish temporality and addressed specificity through statistical controls or control/comparison groups.

There is substantial evidence of increases in sales of tobacco products not subject to sales restriction after a sales restriction or ban on flavored tobacco products. Five studies identified increases in the sales of tobacco products not subject to the policy after a sales restriction or ban, providing some evidence for product substitution (Chaiton et al., 2019; Chaiton, Schwartz, Shuldiner, et al., 2020; Brown et al., 2021; Farley & Johns, 2017; Delnevo & Hrywna, 2015). These studies were designed to establish temporality, most studies addressed specificity through statistical controls or control/comparison groups, and all found increases in sales of products not subject to the policy, across different policies and using different data sources. The increases were small (e.g., a 0.4% increase in sales of non-menthol cigarettes after the Ontario menthol tobacco product sales restriction [Brown et al., 2021]; a 5% increase in sales of non-flavored cigars and a 4% increase in sales of non-flavored pipe/RYO tobacco after New York City's flavored non-cigarette tobacco product sales restriction [Farley & Johns, 2017]). More specifically, increases in sales of non-menthol cigarettes (0.4% [Brown et al., 2021]) after the Ontario menthol tobacco product sales restriction were smaller than the previous market share of menthol cigarettes (about 5%). Similar to the evidence on adult behavior discussed previously, this suggests that the availability of flavored cigars may impact the public health benefit of a national menthol sales restriction.

There is also substantial evidence of increases in sales of products with concept flavor names or products in which flavor status is ambiguous. Three studies provide evidence that sales of tobacco products in which flavor status is ambiguous may increase after a flavored tobacco sales restriction or ban (e.g., increase in sale of cigarettes with menthol-suggestive descriptors in Ontario post-policy; increase in sale of concept-flavor named cigars in Providence post-policy), potentially increasing the difficulty of policy enforcement (Chaiton et al., 2019; Brown et al., 2021; Rogers et al., 2020). All studies reviewed were designed to establish temporality and addressed specificity through statistical controls or control/comparison groups. Findings across these studies were consistent for different policies in different locations using different study designs and data sources.

### Summary of Studies on the Impact of Flavored Tobacco Sales Restrictions or Bans on Illicit Sales of Tobacco Products

The following section reports on findings related to illicit, cross-border, and online sales. The research question and search strategy employed focused on illicit sales; however, some articles included in the RTD that examined illicit sales (and legal sales) of tobacco products also included findings related to cross-border and online sales, which, given their relevance, are also discussed below.

#### Illicit Sales

Six studies reported on illicit sales after a flavored tobacco product sales restriction or ban (Chung-Hall et al., 2021; Guydish et al., 2020; Kock et al., 2021; Soule et al., 2019; Stoklosa, 2019; Yang et al., 2020). Stoklosa (2019) analyzed seized illicit cigarette data from the Audit and Enforcement unit of

the Provincial Tax Commission Service of Nova Scotia. Three studies used a cross-sectional design (Guydish et al., 2020; Kock et al., 2021; Yang et al., 2020) and one study used a longitudinal design (Chung-Hall et al., 2021) to assess self-report purchasing behaviors related to products that were banned or restricted by a flavored tobacco policy. One mixed-methods study asked a small number of randomly selected adult participants in an existing cohort of past year menthol cigarette smokers to complete an online concept mapping, sorting, and rating study to assess how Ontario's flavored tobacco sales restriction affected them and specific actions they had taken in response to it, including perceptions of illegal menthol sales and buying menthol cigarettes in alternative locations (Soule et al., 2019).

*Reports of Illicit Tobacco Product Sales Following a Flavored Tobacco Sales Restriction or Ban (Limited Evidence)*

Stoklosa (2019) examined the number of seized illicit cigarette products from 2007 to 2018 in Nova Scotia, Canada to determine whether there was an increase in seized illicit cigarette products after Nova Scotia's 2015 provincial restriction on the sale of menthol cigarettes. The Audit and Enforcement unit of the Provincial Tax Commission, Service of Nova Scotia, tracks data related to seized cigarettes, including the total number of illicit cigarettes seized in Nova Scotia in each fiscal year. The data are obtained from reports of seizures made by Nova Scotia's law enforcement as well as other Canadian law enforcement agencies working in Nova Scotia. The study found that the amount of seized illicit cigarettes declined significantly from greater than 60,000 cartons in 2007-2008 to less than 10,000 cartons in 2017-2018. Although the bulk of the decline in illicit cigarettes seized occurred before the menthol policy, the authors found that in the recent years after the menthol ban, seizure volume remained stable; there was no statistically significant difference in the number of illicit cigarettes seized before and after the menthol policy ( $t=-0.71$ ,  $p=0.55$ ). The author noted that according to local authorities, "the enforcement efforts in Nova Scotia have not declined during the period from 2014 to 2018 and, in fact, they intensified in some areas." Additionally, the authors noted that according to local authorities, there were only a few small seizures of menthol cigarettes in the year following the policy, and there were no further seizures of menthol cigarettes after the first year.

Studies using self-report data to assess the impact of flavored tobacco sales restrictions report that some individuals use (and were therefore able to access) policy-restricted tobacco products after policy implementation (Chung-Hall et al., 2021; Guydish et al., 2020; Kock et al., 2021; Soule et al., 2019; Yang et al., 2020). Chung-Hall et al. (2021) evaluated the impact of menthol cigarette sales restrictions in seven Canadian provinces (including Ontario) on cessation and smoking behaviors of adults. The study used longitudinal, nationally representative data from the Canadian arm of the ITC Four Country Smoking and Vaping Survey from 2016 (Wave 1; pre-policy) and 2018 (Wave 2; post-policy). For menthol cigarette smokers who continued to use menthol cigarettes post-policy and who reported a menthol cigarette brand as their last purchase ( $n=13$ ), 31% reported buying menthol cigarettes from convenience stores (95% CI 12.3-58.9). The study was not able to determine the proportion of menthol cigarettes purchased by cigarette smokers post-policy that were contraband.

Kock et al. (2021) examined the prevalence of menthol cigarette smoking after the May 2020 European Union Tobacco Products Directive ban on the sale of menthol cigarettes. The study used repeated monthly cross-sectional surveys of a representative sample of current smokers (18 years and older) in England (unweighted  $n=2681$ ) between July 2020 and June 2021. This study assessed sources of

purchase of menthol cigarettes in the past 6 months (i.e., July-December 2020; January-June 2021). The most popular sources of menthol cigarette purchases during July-December 2020 and January-June 2021 were newsagent/off license/corner shops, supermarkets, and petrol garage shops. Sources of purchase were similar between July-December 2020 and January-June 2021 with the exception of declines in buying abroad (14.2% vs. 10.4%,  $p=0.01$ ) and buying from friends (12.3% vs. 4.2%,  $p=0.005$ ). Past-6-month purchases of menthol cigarettes from any illicit or cross-border source declined from 30.1% in the last 6 months of 2020 to 17.5% in the first 6 months of 2021 ( $p=0.006$ ). This study did not include measures on menthol smoking before the ban was implemented. It is also important to note that the measure of flavored cigarette use included menthol flavored accessories (e.g., flavored capsules, filter tips, cards) that were exempt from the ban. The findings regarding decline in purchase from any illicit or cross-border source may reflect the impact of COVID-19-related restrictions which were more restrictive in late 2020/early 2021 compared with summer/autumn of 2020.

Yang et al. (2020) and Guydish et al. (2020) evaluated the impact of San Francisco's flavored (including menthol) tobacco product (including ENDS) sales restriction on tobacco use behaviors. Yang et al. (2020) used a post only study design that collected data at only one point in time from young adults (aged 18-34). Self-report data were collected from participants recruited via MTurk in November 2019, after the policy was enforced in January 2019. A small percentage of young adults reported purchasing flavored tobacco products illegally in San Francisco (5.3%) post-policy. It is important to note that this study employed a relatively small convenience sample; and that the survey was conducted in November 2019 and required that participants recall behaviors from December 2018, thus participants may not have been able to precisely recall their past tobacco use patterns. Guydish et al. (2020) evaluated the policy impact on clients of two residential substance use treatment facilities. The study utilized cross-sectional purposive samples of participants from these facilities 6-months prior to policy enforcement ( $n=160$ ), 5-months after policy enforcement ( $n=102$ ), and 11-months ( $n=120$ ) after policy enforcement, providing an opportunity for pre- and post-policy analyses. The authors found that among the 36 menthol smokers surveyed 11 months post-policy enforcement, 50% ( $n=18$ ) reported purchasing menthol cigarettes in San Francisco in the previous month.

In a mixed-methods study, Soule et al. (2019) asked a small number of randomly selected adult participants in an existing cohort of past-year menthol cigarette smokers to complete an online concept mapping, sorting, and rating study to assess how Ontario's flavored tobacco sales restriction affected them and report specific actions they had taken in response to it. Overall, seven clusters describing menthol smokers' reactions to menthol policy were identified; one of the seven clusters concerned alternative menthol cigarette purchasing behaviors (e.g., described perceptions of illegal menthol cigarette sales and buying menthol cigarettes in alternative locations). Of the statements about alternative menthol cigarette purchasing behaviors, the statement "I believe [the policy] has increased the presence of 'black-market' menthols" had the highest rating in the cluster ( $M=4.94$ ); the statement "I have purchased illegal/black market menthol cigarettes" was rated lower ( $M=2.79$ ).

### Cross-Border Sales

Seven studies reported on cross-border sales of tobacco products following a flavored tobacco sales restriction or ban (Chaiton et al., 2018; Chaiton, Nicolau, Schwartz, et al., 2020; Chung-Hall et al., 2021; Kock et al., 2021; Rogers et al., 2017; Rogers et al, 2020; Yang et al., 2020). Three studies used a longitudinal design (Chaiton et al., 2018; Chaiton, Nicolau, Schwartz, et al., 2020; Chung-Hall et al.,

2021); one study used a cross-sectional post-policy design (Yang et al., 2020), and one study used a repeated cross-sectional design (Kock et al., 2021) to assess self-report cross-border purchasing behavior. Two studies used sales data to compare purchases in policy and non-policy areas to assess cross-border purchasing (Rogers et al., 2017; Rogers et al., 2020).

*Reports of Cross-Border Tobacco Product Sales Following a Flavored Tobacco Sales Restriction or Ban (Moderate Evidence)*

Studies evaluating the impact of flavored tobacco sales restrictions in Canadian provinces have reported some evidence of cross-border sales of tobacco products subject to sales restriction after policy implementation (Chung-Hall et al., 2021; Chaiton et al., 2018; Chaiton, Nicolau, Schwartz, et al., 2020). The Chung-Hall et al. (2021) study mentioned previously found that for menthol cigarette smokers who continued to use menthol cigarettes post-policy and who reported a menthol cigarette brand as their last purchase (n=13), 54.7% (95% CI 28.6-78.4) reported buying menthol cigarettes from a First Nations reserve. Chaiton et al. (2018) conducted a survey assessing menthol smokers' behavioral response to Ontario's provincial menthol cigarette sales restriction (effective January 1, 2017) one month following policy implementation. Participants (n=325) were recruited through a random-digit dial of residential telephone numbers from September 12 to December 31, 2016. Eligible participants were Ontario residents aged 16 and older who had smoked at least one menthol cigarette in the past year and were past-month smokers. One month after the sales restriction, 14.1% (n=29, 95% CI 10.0-19.6) of smokers reported using menthol cigarettes purchased from a First Nations reserve, other province, other country, or online; a total of 35.1% (n=72, 95% CI 28.9-42.0) of participants reported using menthol cigarettes from any source in the past month. In a follow-up study to the Chaiton et al. (2018) study, Chaiton, Nicolau, Schwartz, et al. (2020) implemented a survey assessing smokers' behavioral responses to Ontario's menthol cigarette sales restriction one year following policy implementation. The sample was comprised of current cigarette smokers at baseline who were recruited through a random digit dial of residential telephone numbers from September to December 31, 2016 (n=1,026) and a supplemental convenience sample (n=772). A total of 913 participants completed both a pre-policy and a post-policy survey. At follow-up, 0.3% of the baseline non-menthol smokers, 5% of the baseline occasional menthol smokers, and 22% of the baseline daily menthol smokers reported purchasing menthol cigarettes after policy implementation (p<0.001). The primary source for purchasing menthol cigarettes was First Nations reserves. At both short-term and long-term follow-up, 21% of prior daily menthol smokers reported that they had purchased menthol cigarettes on First Nations reserves.

The Kock et al. (2021) study mentioned previously assessed sources of purchase of menthol cigarettes in England after the May 2020 European Union Tobacco Products Directive ban on the sale of menthol cigarettes. The most popular sources of menthol cigarette purchases during July-December 2020 and January-June 2021 were newsagent/off license/corner shops, supermarkets, and petrol garage shops. Sources of purchase were similar between July-December 2020 and January-June 2021 with the exception of declines in buying abroad (14.2% vs. 10.4%, p=0.01) and buying from friends (12.3% vs. 4.2%, p=0.005). Past-6-month purchases of menthol cigarettes from any illicit or cross-border source declined from 30.1% in the last 6 months of 2020 to 17.5% in the first 6 months of 2021 (p=0.006).

Studies evaluating the impact of flavored tobacco sales restrictions in the US, specifically policies in San Francisco, California, and Providence, Rhode Island, have also reported some evidence of cross-border sales of tobacco products subject to sales restriction (Yang et al., 2020; Guydish et al., 2020;

Rogers et al., 2020). The Yang et al. (2020) study mentioned previously found self-reported proportions of e-cigarettes, cigarettes, and cigars obtained from retailers outside of San Francisco (i.e., cross-border purchases) increased overall post-policy. However, the overall distribution was only significantly different for e-cigarettes ( $<0.001$ ), not for cigarettes or cigars.

Rogers et al. (2020) examined the effects of Providence, Rhode Island's restriction on the sale of all flavored (except menthol, mint, and wintergreen) non-cigarette tobacco products (cigars, smokeless tobacco, loose tobacco, and e-cigarettes with nicotine). The authors used interrupted time series regression and Nielsen retail scanner data from January 2012 to December 2016 to assess weekly changes in unit sales of all flavored non-cigarette tobacco products and flavored cigars in Providence, Rhode Island and a comparison area consisting of all localities in the rest of the state of Rhode Island. The study found that in Providence average weekly unit sales declined significantly from pre- to post-policy for all flavored non-cigarette products and for flavored cigars (both  $-51\%$ ,  $p < 0.01$ ), whereas in the rest of the state, average weekly unit sales for all flavored non-cigarette products and for flavored cigars increased (each by  $10\%$ ,  $p < 0.01$ ). The authors note that the increase in sales of flavored cigars (explicit-flavored cigars and concept-flavored cigars combined) from pre-policy to post-policy in the rest of the state could suggest cross-border purchasing of flavored cigars by Providence, Rhode Island consumers following policy implementation.

A study evaluating the impact of New York City's flavored tobacco sales restriction reported limited evidence of cross-border sales of tobacco products subject to the sales restriction (Rogers et al., 2017). Rogers et al. (2017) used Nielsen retail scanner 4-week data from January 2010 to January 2014 to assess changes in unit sales of flavored (excluding menthol) cigars, flavored smokeless tobacco, and flavored loose tobacco (i.e., RYO), in New York City and in a control area not subject to the New York City sales restriction before and after policy implementation. The control area consisted of ten non-New York City counties surrounding the city, where retailers were not subject to the New York City sales restriction. In New York City, statistically significant changes ( $p < 0.01$ ) occurred in the level of unit sales of flavored tobacco products: all flavored tobacco products combined (cigars, flavored smokeless tobacco, and flavored loose tobacco [i.e., RYO]) declined by  $27.1\%$ ; sales of flavored cigars declined by  $22.3\%$ ; flavored smokeless tobacco declined by  $97.6\%$ ; and flavored RYO declined by  $42.5\%$ . Trends in unit sales observed in the control area differed from those in New York City. In addition, the authors note that a significant increase in the sales of flavored cigars was observed in the control area and nationally at the time of policy implementation. They conclude that this provides little evidence for any increase in cross-border sales after implementation of the New York City policy.

### Online Sales

Three studies reported on online sales of tobacco products following a flavored tobacco sales restriction or ban (Chaiton et al., 2018; Chung-Hall et al., 2021; Yang et al., 2020). Two studies used a longitudinal design (Chaiton et al., 2018; Chung-Hall et al., 2021) and one study used a cross-sectional post-only design (Yang et al., 2020) to assess self-report cross-border purchasing behavior.

### Reports of Online Tobacco Product Sales Following a Flavored Tobacco Sales Restriction or Ban (Limited Evidence)

Studies evaluating the impact of flavored tobacco sales restrictions in Canadian provinces have reported some evidence of online sales of tobacco products subject to sales restriction after these

policies (Chung-Hall et al., 2021; Chaiton et al., 2018; Yang et al., 2020). The Chung-Hall et al. (2021) study mentioned previously evaluated the impact of menthol cigarette sales restrictions in seven Canadian provinces (including Ontario) representing over 80% of the national population on cessation and smoking behaviors of adults. For menthol cigarette smokers who continued to use menthol cigarettes post-policy and who reported a menthol cigarette brand as their last purchase (n=13), 7.5% (95% CI 0.7-48.4) reported buying menthol cigarettes online. The study was not able to determine the proportion of menthol cigarettes purchased by cigarette smokers post-policy that were contraband. The Chaiton et al. (2018) study mentioned previously found one month after the sales restriction, 14.1% (n=29, 95% CI 10.0-19.6) of smokers reported using menthol cigarettes purchased from a First Nations reserve, other province, other country, or online; a total of 35.1% (n=72, 95% CI 28.9-42.0) of participants reported using menthol cigarettes from any source in the past month.

The Yang et al. (2020) study mentioned previously that evaluated the impact of San Francisco's flavored (including menthol) tobacco product (including ENDS) sales restriction on tobacco use behaviors among young adults found self-reported proportions of e-cigarettes, cigarettes, and cigars obtained online or through the mail increased post-policy. However, the overall distribution was only significantly different for e-cigarettes (<0.001), not for cigarettes or cigars. Approximately 15% of young adults reported purchasing flavored tobacco products online post-policy.

### Summary and Conclusion

Overall, we conclude that the impact of a flavored tobacco product sales restriction or ban on the illicit market is not significant. Additionally, we conclude that there are reports of cross-border and online tobacco product sales following a flavored tobacco product sales restriction or ban. Implementation of a national flavored tobacco policy as compared to state or local policies would prohibit the manufacture and sale of menthol cigarettes and reduce the extent of available and accessible restricted tobacco products in nearby jurisdictions where they are not restricted and thus reduce the likelihood of illicit and cross-border sales.

There is limited evidence of reports of illicit tobacco product sales following a flavored tobacco product sales restriction or ban (Chung-Hall et al., 2021; Guydish et al., 2020; Kock et al., 2021; Soule et al., 2019; Stoklosa, 2019; Yang et al., 2020). One study examining data obtained from reports of seizures made by law enforcement found no statistically significant difference in the number of illicit cigarettes seized before and after a menthol policy in Nova Scotia (Stoklosa, 2019). While longitudinal (Chung-Hall et al., 2021) and cross-sectional self-report surveys (Kock et al., 2021; Yang et al., 2020; Guydish et al., 2020) and a mixed-methods study (Soule et al., 2019) of Canadian and local US policies suggest low levels of illicit sales following policy implementation, it is important to note that most of these studies were not designed to look specifically at illicit sales. While none of the studies were designed with a control or comparison group, three of the studies addressed specificity through statistical controls (Chung-Hall et al., 2021; Guydish et al., 2020; Yang et al., 2020). Additionally, measures in Chung-Hall et al. (2021) and Kock et al. (2021) did not allow for distinguishing cigarettes purchased that were exempt from sales restriction.

There is moderate evidence of reports of cross-border tobacco product sales following a flavored tobacco sales restriction or ban. Seven studies reported on cross-border tobacco product sales following a flavored tobacco sales restriction or ban (Chaiton et al., 2018; Chaiton, Nicolau, Schwartz, et al., 2020; Chung-Hall et al., 2021; Kock et al., 2021; Rogers et al., 2017; Rogers et al., 2020; Yang et al.,



2020). While one study examining sales of flavored tobacco products found little evidence for any increase in cross-border sales after implementation of the New York City policy (Rogers et al., 2017), several longitudinal and cross-sectional self-report surveys (Chung-Hall et al., 2021; Chaiton et al., 2018; Chaiton, Nicolau, Schwartz, et al., 2020; Kock et al., 2021; Yang et al., 2020) and a sales study (Rogers et al., 2020) of Canadian and local US policies suggest low levels of cross border sales following policy implementation. The three studies from Canada (Chung-Hall et al., 2021; Chaiton et al., 2018; Chaiton, Nicolau, Schwartz, et al., 2020) identify sales at First Nations reserves, which were generally exempted from sales restrictions. Two of the studies reporting on cross-border tobacco product sales (Rogers et al., 2017; Rogers et al., 2020) were designed to assess specificity with control groups and three studies addressed specificity through statistical controls (Chaiton, Nicolau, Schwartz, et al., 2020; Chung-Hall et al., 2021; Yang et al., 2020). Measures in two studies (Chung-Hall et al., 2021; Kock et al., 2021) did not allow for distinguishing cigarettes purchased that were exempt from the sales restriction. Measures in one study (Chaiton et al., 2018) did not distinguish between cross-border and online sales.

There is limited evidence of reports of online tobacco product sales following a flavored tobacco sales restriction or ban. Three studies found some users report purchasing policy restricted tobacco products online following policy implementation (Chung-Hall et al., 2021; Chaiton et al., 2018; Yang et al., 2020). These studies were designed to establish temporality, addressed specificity through statistical controls, and showed consistent findings across studies of different policies in different locations using different study designs and data sources. However, measures in two studies (Chung-Hall et al., 2021; Kock et al., 2021) did not allow for distinguishing cigarettes purchased that were exempt from the sales restriction. Measures in one study (Chaiton et al., 2018) did not distinguish between cross-border and online sales.

### Summary of Studies on the Impact of Flavored Tobacco Sales Restrictions or Bans on User Modification of Tobacco Products

Two studies (Chaiton et al., 2018; Chaiton, Schwartz, Cohen, et al., 2020) analyzed data from surveys of tobacco users reported on user modifications of tobacco products after a flavored tobacco sales restriction in the province of Ontario, Canada.

#### Reports of Increased User Modifications of Tobacco Products after a Flavored Tobacco Sales Restriction (Limited Evidence)

There are reports of user modification of tobacco products after a menthol cigarette sales restriction (Chaiton et al.; 2018, Chaiton, Schwartz, Cohen, et al., 2020). Chaiton et al. (2018) implemented a survey with a random sample (n=325) assessing smokers' behavioral response to Ontario's menthol cigarette sales restriction one month following policy implementation. Participants were Ontario residents aged 16 and older who had smoked at least one menthol cigarette in the past year and were past-month smokers. One month after the sales restriction, 14.1% (n=29, 95% CI 10.0-19.6) reported having added menthol to cigarettes using flavor cards, oils, or papers or another reaction.

Chaiton, Schwartz, Cohen, et al. (2020) examined changes in the self-reported use of menthol additives after Ontario's menthol cigarette sales restriction. Current past month cigarette smokers 16 years and older living in Ontario completed a baseline survey in September-October 2016 and were contacted for follow up in January 2017, January 2018, and January 2019. A total of 1,309 people responded to at least one of the additive questions. The authors found that overall, 14.6% (n=294) of

baseline daily menthol cigarette smokers reported using some sort of menthol additive (e.g., additive cards, drops, oils) after the policy, compared with 9.8% (n=702) of baseline occasional menthol cigarette smokers and 2.6% (n=313) of baseline non-menthol cigarette smokers ( $p<0.001$ ). The percent of baseline daily menthol smokers using flavor additives increased from 4.4% pre-policy in 2016 to 5.1% in 2017, and 12.5% in 2018, then dipped to 9.5% in 2019; however, the statistical significance of year-over-year changes is not presented. It is important to note the potential selection bias given the use of a convenience sample to supplement the longitudinal cohort sample.

### Summary and Conclusion

Based on the two studies that address user modification, we conclude that there is limited evidence of reports of increased user modification of tobacco products after a flavored tobacco sales restriction. While the two studies of Ontario, Canada's menthol cigarette sales restriction were designed to establish temporality, they found that only a small percentage of tobacco users reported modifying their products after a flavored tobacco sales restriction (Chaiton et al., 2018; Chaiton, Schwartz, Cohen, et al., 2020). Given the limited studies on user modification, it is unclear whether observed user modification of tobacco products was an initial reaction to the menthol cigarette sales restriction and the extent that user modification would be sustained overtime.

### Limitations

Limitations of this RTD include the possibility of publication bias, only articles in English were included, and studies that were not peer reviewed were excluded. Because some of the longitudinal studies may have used the same study populations at different points in time for their analyses, it is possible that some results are duplicative; however, we note the data source and sample populations when discussing findings from each study. We did not have access to raw data for any study to perform independent statistical analyses and did not include additional information about the study beyond what was in the publication.

Regarding the studies that used sales data as an outcome measure—it is important to note that the generalizability of findings from these studies is limited by the types of retail outlets and channels tracked by the data sources employed in the analyses. For example, many of the studies included in the RTD use Nielsen retail scanner data that reports on tobacco product sales to consumers. Nielsen uses proprietary methods to project sales to consumers from tobacco products scanned at the point-of-sale in certain types of retail outlets (e.g., convenience stores, mass merchandisers, supermarkets, drug, dollar and club stores and military commissaries); these data do not include specialty stores such as vape stores, online sales, or retailers making less than \$2 million in yearly sales. As a result, retail scanner data may not completely reflect individual-level tobacco use as some consumers may obtain tobacco products through other channels not captured by scanner data. Other studies reported in the RTD use wholesale data reported to Health Canada by tobacco manufacturers. Wholesale data may not accurately represent total consumption in smaller territories such as Prince Edward Island and the territories as wholesalers and retailers in small territories may receive their product from wholesalers in larger provinces. Additionally, wholesale data may not accurately reflect sales of tobacco products to consumers and wholesale data may change due to auditing done by Health Canada or resubmission. Lastly, many of these studies only examine a policy's effect on the sales of one or a few (and not all) tobacco product categories; therefore, these studies may underestimate product switching after a sales restriction or ban on flavored tobacco products.

In addition to the limitations of the summary of the evidence, we also want to acknowledge considerations for comparability of the policies, and thus related outcomes across the various studies, and for the generalizability of these evaluation findings to a national US context. While the policies evaluated in this RTD are all related to restrictions or bans on flavored tobacco products, the roughly sixteen unique policies examined across the 28 studies represented may differ in meaningful ways. For example, policies fall under different jurisdictions (e.g., US, both federal and local; and Canada, both federal and provincial); and across these jurisdictions, populations may vary in demographic composition, how industry marketing targets populations, and tobacco product use behaviors. Policies may also differ by policy type (i.e., sales restrictions vs. bans focus); product categories (i.e., combustibles only vs. combustibles plus non-combustibles [namely ENDS]), flavors (i.e., menthol only vs. flavors excluding menthol vs. flavors including menthol), and retailers (e.g., adult only stores, internet) subject to the policies, as well as by the extent of compliance by retailers or manufacturers and enforcement. Canada had banned all flavors other than menthol in cigarettes before implementation of their federal menthol cigarette sales restriction, which would be an analogous situation to the US if a menthol product standard is implemented in the US. It is important to note that menthol cigarettes comprise a larger proportion of cigarette sales in the US than in Canada (26% in US vs. 4% in Canada in 2001) and a larger proportion of Black cigarette smokers in the US use menthol cigarette brands than in Canada (78.4% of Black cigarette smokers in US vs. 9.8% of Black cigarette smokers in Canada in 2002) (Giovino et al., 2004). Given these differences, findings from Canada likely underestimate the impact of a menthol cigarette ban in the US. Flavored tobacco policies that cover tobacco products that are potential substitutes and more flavor categories (e.g., menthol) as well as policies that minimize exemptions for retailer types (e.g., adult-only stores) could have a much greater impact on the tobacco use behaviors.

Rigorous enforcement infrastructure including extensive retailer outreach, retailer education, routine monitoring, and educational materials and resources can increase retailer compliance. Several studies provide evidence of high rates of retailer compliance after policy implementation resulting in reduced availability of flavored tobacco products in policy affected stores in US jurisdictions and in Canada (Kingsley et al., 2020; Pearlman et al., 2019; Kingsley et al., 2019; D'Silva et al., 2021; Brock et al., 2019; Bosma et al., 2021; Vyas et al., 2020; Kephart et al., 2020; Borland et al., 2017; Andersen-Rodgers et al., 2021). For example, Kingsley et al. (2019) found the proportion of retailers with one or more flavored tobacco products available for sale decreased from 77.3% to 7.3% in Lowell, Massachusetts and remained similar (76% to 78%) in the control community, suggesting a high degree of retailer compliance in Lowell. The authors concluded this was likely supported by the Massachusetts Tobacco Control Program's rigorous compliance and enforcement infrastructure that included multiple education visits and educational materials. In San Francisco, California, Vyas et al. (2020) found that 83% of inspected stores had flavored tobacco products available for sale in December 2018 before policy enforcement. However, during the 3-to-8-month period following the start of routine inspections, an average of 20% of retailers had flavored tobacco products available for sale. However, studies have also reported continued availability of flavored tobacco products after flavored tobacco product sales restriction, suggesting the need for additional and continued enforcement activities (Kurti et al., 2020; Farley et al., 2020; Czaplicki et al., 2019; Schroth et al., 2021). For example, challenges with compliance with the New York City policy have been reported. A study examining flavored tobacco product availability in New York City nearly 7 years after policy implementation found that 70.9% of retailers had policy-restricted explicit-named flavored tobacco products available for sale, and 69.3% of retailers had

concept-named flavored products available for sale, highlighting the need for additional retailer education and enforcement efforts (Farley et al., 2020). Additionally, a discarded cigar package survey conducted in New York City about 6 years after policy implementation found that 28.6% of all collected products had explicit or concept flavor names (Kurti et al., 2020).

Furthermore, some of the policies were enacted and implemented at different points in time in highly dynamic environments with varying policy contexts (e.g., types of tobacco products available in the marketplace, distinct but relevant tobacco control policies [pre-existing flavor policy before menthol policy, T21 policy, tobacco taxation]). Lastly, evaluation of state and local flavored tobacco product sales restriction policies likely under-estimate the potential effects of federal policies that would apply nationally, throughout the US (e.g., manufacturing product standards banning flavors in tobacco products). A flavored tobacco product standard, like the US 2009 flavored cigarette ban, would apply to tobacco product manufacturers and retailers and be accompanied with strong enforcement at the federal level, unlike local flavored tobacco product sales restrictions that apply only to retailers. Furthermore, federal policies as compared to state/local policies would minimize the potential for cross-border purchasing of restricted tobacco products from nearby jurisdictions where the products are not restricted.

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Appendix A Table. Summary of Flavored Tobacco Sales Restrictions or Bans<sup>1</sup> Included in RTD Evaluation Studies<sup>2</sup>

Jurisdiction	Effective and/or Enforcement Date	Tobacco Products Included in the Sales Restriction or Ban	Excluded Tobacco Products <sup>3</sup>	Excluded Flavors	Retailer Exemptions	Citations for Studies Included in RTD
<b>US</b>						
Attleboro, MA	Effective: January 2016	Flavored tobacco products, including but not limited to cigars, little cigars, chewing tobacco, pipe tobacco, snuff, e-cigarettes	Menthol cigarettes	Menthol, mint, and wintergreen	Adult-only (21+ years old) retail tobacco stores with ≥90% of sales from tobacco products  Smoking bars	Kingsley et al., 2021
Lowell, MA	Effective: October 2016	Flavored tobacco products, including but not limited to cigars, little cigars, chewing tobacco, pipe tobacco, snuff, e-cigarettes	Menthol cigarettes	Menthol, mint, and wintergreen	Adult-only (21+ years old) retail tobacco stores with ≥90% of sales from tobacco products	Kingsley et al., 2019
New York, NY	Effective: July 2010  Enforcement: November 2010	Flavored tobacco products containing tobacco, including cigars, cigarillos, little cigars, chewing tobacco, snuff, snus, pipe tobacco, RYO tobacco, and dissolvables	Menthol cigarettes  E-cigarettes/e-liquid	Menthol, mint, and wintergreen	Tobacco bars with ≥10% gross income from tobacco sales	Farley & Johns, 2017; Rogers et al., 2017

Providence, RI	Effective: January 2013	Flavored tobacco products containing tobacco or nicotine, including but not limited to cigars, pipe tobacco, snuff, chewing tobacco, dipping tobacco, bidis, snus, dissolvable tobacco products, and e-cigarette cartridges/e-liquid	Menthol cigarettes	Menthol, mint, and wintergreen	All smoking bars	Pearlman et al., 2019; Rogers et al., 2019
Salem, MA	Effective: March 2017	Flavored tobacco products, including but not limited to cigars, little cigars, chewing tobacco, pipe tobacco, snuff, e-cigarettes	Menthol cigarettes	Menthol, mint, and wintergreen	Adult-only (21+ years old) retail tobacco stores with $\geq 90\%$ of sales from tobacco products  Smoking bars	Kingsley et al., 2021
San Francisco, CA <sup>4</sup>	Effective: July 2018  Enforcement: January 2019  Enforcement with routine retailer compliance inspections: April 2019	Flavored e-cigarettes, menthol cigarettes, and other non-tobacco flavored tobacco products including cigars, cigarillos, and little cigars; hookah/waterpipe; and smokeless/dissolvable tobacco	None	None	None	Friedman, 2021; Gammon et al., 2021; Guydish et al., 2020; Yang et al., 2020

US (National)	Effective: September 2009	Flavored cigarettes	Menthol cigarettes	Menthol	None	Courtemanche et al., 2017; Delnevo & Hrywna, 2015; Rosshiem et al., 2020
<b>Canada</b>						
Alberta, Canada	Non-menthol Policy Effective: October 2015  Menthol Policy Effective: September 2015	October 2015: Most non-menthol flavored tobacco products  September 2015: Addition of menthol flavored tobacco products	Pipe tobacco  Waterpipe tobacco  Cigars weighing $\geq 5$ grams and costing $\geq \$4$ each	None	None	Chaiton, Schwartz, Kundu, et al., 2021
Canada (National)	Non-Menthol Policy Effective: April 2010 at the manufacturer/ importer level and July 2010 at the retail level  Menthol Policy Effective: October 2017	April/July 2010: Non-menthol flavor additives in cigarettes, blunt wraps, and cigars $\leq 1.4$ grams or having a cigarette filter  December 2015: Non-menthol flavors in cigars weighing $> 1.4$ grams and $\leq 6$ grams with tipping paper or non-spiral wrapper  October 2017: Addition of menthol additives in cigarettes, blunt wraps, cigars $\leq 1.4$ grams or having a cigarette filter, cigars weighing $> 1.4$ grams and $\leq 6$ grams with tipping paper or non-spiral wrapper	Cigars weighing $> 6$ grams  Smokeless tobacco  Waterpipe  Pipe tobacco  Heated tobacco  RYO tobacco	Wine, port, whiskey and rum flavored cigars weighing $> 1.4$ grams and $\leq 6$ grams with spiral wrapper and no tipping paper in December 2015  Menthol until October 2017  Clove until November 2018	None	Chaiton et al., 2019; Chaiton, Schwartz, Kundu, et al., 2021; Chung-Hall et al., 2021

Nova Scotia, Canada	Effective: May 2015	Most menthol and flavored tobacco products including menthol cigarettes	Wine, port, whiskey, and rum flavored cigars that weigh $\geq 5$ grams and costing $\geq \$4$ each  Pipe tobacco  Waterpipe tobacco	Wine, port, whiskey, and rum flavored cigars that weigh $\geq 5$ grams and costing $\geq \$4$ each	None	Stoklosa, 2019
New Brunswick, Canada	Effective: January 2016	Menthol and flavored tobacco products including cigarettes, cigars, smokeless tobacco, pipe tobacco, waterpipe tobacco, RYO tobacco	None	None	None	Chaiton, Schwartz, Kundu, et al., 2021
Newfoundland & Labrador, Canada	Effective: July 2017	Most menthol and flavored tobacco products including menthol cigarettes	Wine, port, whiskey, and rum flavored pipe tobacco  Wine, port, whiskey, and rum cigars that weigh $\geq 5$ grams and costing $\geq \$4$ each	Wine, port, whiskey, and rum flavored pipe tobacco  Wine, port, whiskey, and rum cigars that weigh $\geq 5$ grams and costing $\geq \$4$ each	None	Chaiton, Schwartz, Kundu, et al., 2021; Chung-Hall et al., 2021

Ontario, Canada	Non-menthol Policy Effective: January 2016  Menthol Policy Effective: January 2017	2016: Most non-menthol or clove flavored tobacco products  2017: Addition of menthol and clove tobacco products, including menthol cigarettes	Pipe tobacco other than waterpipe  Cigars $\geq 6$ grams with spiral wrapper and no tipping paper or filter  Wine, port, whiskey, and rum flavored cigars weighing $>1.4$ grams and $\leq 6$ grams with spiral wrapper, no tipping paper or filter	Wine, port, whiskey, and rum flavored cigars weighing $>1.4$ grams and $\leq 6$ grams  Menthol and clove until January 2017	None	Brown et al., 2021; Chaiton et al., 2018; Chaiton, Nicolau, Schwartz, et al., 2020; Chaiton, Schwartz, Shuldiner, et al., 2020; Chaiton, Papadhima, Schwartz, et al., 2020; Chaiton, Schwartz, Cohen, et al., 2020; Chaiton, Schwartz, Cohen, et al., 2021; Chaiton, Schwartz, Kundu, et al., 2021; Chung-Hall et al., 2021; Soule et al., 2019
Prince Edward Island, Canada	Effective: May 2017	Menthol and flavored tobacco products including cigarettes, cigars, smokeless tobacco, pipe tobacco, waterpipe tobacco, RYO tobacco	None	None	None	Chaiton, Schwartz, Kundu, et al., 2021; Chung-Hall et al., 2021
Quebec, Canada	Effective: August 2016	Menthol and flavored tobacco products including cigarettes, cigars, smokeless tobacco, pipe tobacco, waterpipe tobacco, RYO tobacco	None	None	None	Chaiton, Schwartz, Kundu, et al., 2021; Chung-Hall et al., 2021
<b>European Union</b>						

European Union (National)	Effective: May 2016  Enforcement: Transitional period until May 2017 for non-menthol characterizing flavors; May 2020 for menthol cigarettes	Flavored cigarettes and RYO tobacco including menthol	Menthol accessories sold in separate packaging to tobacco or cigarettes	Menthol until May 2020	None	Zatoński et al., 2020; Kock et al., 2021
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<sup>1</sup>Information about each flavored tobacco sales restrictions and bans were obtained from studies included in the RTD and also the following resources:

Physicians for a Smoke-Free Canada. Flavour bans on tobacco products in Canada and selected other jurisdictions. <http://www.smoke-free.ca/SUAP/2020/Menthol%20bans.pdf>. Accessed: 12/15/21.

Public Health Law Center. U.S. sales restrictions on flavored tobacco products. <https://www.publichealthlawcenter.org/sites/default/files/resources/US-sales-restrictions-flavored-tobacco-products.pdf>. Accessed: 12/15/21.

Public Health Law Center. Leading from up north: How Canada Is solving the menthol tobacco problem. <https://www.publichealthlawcenter.org/sites/default/files/resources/tclc-Canadian-Menthol-CaseStudy-2017.pdf>. Accessed: 12/15/21.

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<sup>2</sup>One of the studies included in the review (Hawkins et al. 2021) examined a variety of county-level restrictions limiting the sale of flavored tobacco products in several municipalities in MA. Since the specific municipalities included in the analysis are not mentioned in the article, these jurisdictions are not included in Table 1.

<sup>3</sup>“Vaping products” are not considered “tobacco products” in Canadian laws.

<sup>4</sup>Of the various local flavored tobacco sales restrictions included in this review, San Francisco’s flavored tobacco sales restriction is the only policy that is comprehensive – covering all tobacco products, including e-cigarettes, menthol/mint/wintergreen flavor, and with no retailer exemptions.

## Appendix B Table. Summary of RTD Evaluation Studies on the Impact of Flavored Tobacco Sales Restrictions or Bans

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
<b>Outcome: Tobacco Use of Young People</b>					
Courtemanche et al., 2017	US	Pre/post design with no control or comparison  Repeated cross-sectional	NYTS 1999 – 2013  197,834 middle and high schoolers aged 11–19 years	<ul style="list-style-type: none"> <li>• Percent of youth reporting current cigarette smoking decreased by 34% from 14.0% pre-ban to 9.3% post-ban (<math>p=0.003</math>)</li> <li>• Percent of youth reporting any current tobacco use decreased by 19.6%, from 17.9% to 14.4% (<math>p=0.011</math>)</li> <li>• 17.1% reduction in the probability of youth being a cigarette smoker (<math>OR=0.829</math>, <math>p&lt;0.001</math>) and a 6.1% reduction in the probability of youth reporting any current tobacco use (<math>OR=0.939</math>, <math>p&lt;0.001</math>)</li> <li>• 15.9% increase in the proportion of youth smokers who typically smoked</li> </ul>	<ul style="list-style-type: none"> <li>+Pre/post study design</li> <li>+Large, nationally representative sample</li> <li>+Data adjusted for non-response and differences in selection probabilities</li> <li>+Individual and national level controls were included in the regression analysis</li> <li>-Cross-sectional survey, so unable to draw causal inferences about policy impact</li> <li>-Challenges in estimating causal effect; cannot rule out changes in other tobacco use determinants that may have occurred between end of pre-policy period (2009) and beginning of post-policy period (2011); including an</li> </ul>



Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
				<p>menthol cigarettes (45.3% pre to 52.5% post, <math>p=0.006</math>)</p> <ul style="list-style-type: none"> <li>Increased probability of youth reporting use of cigars (34.4%, <math>p&lt;0.001</math>) and pipe (54.6%, <math>p&lt;0.001</math>)</li> </ul>	<p>increase in the federal excise tax for cigarettes</p> <ul style="list-style-type: none"> <li>Data do not allow for analysis of use of flavored vs. unflavored other tobacco products or pre-ban prevalence of hookah and e-cigarette use, to further examine product substitution</li> <li>Policy does not include a menthol cigarette sales restriction, or restriction on other flavored tobacco products</li> </ul>
Farley & Johns, 2017	New York, NY	<p>Pre/post design with no control or comparison</p> <p>Cross-sectional, with one post-policy time point (2013)</p>	<p>New York City YRBS 2010 and 2013</p> <p>2010: n=1,800 students from 28 schools. Analytical sample n=1708.</p> <p>2013: n=9,439 students from 81 schools. Analytical sample n=8814.</p>	<ul style="list-style-type: none"> <li>In 2013, youth had 37% lower odds of ever trying flavored tobacco products vs. youth in 2010 (adjusted OR=0.63, 95% CI 0.52-0.77, <math>p\leq 0.05</math>)</li> <li>In 2013, youth had 28% lower odds of using any type of tobacco product (adjusted OR= 0.72, 95% CI 0.62-0.85, <math>p\leq 0.05</math>) vs. youth in 2010</li> </ul>	<p>+Pre/post study design</p> <p>+YRBS survey design produces representative sample</p> <p>+Adjusted for covariates in multivariable logistic regressions</p> <ul style="list-style-type: none"> <li>-Cross-sectional survey, so cannot draw causal inferences about policy impact</li> <li>-Study does not assess the impact of time related trends unrelated to the policy</li> <li>-Smaller sample size of 2010 YRBS may reduce the likelihood of observing significant differences</li> <li>-Policy does not include a menthol cigarette sales restriction</li> </ul>
Friedman, 2021	San Francisco, CA	Pre/post design with comparison to eight other school districts	<p>2011-2019 YRBS</p> <p>Analytic sample of 100,695 high school students; 95,843 high school students who</p>	<ul style="list-style-type: none"> <li>High school students had 2.24 times the odds of recent smoking relative to concurrent changes in other districts (adjusted OR; 95% CI 1.42-3.53; <math>p=.001</math>)</li> </ul>	<p>+Study design with comparison school districts</p> <p>+Large analytic sample</p> <p>+Policy includes a menthol sales restriction</p>

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
		nationwide (Author describes a pre/post design, but Liu et al., 2022 found that the 2019 YRBS was conducted in Fall 2018 prior to when the flavor policy was enforced in April 2019 signifying it was a pre-only design)  Cross-sectional, difference-in-differences models	had non-missing data on recent smoking	<ul style="list-style-type: none"> <li>In 2019, youth cigarette smoking prevalence was 6.2% (95% CI 5.2-7.1) in San Francisco and 5.6% (95% CI 5.3-5.9) in other districts.</li> </ul>	<ul style="list-style-type: none"> <li>+Analyses adjusted for demographic and policy covariates</li> <li>-Cross-sectional survey, so unable to draw causal inferences about policy impact</li> <li>-Temporal precedence is unclear, as the policy was formally enforced in April 2019, but the timeframe for “spring semester” 2019 YRBS is not known; Liu et al., 2022 reports that data collection for the 2019 YRBS in San Francisco occurred in Fall 2018 prior to when the flavor policy was enforced in April 2019</li> <li>-Study did not report on changes in overall tobacco use</li> </ul>
Hawkins et al., 2021	MA	Pre/post design with comparison counties  Repeated cross-sectional,	2011-2017 biennial Massachusetts YHS  Analytic sample n=9,988 for cigarette use and n=10,168 for e-cigarette use	<ul style="list-style-type: none"> <li>Decrease in the level of cigarette use among youth users (difference in difference incidence RR= -1.56; 95% CI -2.54 - -0.58, p≤0.05)</li> <li>Reductions in youth e-cigarette use (difference in difference OR= -0.87; 95% CI -1.68 - -0.06, p≤0.05)</li> </ul>	<ul style="list-style-type: none"> <li>+Pre/post study design</li> <li>+Design with comparison counties</li> <li>+Relatively large analytic sample size</li> <li>+Models adjusted for covariates</li> <li>-Cross-sectional survey, so unable to draw causal inferences about policy impact</li> </ul>

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
		difference-in-differences models			-Despite including fixed effects in the models, may not have captured other tobacco control activities that occurred over the study period -Could not assess whether policies were in place within the actual municipality of each student's residence
Kingsley et al., 2019	Lowell, MA	Post- design with a matched control community (Malden, MA)  Cross-sectional, difference-in-differences models, with post-policy baseline and follow-up	Massachusetts Tobacco Control Program surveys of 9 <sup>th</sup> -12 <sup>th</sup> graders  Lowell baseline n=593; follow-up n=524  Malden baseline n=636; follow up n=646	<ul style="list-style-type: none"> <li>• Current youth use of any flavored (excluding menthol and mint) tobacco products decreased 2.4% (95% CI -6.2 - 1.3, p&gt;0.05) in Lowell from baseline to follow-up and increased 3.3% (95% CI -0.3 - 6.9, p&gt;0.05) in Malden, resulting in a significant difference of -5.7% between the two (95% CI -10.7- -0.7, p=0.03)</li> <li>• Current youth use of any non-flavored (including menthol and mint) tobacco products decreased 1.9% (95% CI -5.5 - 1.7, p&gt;0.05) in Lowell from baseline to follow-up and increased significantly in the control community by 4.3% (95% CI 0.9 - 7.8, p&lt;0.05), resulting in a significant difference of -6.2% (95% CI -11.0 - -1.4, p=0.01) between the communities</li> </ul>	+Design with a control community matched on demographics, retailer characteristics, and POS policies (but without a sales restriction) +Models controlled for demographic covariates and baseline differences between communities on the outcomes of interest  -Cross-sectional survey, so unable to draw causal inferences about policy impact -Lack of temporal precedence, as baseline surveys in Lowell took place 1-3 months <i>after</i> policy implementation -Policy does not include a menthol restriction
Kingsley et al., 2021	Attleboro, MA and Salem, MA	Pre/post design, with a control city of Gloucester,	Baseline surveys (Dec 2015) in randomly selected classrooms in the	<ul style="list-style-type: none"> <li>• Current use of flavored (excluding menthol) and non-flavored (including menthol) tobacco</li> </ul>	+Pre/post study design with a control city +All three cities were matched on geographic and population size,

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
		MA (no flavored tobacco restriction)  Cross-sectional, with one post-policy time point	sole public high school in each city  Follow-up surveys (Jan/Feb 2018) to a census of students in each school  Attleboro baseline n=1413; follow-up n=1565 Salem baseline n=480; follow-up n=620 Gloucester baseline n=539; follow-up n=629	increased from baseline to follow-up in all three municipalities  • Increases were significantly smaller in the combined municipalities with flavored tobacco restrictions than in the control municipality (flavored [excluding menthol] tobacco use difference in difference estimates: -9.4%, 95% CI: -14.2% - -4.6% p=0.000; nonflavored [including menthol] tobacco use difference in difference estimates: -6.3%, 95% CI: -10.8% - -1.8% p=0.006)	demographics, retailer characteristics, and all had a cigar pricing and packaging restriction in place +Models controlled for demographic covariates and baseline differences between communities on the outcomes of interest  -Cross-sectional survey, so unable to draw causal inferences about policy impact -Analyses did not control for multiple comparisons, so some significant outcomes may have emerged by chance alone -Policy does not include a menthol restriction
Pearlman et al., 2019	Providence, RI	Pre/post design with no control or comparison  Cross-sectional, with two post-policy time points	Annie E. Casey Evidence2Success Providence YES of 10 <sup>th</sup> and 12 <sup>th</sup> grade students  Pre-policy: 2012 Post-policy: 2016, 2018  n=2,150 (2012); n=2,062 (2016); n=2,223 (2018)	• Current cigarette smoking prevalence was 3.2% (95% CI 2.4-4.0) in 2012 (pre-policy), 7.6% (95% CI 6.3-9.0) in 2016 (3 years post-policy), and 3.0% (95% CI 2.1-3.8) in 2018 (5 years post-policy) • Current use of any tobacco product declined from 22.2% (95% CI 20.0-23.3) in 2016 to 12.1% (95% CI 10.5-13.7) in 2018 • Cigars and cigarillos use decreased from 7.1% (95% CI 5.7-8.5) to 1.9% (95% CI 1.2-2.6)	+Pre/post study design with two follow-up points  -Cross-sectional survey, so unable to draw causal inferences about policy impact -Policy does not include a menthol restriction -No pre-policy data collected for non-cigarette tobacco products; questions about other (non-cigarette) tobacco products were asked only in post-policy years (i.e., 2016 and 2018)

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
				<ul style="list-style-type: none"> <li>E-cigarettes use decreased from 13.3% (95% CI 11.4 to 15.1) to 6.6% (95% CI 5.3–7.8)</li> <li>Hookah use decreased from 13.5% (95% CI 11.6-15.3) to 7.7% (95% CI 6.4-9.2)</li> </ul>	<ul style="list-style-type: none"> <li>-Flavor-related data were not captured for any year</li> <li>-Post-policy data were for 3 and 5 years after the policy was implemented, introducing the possibility that contextual factors beyond the policy itself could have impacted behavior change</li> <li>-The flavor policy was implemented concurrently with restrictions on price promotions that could have confounded the findings</li> </ul>
Rosshiem et al., 2020	US	Pre/post quasi-experimental design with no control or comparison  Repeated cross-sectional  Elements of interrupted time series analysis and difference in difference designs	2002-2017 National Survey on Drug Use and Health (NSDUH)  n=893,226 (full sample, 2002-2017); data collected quarterly from approximately 12,000 respondents	<p>Youth:</p> <ul style="list-style-type: none"> <li>17% increase in the odds of reporting any current cigarette smoking immediately after the flavor ban (OR=1.17, 95% CI 1.07-1.29, p&lt;0.001); 2.2% reduction in the odds of youth reporting any cigarette smoking each quarter thereafter (OR=0.98, 95% CI 0.97-0.98, p&lt;0.001) over the pre-ban trend.</li> <li>Immediate 33% increase in the odds of youth reporting current menthol cigarette smoking (OR=1.33, 95% CI 1.15-1.54, p&lt;0.001); followed by an additional 3.6% reduction in the odds each quarter (OR=0.96, 95% CI 0.96-0.97, p&lt;0.001) over the pre-ban trend.</li> </ul> <p>Young Adults:</p>	<ul style="list-style-type: none"> <li>+ Pre/post study design with multiple time points</li> <li>+ Large and nationally representative dataset</li> <li>+ Regression models included the consumer price index for cigarettes as a covariate</li> <li>-Cross-sectional survey, so unable to draw causal inferences about policy impact</li> <li>-Policy does not include a menthol restriction</li> <li>-It is possible that changes occurred in the tobacco environment during the study timeline that may have affected cigarette use</li> <li>-Study does not assess tobacco products other than menthol and non-menthol cigarettes.</li> </ul>

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
				<ul style="list-style-type: none"> <li>• Immediate 9% increase in the odds of reporting any current cigarette smoking (OR=1.09, 95% CI 1.03-1.16, p=0.0047), followed by an additional 1.2% reduction in the odds of cigarette smoking each quarter thereafter (OR=0.99, 95% CI 0.99-0.99, p&lt;0.001) over the pre-policy trend</li> <li>• Immediate increase of 29% in the odds of young adults reporting any current menthol cigarette smoking (OR=1.29, 95% CI 1.19-1.41, p&lt;0.001), followed by a 2.6% reduction in the odds of menthol cigarettes smoking each quarter (OR=0.97, 95% CI 0.97-0.98, p&lt;0.001) over the pre-policy trend</li> <li>• The predicted probability of menthol use was reduced by 60% and 55% for youth and young adults, respectively</li> </ul>	
Yang et al., 2020	San Francisco, CA	Post-only with no control or comparison  Cross-sectional	Amazon MTurk (Nov 2019) convenience sample of young adult (age 18-34) ever users of tobacco products  n=247	<ul style="list-style-type: none"> <li>• Among the 18-24 age group, use of any tobacco products decreased by 17.7 percentage points (95% CI -27.5 - -8.0; p&lt;0.01) from 100% to 82.3%</li> <li>• Flavored cigar use decreased by 12.9 percentage points (95% CI, 23.7 - -2.1; p&lt;0.05) from 19.4% to 6.5%</li> </ul>	<p>+Policy includes a menthol cigarette restriction +Regression models adjusted for basic demographics and tobacco use before the ban</p> <p>-Convenience sample -Small sample size -Retrospective self-report (survey was conducted in November 2019 and</p>

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
					respondents recalled behaviors from December 2018) -Study does not assess the impact of time related trends unrelated to the policy
<b>Outcome: Tobacco Use of Adults</b>					
Chaiton et al., 2018	Ontario, Canada	Pre/post design with no control or comparison  Repeated longitudinal	Telephone and online survey of baseline current smokers 16 years or older  Baseline: September 12- December 31, 2016  Follow up: February 2017  Baseline n=325 Follow-up n=206	<ul style="list-style-type: none"> <li>• One month after implementation, 29.1% (95% CI 23.3-35.8) of baseline current menthol smokers quit cigarette smoking or had made a serious quit attempt; of those who had attempted to quit cigarette smoking, 12.1% (95% CI 8.3-17.4) reported not smoking.</li> <li>• Of participants who reported their anticipated planned reaction to the policy, approximately 28% (95% CI 22.0-35.2) reported having actually switched to or only using non-menthol cigarettes</li> <li>• Among participants who reported at baseline their anticipated planned reaction to the policy 29.1% (95% CI 23.3-35.8) reported switching to alternative flavored products</li> </ul>	<ul style="list-style-type: none"> <li>+Longitudinal cohort</li> <li>+Temporal precedence of policy and post-survey</li> <li>+Probability sample supplemented with a convenience sample</li> <li>+Policy includes a menthol cigarette restriction</li> <li>-Small sample</li> <li>-Not clear how study authors defined menthol smokers</li> <li>-Different demographics for menthol smokers in Canada and US</li> </ul>
Chaiton, Nicolau, Schwartz, et al., 2020	Ontario, Canada	Pre/post design with no control or comparison  Repeated longitudinal	Telephone and online survey of baseline current smokers 16 years or older  Baseline (September-December 2016)	<ul style="list-style-type: none"> <li>• Baseline daily menthol smokers were more likely to report having quit (adjusted RR 1.62; 95% CI 1.08-2.42, p&lt;0.05) or having made a quit attempt (adjusted RR 1.25; 95% CI 1.03-1.50, p&lt;0.05) than baseline non-menthol smokers</li> </ul>	<ul style="list-style-type: none"> <li>+Longitudinal cohort</li> <li>+Probability sample supplemented with a convenience sample</li> <li>+Temporal precedence of policy and post-survey</li> <li>+Policy includes a menthol cigarette restriction</li> </ul>

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
			random digit dialing n=1026; baseline convenience n=772  Follow-up (January-August 2018) n=913		+Regression models were adjusted for demographics, baseline smoking characteristics, sampling method, and the number of days between baseline and follow-up survey  -Study does not assess the impact of time related trends unrelated to the policy -Different demographics for menthol smokers in Canada and US
Chaiton, Papadhima, Schwartz, et al., 2020	Ontario, Canada	Pre/post design with no control or comparison  Repeated longitudinal	Telephone and online survey of baseline current smokers 16 years or older  Baseline (September-December 2016) n=1738  Follow-up (January-August 30, 2018) n=913	<ul style="list-style-type: none"> <li>Baseline daily menthol smokers (n=187) were more likely to use flavored cigar products after the policy (adjusted RR=1.53, 95% CI 1.01-2.31, p=0.042) relative to baseline non-menthol cigarette smokers (n=306)</li> <li>Baseline occasional menthol smokers (n=420) were more likely than baseline non-menthol smokers to use other tobacco products (adjusted RR=1.25, 95% CI 1.02-1.53, p=0.028), flavored alternative tobacco products (adjusted RR=1.56, 95% CI 1.09-2.24, p=0.016); and flavored cigars (adjusted RR =1.57, 95% CI 1.06-2.30, p=0.023) after the policy</li> </ul>	+Longitudinal cohort +Temporal precedence of policy and post-survey +Policy includes a menthol cigarette restriction +Regression models were adjusted for demographics, baseline smoking characteristics, sampling method, and the number of days between baseline and follow-up survey  -Convenience sample -Study does not assess the impact of time related trends unrelated to the policy -Different demographics for menthol smokers in Canada and US
Chaiton, Schwartz,	Ontario, Canada	Pre/post design with no	Telephone and online survey of baseline	<ul style="list-style-type: none"> <li>Baseline daily menthol smokers had significantly higher likelihood of reporting having quit smoking</li> </ul>	+Longitudinal cohort +Probability sample supplemented with a convenience sample



Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
Cohen, et al., 2021		control or comparison  Repeated longitudinal	current smokers 16 years or older  Baseline (September-December 2016) n=1821 (RDD n=1064; Baseline Convenience n=757);  Follow-up (January-August 2018 and 2019) n=810	compared to baseline non-menthol smokers (adjusted RR 2.08; 95% CI 1.20–3.61; p<0.01)  • There was a significant increase in probability of reporting more quit attempts for baseline daily (adjusted RR 1.45; 95% CI 1.15-1.82, p<0.01) and occasional menthol smokers (adjusted RR 1.27; 95% CI 1.03-1.56, p<0.05) compared to baseline non-menthol smokers	+Temporal precedence of policy and post-survey +A strong measure of quitting was used in this study (i.e., defined as being smoke-free for six months at the two-year follow-up) +Policy includes a menthol cigarette restriction +Regression models were adjusted for demographics, baseline smoking characteristics, sampling method, and the number of days between baseline and follow-up survey  -Sample size of population subgroups was small and may not have been powered to detect changes -Study does not assess the impact of time related trends unrelated to the policy -Different demographics for menthol smokers in Canada and US
Chung-Hall et al., 2021	Quebec, Ontario, Prince Edward Island, Newfoundland and Labrador; and a	Prospective pre/post design with no control or comparison  Repeated longitudinal	Canadian arm of the ITC Four Country Smoking and Vaping Survey, nationally representative data; 2016 (Wave 1) and 2018 (Wave 2) n=1,236	• Of 138 baseline menthol cigarette smokers, 21.5% had quit smoking post-policy. • Baseline menthol cigarette smokers were more likely to have attempted to quit (tried to quit in past 18 months; adjusted OR=1.61; 95% CI 1.03-2.51; p<0.05) and to have remained quit (quit >6 months	+Nationally representative data +Longitudinal design +Policy includes a menthol cigarette restriction +Regression models controlled for covariates  -Inconsistent alignment of timing of data collection with provincial policies; post-

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
	nationwide ban covering British Columbia, Saskatchewan and Manitoba, Canada			<p>before nationwide menthol ban and remained quit; adjusted OR=2.30; 95% CI 1.06-5.01; p&lt;0.05) post-policy than baseline non-menthol cigarette smokers</p> <ul style="list-style-type: none"> <li>• Among pre-policy daily smokers, daily menthol smokers were significantly more likely than daily non-menthol smokers to have long-term quit (12.7% versus 5.2%; adjusted OR=2.81, p&lt;0.05)</li> <li>• Of 138 baseline menthol smokers who reported usual cigarette brand or last purchased brand as menthol, 59.1% (n=82) switched to non-menthol cigarettes post-policy</li> </ul>	<p>policy data collection may have captured quit attempts that occurred prior to the menthol policies</p> <p>-Different demographics for menthol smokers in Canada and US</p>
Guydish et al., 2020	San Francisco, CA	Pre/post design with no control or comparison  Repeated cross-sectional	<p>Electronic survey of clients in residential substance use disorder treatment facilities administered on iPad; June 2018, May 2019, November 2019</p> <p>June 2018 (6-months prior to policy enforcement n=160), May 2019 (roughly 5-months post-policy enforcement n=102),</p>	<ul style="list-style-type: none"> <li>• Current cigarette smokers were less likely to think of quitting smoking in the next 30 days (OR=0.44, 95% CI 0.29-0.67, p&lt;0.001) at 5-months post-policy compared with pre-policy, and less likely to have past-year quit attempts (OR=0.80, 95% CI 0.71-0.91, p&lt;0.001) at 11-months post-policy compared to pre-policy</li> <li>• Current smokers were less likely to report menthol as their usual cigarette (OR=0.80, 95% CI 0.72-0.90, p=0.0002) at 5-months post-policy compared with pre-policy, and less likely to only smoke menthol cigarettes in the past</li> </ul>	<p>+Policy includes a menthol cigarette restriction</p> <p>+All models adjusted for demographic characteristics</p> <p>-Cross-sectional design</p> <p>-Convenience sample</p> <p>-Small study sample of adult current smokers in a residential treatment facility for substance abuse</p>

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
			November 2019 (11-months after enforcement n=120)	<p>month (OR=0.19, 95% 0.18-0.19, <math>p&lt;0.0001</math>) at 11-months post-policy compared to pre-policy</p> <ul style="list-style-type: none"> <li>Among pre-policy current menthol smokers who responded to a question about how the policy had impacted their cigarette smoking, 30.6% (n=11) indicated they had switched to non-menthol cigarettes post-policy</li> </ul>	
Yang et al., 2020	San Francisco, CA	<p>Post-only design with no control or comparison</p> <p>Cross-sectional</p>	<p>MTurk, November 2019</p> <p>n= 247</p>	<ul style="list-style-type: none"> <li>Among the 20 respondents who reported exclusive use of menthol cigarettes before the policy, 5% (n=1) reported having quit all tobacco use after the policy while 70% (n=14) reported having maintained exclusive use of menthol cigarettes</li> <li>Among a sample of 61 respondents who reported using menthol cigarettes in addition to other tobacco products before the policy, 3.3% (n=2) quit use of all tobacco products after the policy, while 73.8% (n=45) reported having maintained use of tobacco products (including menthol cigarettes)</li> </ul>	<p>+Policy includes a menthol cigarette restriction</p> <p>+Regression models adjusted for basic demographics and tobacco use before the ban</p> <p>-Convenience sample</p> <p>-Small sample size</p> <p>-Retrospective self-report (survey was conducted in November 2019 and respondents recalled behaviors from December 2018)</p> <p>-Study does not assess the impact of time related trends unrelated to the policy</p>
Zatoński et al., 2020	European Union	Pre/post design with no control or comparison	EUREST-PLUS ITC Europe Surveys; 2016 (Wave 1), 2018 (Wave 2)	<ul style="list-style-type: none"> <li>Small but significant declines in the weighted prevalence of menthol (by 0.94%, <math>p=0.041</math>) and other flavored cigarette use (by 1.32%, <math>p&lt;0.001</math>) following the 2016 ban, driven</li> </ul>	<p>+Large sample size</p> <p>+Longitudinal cohort</p> <p>+Models controlled for sex, age, and smoking status at wave of recruitment</p>

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
		Repeated longitudinal	Overall survey sample n=19,691; respondents participating in both waves n=5,612	<p>largely by the menthol and flavored cigarette smokers switching to unflavored tobacco (rather than quitting)</p> <ul style="list-style-type: none"> <li>• About 52% of menthol cigarette smokers continued to smoke menthol cigarettes and 22.8% switched to unflavored tobacco</li> <li>• Among other flavored cigarette smokers, 11% continued to smoke other flavors and about 62% switched to unflavored tobacco</li> </ul>	<p>-Large loss to follow-up</p> <p>-Study does not assess quit attempts or detect short term changes in smoking prevalence</p> <p>-Study does not assess the impact of time related trends unrelated to the policy</p> <p>-Study does not assess the impact of menthol cigarette ban</p>
<b>Outcome: Sales of Tobacco Products</b>					
Brown et al., 2021	Ontario, Canada	Pre/post design with control group  Repeated data	Nielsen scanner data; January—June 2016 (Pre) and January—June 2017 (Post)	<ul style="list-style-type: none"> <li>• Compared to the 6 months prior to implementation, menthol cigarette sales decreased by 93.2% (596 to 40 packs per capita<sup>5</sup>) in the 6 months following policy implementation and as compared to a decrease of 2.3% (696 to 679 packs per capita) in the control</li> <li>• Compared to the 6 months prior to implementation, sales of non-menthol cigarettes increased 0.4% (11,470 to 11,519 packs per capita) post policy</li> <li>• Per capita sales of cigarettes with menthol-suggestive descriptors (e.g., green) increased by 2.7% (from 4,705 to 4,829) in Ontario compared</li> </ul>	<p>+Repeated data</p> <p>+Pre/post design with a control group</p> <p>+Study controls for seasonal trends in sales of tobacco products</p> <p>+Policy includes a menthol cigarette restriction</p> <p>-Analysis did not include data on cigar sales</p> <p>-Statistical testing of changes in tobacco sales from pre-policy to post-policy was not possible since the Nielsen data were aggregated projected sales volume for each UPC in the pre- and post-policy periods with no measure of estimation variance</p>

<sup>5</sup> Per capita defined as per 1000 people.

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
				to a 2.6% decrease (4,154 to 4,044) in the control	-Data did not include all retail outlets (e.g., tobacco specialty shops, vape stores, small grocery stores, First Nations retailers, or online retailers)
Chaiton et al., 2019	Canada	Pre/post design with control group  Repeated data	Seasonally corrected, quarterly cigar wholesale data reported by manufacturers to Health Canada; 2004-2016	<ul style="list-style-type: none"> <li>Sales of flavored cigars significantly decreased by 59.2 million units (95% CI -86.0 - -32.4, p&lt;0.001) in the quarter immediately following policy enactment</li> <li>A decrease in overall sales of cigars of 49.6 million units (95% CI -73.5 - 25.8, p&lt;0.001) after the federal Canadian flavored tobacco ban was also observed in this same time</li> </ul>	<ul style="list-style-type: none"> <li>+Repeated data</li> <li>+Pre/post design with a control group</li> <li>+Nationally representative</li> <li>+Study used sensitivity analysis to assess the impact of time related trends unrelated to the policy</li> <li>-Policy does not include a menthol cigarette sales restriction</li> </ul>
Chaiton, Schwartz, Shuldiner, et al., 2020	Ontario, Canada	Pre/post design with control group  Repeated data	Seasonally adjusted, monthly wholesale data reported by manufacturers to Health Canada; October 2012-September 2017	<ul style="list-style-type: none"> <li>In the month following implementation, there was an immediate decline of 55-million-unit sales of menthol cigarettes in Ontario relative to the control (95% CI -78.5 - -31.5, p&lt;0.001), and a corresponding decline of 127.8 million of overall cigarette unit sales (95% CI -208.2 - -47.4, p&lt;0.01)</li> <li>There was a significant decline in the overall cigarette unit sales in Ontario immediately following implementation; this was followed by a significant increase in the sale of non-menthol cigarettes (23.8 million units per month, 95% CI 10.2-37.4, p&lt;0.001) relative to the control during the post-policy period</li> </ul>	<ul style="list-style-type: none"> <li>+Repeated data</li> <li>+Nationally representative</li> <li>+Policy includes a menthol cigarette restriction</li> <li>+Study controls for seasonal trends in sales of tobacco products</li> <li>-Different demographics for menthol cigarette smokers in the US and Canada</li> </ul>

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
Chaiton, Schwartz, Kundu, et al., 2021	Canada	Pre/post design with no control or comparison  Repeated data	Monthly wholesale data reported by manufacturers to Health Canada; October 1, 2010-December 31, 2018	<ul style="list-style-type: none"> <li>• After the sales restrictions, sales of menthol cigarettes decreased to 0 in all provinces, and overall cigarette sales decreased 4.6% (95% CI: -8.2% – -1.0%, p=0.02)</li> <li>• Wholesale cigarette sales decreased in all 10 provinces studied after the menthol cigarette sales restrictions and was statistically significant (p≤0.05) in three provinces</li> </ul>	<ul style="list-style-type: none"> <li>+Repeated data</li> <li>+Nationally representative</li> <li>+Policy includes a menthol cigarette restriction</li> <li>+Study controls for seasonal trends in sales of tobacco products</li> <li>-Different demographics for menthol cigarette smokers in the US and Canada</li> </ul>
Delnevo & Hrywna, 2015	US	Pre/post review of industry documents and news articles  Post, no control, repeated Nielsen sales data  Pre/post, no control, repeated tobacco import data	<p>Industry documents from Kretek International from Committee on Energy and Commerce and news articles</p> <p>Nielsen's Convenience Track retail scanner databased from 2009-2012</p> <p>USDA Foreign Agricultural Service's Global Agriculture Trade System tobacco import data for Indonesia, 2006-2012</p>	<ul style="list-style-type: none"> <li>• Kretek International began planning in 2007 for the transition of their clove cigarette to a clove cigar product</li> <li>• Following implementation, unit sales of Djarum brand clove cigars increased from 444,192 units in 2009 to 6,750,665 units in 2012</li> <li>• Tobacco imports to the US from Indonesia shifted completely from clove cigarettes to cigars between 2006-2012. Cigar imports increased dramatically after 2009, increasing to over 626 million sticks by 2012. Meanwhile, imports of clove cigarettes decreased from a high of 532 million sticks in 2008 to zero in 2010.</li> </ul>	<ul style="list-style-type: none"> <li>+Mixed methods approach including repeated data and nationally representative data</li> <li>-Policy does not include a menthol cigarette sales restriction</li> <li>-Nielsen data do not include all retail outlets</li> <li>-Authors did not have access to all industry documents released to Committee on Energy and Commerce</li> <li>-Import data for cigars does not specify clove</li> <li>-Study does not control for seasonal trends in sales of tobacco products</li> </ul>

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
Farley & Johns, 2017	New York, NY	Pre/post design with no control or comparison  Repeated data	Symphony Information Resources Inc, 2008-2012  n= 922 unique stores with annual sales of over US \$2 million	<ul style="list-style-type: none"> <li>Following policy enforcement, there were significant declines in the mean dollar sales of: flavored (excluding menthol or mint) non-cigarette tobacco products overall (i.e., cigars, smokeless, and pipe/RYO) (86.8% [from \$31,918.00 to \$4,227.07]; <math>p &lt; 0.001</math>); flavored cigars (86.2% [\$27,403.52 to \$3,774.76]; <math>p &lt; 0.001</math>); and flavored pipe/RYO tobacco (91.1% [\$3,764.03 to \$334.70]; <math>p &lt; 0.001</math>)</li> <li>After policy enforcement statistically significant increases in dollar sales of non-flavored (but including menthol/mint) cigars (5.17%, <math>p = 0.003</math>) and non-flavored (again including menthol/mint) pipe/RYO (4.3%, <math>p = 0.030</math>)</li> <li>Increase in the sale of non-flavored non-cigarette tobacco products overall, but this increase was not statistically significant (18.83%, <math>p = 0.066</math>)</li> </ul>	<ul style="list-style-type: none"> <li>+Repeated data</li> <li>+Pre/post design</li> <li>+Models controlled for implementation of the 2009 federal flavored cigarette ban, the number of stores each year, and secular trends in sales</li> <li>-Non-random sample</li> <li>-Exclusion of small, independent stores – the predominant tobacco retailers in New York City</li> <li>-Challenges in correctly classifying flavored vs. non-flavored tobacco products using available product name descriptors</li> <li>-Study does not assess the impact of time related trends unrelated to the policy</li> <li>-Study does not include a menthol cigarette sales restriction</li> </ul>
Gammon et al., 2021	San Francisco, CA	Pre/post design with two control groups  Repeated data	Weekly Nielsen retail scanner data; July 2015-December 2019	<ul style="list-style-type: none"> <li>Average weekly unit sales of flavored tobacco products overall decreased 96% from pre-policy to enforcement period (<math>p &lt; 0.05</math>)</li> <li>Sales of menthol cigarettes (-96%), flavored cigars (-96%), flavored smokeless tobacco (-97%), and flavored ENDS (-100%) all</li> </ul>	<ul style="list-style-type: none"> <li>+Repeated data</li> <li>+Pre/post study design with two control groups</li> <li>+Policy includes a menthol cigarette restriction</li> <li>+Weekly sales</li> </ul>

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
				<p>significantly decreased to low levels from pre-policy to enforcement period (<math>p &lt; 0.05</math>)</p> <ul style="list-style-type: none"> <li>• In the control cities, average weekly sales of flavored tobacco products either decreased modestly or did not significantly change from pre-policy to enforcement period, with the exception of flavored ENDS (which increased in both control cities), and flavored smokeless tobacco (which increased modestly in San Diego)</li> <li>• The proportion of explicit flavored (other than menthol/mint) product sales and menthol/mint flavored product sales significantly decreased in San Francisco (from 6.9% to 0.3% and from 26.5% to 1.1%, respectively; <math>p &lt; 0.05</math>), whereas they significantly increased in San Jose and San Diego</li> <li>• The proportion of concept-named flavored product sales decreased for San Francisco (from 1.1% to 0.4%, <math>p &lt; 0.05</math>) and San Jose (1.2% to 0.7%, <math>p &lt; 0.05</math>) from the pre-policy to enforcement periods and did not change for San Diego.</li> <li>• Average weekly total tobacco sales in San Francisco decreased 25% from pre-policy to enforcement (<math>p &lt; 0.05</math>)</li> </ul>	<p>+Models controlled for seasonality (except the ENDS model) and California’s cigarette excise tax increase</p> <p>-Data did not include all retail outlets (e.g., tobacco specialty shops, vape stores, small grocery stores, First Nations retailers, or online retailers)</p>



Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
Rogers et al., 2017	New York, NY	Pre/post design with control group  Repeated data	Nielsen retail scanner, 4-week data, January 2010 – January 2014	<ul style="list-style-type: none"> <li>Unit sales of all flavored tobacco products combined (-27.1%), and sales of flavored cigars (-22.3%), flavored smokeless tobacco (-97.6%), and flavored RYO tobacco (-42.5%) declined at implementation</li> <li>Implementation was associated with an immediate significant 11.6% decrease in total cigar sales in New York City (<math>p &lt; 0.05</math>); a non-significant 6.4% decrease was observed in the control area; and a non-significant 2.1% increase in sales was observed nationally</li> <li>Average sales of all cigars in New York City decreased by 7.4% (<math>p &lt; 0.01</math>) from pre to post while average sales of all cigars increased 9.8% (<math>p &lt; 0.01</math>) in the control area and 12% nationally (<math>p \geq 0.05</math>) from pre to post</li> </ul>	<p>+Repeated data +Pre/post study design with control group</p> <p>-Data did not include all retail outlets (e.g., vape stores, online sales, or retailers making less than \$2 million in yearly sales) -Study does not include a menthol cigarette sales restriction -Study does not control for seasonal trends in sales of tobacco products</p>
Rogers et al., 2020	Providence, Rhode Island	Pre/post design with comparison group  Repeated data	Weekly Nielsen retail scanner data, January 2012-December 2016	<ul style="list-style-type: none"> <li>The average weekly unit sales of flavored cigars decreased by 51% (<math>p &lt; 0.01</math>) in Providence, while it increased by 10% (<math>p &lt; 0.01</math>) in the rest of the state</li> <li>The decline in flavored cigar sales in Providence is attributed to a 93% (<math>p &lt; 0.01</math>) reduction in sales of cigars labeled with explicit-flavor names</li> <li>Overall cigar sales in Providence decreased by 31% (<math>p &lt; 0.01</math>)</li> </ul>	<p>+Repeated data +Pre/post study design with comparison group +Weekly data</p> <p>-Data did not include all retail outlets (e.g., tobacco specialty shops, groceries with small sales volume, vape shops, and online sources) -Flavor categorization approach used may have resulted in misclassification of flavor</p>

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
					<ul style="list-style-type: none"> <li>-Study does not assess the impact of time related trends unrelated to the policy</li> <li>-Study does not include a menthol cigarette sales restriction</li> <li>-Study does not control for seasonal trends in sales of tobacco products</li> </ul>
<b>Outcome: Illicit Sales</b>					
Chung-Hall et al., 2021	Quebec, Ontario, Prince Edward Island, Newfoundland and Labrador; and a nationwide ban covering British Columbia, Saskatchewan and Manitoba, Canada	Prospective pre/post design with no control or comparison  Repeated longitudinal	Canadian arm of the ITC Four Country Smoking and Vaping Survey, nationally representative data; 2016 (Wave 1) and 2018 (Wave 2)  n=1,236	<ul style="list-style-type: none"> <li>• For menthol cigarette smokers who continued to use menthol cigarettes post-policy and who reported a menthol cigarette brand as their last purchase (n=13), 31% (95% CI 12.3-58.9) reported buying menthol cigarettes from convenience stores</li> </ul>	<ul style="list-style-type: none"> <li>+Nationally representative data</li> <li>+Longitudinal design</li> <li>+Policy includes a menthol cigarette restriction</li> <li>+Regression models controlled for covariates</li> <li>-Inconsistent alignment of timing of data collection with provincial policies; post-policy data collection may have captured quit attempts that occurred prior to the menthol policies</li> <li>-Different demographics for menthol smokers in Canada and US</li> </ul>
Guydish et al., 2020	San Francisco, CA	Pre/post design with no control or comparison	Electronic survey of clients in residential substance use disorder treatment facilities administered on	<ul style="list-style-type: none"> <li>• Among the 36 menthol smokers surveyed 11 months post-policy enforcement, 50% (n=18) reported purchasing menthol cigarettes in San Francisco in the previous month</li> </ul>	<ul style="list-style-type: none"> <li>+Policy includes a menthol cigarette restriction</li> <li>+All models adjusted for demographic characteristics</li> <li>-Cross-sectional design</li> </ul>

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
		Repeated cross-sectional	iPad; June 2018, May 2019, November 2019  June 2018 (6-months prior to policy enforcement n=160), May 2019 (roughly 5-months post-policy enforcement n=102), November 2019 (11-months after enforcement n=120)		-Convenience sample -Small study sample of adult current smokers in a residential treatment facility for substance abuse
Kock et al., 2021	England	Post-only design with no control or comparison  Repeated monthly cross-sectional	Smoking Toolkit Study, representative survey, July 2020-June 2021  Unweighted n= 2,681 Weighted n= 2,908	<ul style="list-style-type: none"> <li>The most popular sources of menthol cigarette purchases during July-December 2020 and January-June 2021 were newsagent/off license/corner shops, supermarkets, and petrol garage shops</li> <li>Sources of purchase were similar between July-December 2020 and January-June 2021 with the exception of declines in buying abroad (14.2% vs. 10.4%, p=0.01) and buying from friends (12.3% vs. 4.2%, p=0.005)</li> <li>Past-6-month purchases of menthol cigarettes from any illicit or cross-border source declined from 30.1% in the last 6 months of 2020 to 17.5% in the first 6 months of 2021 (p=0.006)</li> </ul>	<ul style="list-style-type: none"> <li>+Representative survey</li> <li>+Repeated monthly data collection</li> <li>+Policy includes a menthol cigarette restriction</li> <li>-No pre-policy data</li> <li>-No measure on flavored cigarette use that excludes menthol flavored accessories (e.g., flavored capsules, filter tips, cards) that are exempt from the policy</li> <li>-Study does not assess the impact of time related trends unrelated to the policy</li> </ul>

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
Soule et al., 2019	Ontario, Canada	Post only design, no control, one-time point, qualitative concept mapping	Existing cohort of 1,003 past year menthol smokers from Ontario  n=57	<ul style="list-style-type: none"> <li>Of the statements about alternative menthol cigarette purchasing behaviors, the statement "I believe [the policy] has increased the presence of 'black-market' menthols" had the highest rating in the cluster (M = 4.94); the statement "I have purchased illegal/black market menthol cigarettes"" was rated lower (M = 2.79)</li> </ul>	<ul style="list-style-type: none"> <li>+Policy includes a menthol cigarette restriction</li> <li>-Small sample of menthol smokers from Ontario</li> <li>-Different demographics for menthol smokers in Canada and US</li> </ul>
Stoklosa, 2019	Nova Scotia, Canada	Pre/post design with no control or comparison  Repeated data	Seized illicit cigarette data from the Audit and Enforcement unit of the Provincial Tax Commission, Service of Nova Scotia, 2007-2018	<ul style="list-style-type: none"> <li>The amount of seized illicit cigarettes declined significantly from greater than 60,000 cartons in 2007-2008 to less than 10,000 cartons in 2017-2018.</li> <li>The bulk of the decline in illicit cigarettes seized occurred before the menthol policy, in the recent years after the menthol ban, seizure volume remained stable; there was no statistically significant difference in the number of illicit cigarettes seized before and after the menthol policy (t=-0.71, p=0.55).</li> </ul>	<ul style="list-style-type: none"> <li>+Repeated data</li> <li>+Pre/post design</li> <li>+Policy includes a menthol cigarette restriction</li> <li>-Different demographics for menthol smokers in Canada and US</li> </ul>
Yang et al., 2020	San Francisco	Post-only design with no control or comparison  Cross-sectional	Amazon MTurk, November 2019  n= 247	<ul style="list-style-type: none"> <li>A small percentage of young adults reported purchasing flavored tobacco products illegally in San Francisco (5.3%) post-policy</li> </ul>	<ul style="list-style-type: none"> <li>+Policy includes a menthol cigarette restriction</li> <li>+Regression models adjusted for basic demographics and tobacco use before the ban</li> <li>-Convenience sample</li> </ul>

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
					<ul style="list-style-type: none"> <li>-Small sample size</li> <li>-Retrospective self-report (survey was conducted in November 2019 and respondents recalled behaviors from December 2018)</li> <li>-Study does not assess the impact of time related trends unrelated to the policy</li> </ul>
<b>Outcome: Cross-Border Sales</b>					
Chaiton et al., 2018	Ontario, Canada	Pre/post design with no control or comparison  Repeated longitudinal	Telephone and online survey of baseline current smokers 16 years or older  Baseline: September 12- December 31, 2016  Follow up: February 2017  Baseline n=325 Follow-up n=206	<ul style="list-style-type: none"> <li>• One month after the policy, 14.1% (n=29, 95% CI 10.0-19.6) of smokers reported using menthol cigarettes purchased from a First Nations reserve, other province, other country, or online; a total of 35.1% (n=72, 95% CI 28.9-42.0) of participants reported using menthol cigarettes from any source in the past month</li> </ul>	<ul style="list-style-type: none"> <li>+Longitudinal cohort</li> <li>+Temporal precedence of policy and post-survey</li> <li>+Probability sample supplemented with a convenience sample</li> <li>+Policy includes a menthol cigarette restriction</li> <li>-Small sample</li> <li>-Not clear how study authors defined menthol smokers</li> <li>-Different demographics for menthol smokers in Canada and US</li> </ul>
Chaiton, Nicolau, Schwartz, et al., 2020	Ontario, Canada	Pre/post design with no control or comparison  Repeated longitudinal	Telephone and online survey of baseline current smokers 16 years or older  Baseline (September-December 2016) random digit dialing	<ul style="list-style-type: none"> <li>• At follow-up, 0.3% of the baseline non-menthol smokers, 5% of the baseline occasional menthol smokers, and 22% of the baseline daily menthol smokers reported purchasing menthol cigarettes after policy implementation (<math>p &lt; 0.001</math>)</li> </ul>	<ul style="list-style-type: none"> <li>+Longitudinal cohort</li> <li>+Probability sample supplemented with a convenience sample</li> <li>+Temporal precedence of policy and post-survey</li> <li>+Policy includes a menthol cigarette restriction</li> <li>+Regression models were adjusted for demographics, baseline smoking</li> </ul>

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
			n= 1026; baseline convenience n= 772  Follow-up (January-August 2018) n= 913	<ul style="list-style-type: none"> <li>The primary source for purchasing menthol cigarettes was First Nations reserves</li> <li>At short term and long-term follow-up 21% of prior daily menthol smokers reported that they had purchased menthol cigarettes on First Nations reserves</li> </ul>	<p>characteristics, sampling method, and the number of days between baseline and follow-up survey</p> <p>-Study does not assess the impact of time related trends unrelated to the policy</p> <p>-Different demographics for menthol smokers in Canada and US</p>
Chung-Hall et al., 2021	Quebec, Ontario, Prince Edward Island, Newfoundland and Labrador; and a nationwide ban covering British Columbia, Saskatchewan and Manitoba, Canada	Prospective pre/post design with no control or comparison  Repeated longitudinal	Canadian arm of the ITC Four Country Smoking and Vaping Survey, nationally representative data; 2016 (Wave 1) and 2018 (Wave 2)  n=1,236	<ul style="list-style-type: none"> <li>For menthol cigarette smokers who continued to use menthol cigarettes post-policy and who reported a menthol cigarette brand as their last purchase (n=13), 54.7% (95% CI 28.6-78.4) reported buying menthol cigarettes from a First Nations reserve</li> </ul>	<p>+Nationally representative data</p> <p>+Longitudinal design</p> <p>+Policy includes a menthol cigarette restriction</p> <p>+Regression models controlled for covariates</p> <p>-Inconsistent alignment of timing of data collection with provincial policies; post-policy data collection may have captured quit attempts that occurred prior to the menthol policies</p> <p>-Different demographics for menthol smokers in Canada and US</p>
Kock et al., 2021	England	Post-only design with no control or comparison	Smoking Toolkit Study, representative survey, July 2020-June 2021	<ul style="list-style-type: none"> <li>Sources of purchase were similar between July-December 2020 and January-June 2021 with the exception of declines in buying abroad (14.2% vs. 10.4%, p=0.01)</li> </ul>	<p>+Representative survey</p> <p>+Repeated monthly data collection</p> <p>+Policy includes a menthol cigarette restriction</p>

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
		Repeated monthly cross-sectional	Unweighted n=2,681 Weighted n= 2,908	and buying from friends (12.3% vs. 4.2%, p=0.005) <ul style="list-style-type: none"> <li>Past 6-month purchases of menthol cigarettes from any illicit or cross-border source declined from 30.1% in the last 6 months of 2020 to 17.5% in the first 6 months of 2021 (p=0.006)</li> </ul>	-No pre-policy data -No measure on flavored cigarette use that excludes menthol flavored accessories (e.g., flavored capsules, filter tips, cards) that are exempt from the policy -Study does not assess the impact of time related trends unrelated to the policy
Rogers et al., 2017	New York, New York	Pre/post design with control group  Repeated data	Nielsen retail scanner, 4-week data, January 2010 – January 2014	<ul style="list-style-type: none"> <li>Statistically significant changes (p&lt;0.01) occurred in the level of unit sales of flavored tobacco products: all flavored tobacco products combined (cigars, flavored smokeless tobacco, and flavored loose tobacco [i.e., RYO]) declined by 27.1%; sales of flavored cigars declined by 22.3%; flavored smokeless tobacco declined by 97.6%; and flavored RYO declined by 42.5%</li> <li>Trends in unit sales observed in the control area differed from those in NYC</li> <li>In addition, a significant increase in the sales of flavored cigars was observed in the control area and nationally at the time of policy implementation</li> </ul>	+Repeated data +Pre/post study design with control group  -Data did not include all retail outlets (e.g., vape stores, online sales, or retailers making less than \$2 million in yearly sales) -Study does not include a menthol cigarette sales restriction -Study does not control for seasonal trends in sales of tobacco products
Rogers et al., 2020	Providence, Rhode Island	Pre/post design with	Weekly Nielsen retail scanner data,	<ul style="list-style-type: none"> <li>Average weekly unit sales declined significantly from pre- to post-policy for all flavored non-cigarette</li> </ul>	+Repeated data +Pre/post study design with comparison group

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
		comparison group  Repeated data	January 2012- December 2016	<p>products and for flavored cigars (both -51%, <math>p &lt; 0.01</math>), whereas in the rest of the state, average weekly unit sales for all flavored non-cigarette products and for flavored cigars increased (each by 10%, <math>p &lt; 0.01</math>)</p> <ul style="list-style-type: none"> <li>The authors note that the increase in sales of flavored cigars (explicit-flavored cigars and concept-flavored cigars combined) from pre-policy to post-policy in the rest of the state could suggest cross-border purchasing of flavored cigars by Providence, Rhode Island consumers following policy implementation</li> </ul>	<p>+Weekly data</p> <p>-Data did not include all retail outlets (e.g., tobacco specialty shops, groceries with small sales volume, vape shops, and online sources)</p> <p>-Flavor categorization approach used may have resulted in misclassification of flavor</p> <p>-Study does not assess the impact of time related trends unrelated to the policy</p> <p>-Study does not include a menthol cigarette sales restriction</p> <p>-Study does not control for seasonal trends in sales of tobacco products</p>
Yang et al., 2020	San Francisco, CA	Post-only design with no control or comparison  Cross-sectional	MTurk, November 2019  n= 247	<ul style="list-style-type: none"> <li>Proportions of e-cigarettes, cigarettes, and cigars obtained from retailers outside of San Francisco (i.e., cross-border purchases) increased overall post-policy</li> <li>The overall distribution was only significantly different for e-cigarettes (<math>&lt; 0.001</math>), not for cigarettes or cigars</li> </ul>	<p>+Policy includes a menthol cigarette restriction</p> <p>+Regression models adjusted for basic demographics and tobacco use before the ban</p> <p>-Convenience sample</p> <p>-Small sample size</p> <p>-Retrospective self-report (survey was conducted in November 2019 and respondents recalled behaviors from December 2018)</p> <p>-Study does not assess the impact of time related trends unrelated to the policy</p>



Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
<b>Outcome: Online Sales</b>					
Chaiton et al., 2018	Ontario, Canada	Pre/post design with no control or comparison  Repeated longitudinal	Telephone and online survey of baseline current smokers 16 years or older  Baseline: September 12- December 31, 2016  Follow up: February 2017  Baseline n=325 Follow-up n=206	<ul style="list-style-type: none"> <li>One month after the policy, 14.1% (n=29, 95% CI 10.0-19.6) of smokers reported using menthol cigarettes purchased from a First Nations reserve, other province, other country, or online; a total of 35.1% (n=72, 95% CI 28.9-42.0) of participants reported using menthol cigarettes from any source in the past month</li> </ul>	<ul style="list-style-type: none"> <li>+Longitudinal cohort</li> <li>+Temporal precedence of policy and post-survey</li> <li>+Probability sample supplemented with a convenience sample</li> <li>+Policy includes a menthol cigarette restriction</li> <li>-Small sample</li> <li>-Not clear how study authors defined menthol smokers</li> <li>-Different demographics for menthol smokers in Canada and US</li> </ul>
Chung-Hall et al., 2021	Quebec, Ontario, Prince Edward Island, Newfoundland and Labrador; and a nationwide ban covering British Columbia, Saskatchewan and	Prospective pre/post design with no control or comparison  Repeated longitudinal	Canadian arm of the ITC Four Country Smoking and Vaping Survey, nationally representative data; 2016 (Wave 1) and 2018 (Wave 2)  n=1,236	<ul style="list-style-type: none"> <li>For menthol cigarette smokers who continued to use menthol cigarettes post-policy and who reported a menthol cigarette brand as their last purchase (n=13), 7.5% (95% CI 0.7-48.4) reported buying menthol cigarettes online</li> </ul>	<ul style="list-style-type: none"> <li>+Nationally representative data</li> <li>+Longitudinal design</li> <li>+Policy includes a menthol cigarette restriction</li> <li>+Regression models controlled for covariates</li> <li>-Inconsistent alignment of timing of data collection with provincial policies; post-policy data collection may have captured quit attempts that occurred prior to the menthol policies</li> <li>-Different demographics for menthol smokers in Canada and US</li> </ul>

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
	Manitoba, Canada				
Yang et al., 2020	San Francisco	Post-only design with no control or comparison  Cross-sectional	MTurk, November 2019  n= 247	<ul style="list-style-type: none"> <li>The self-reported proportions of e-cigarettes, cigarettes, and cigars obtained online increased post-policy. However, the overall distribution was only significantly different for e-cigarettes (&lt;0.001), not for cigarettes or cigars</li> <li>15% of young adults reported purchasing flavored tobacco products online post-policy</li> </ul>	<ul style="list-style-type: none"> <li>+Policy includes a menthol cigarette restriction</li> <li>+Regression models adjusted for basic demographics and tobacco use before the ban</li> <li>-Convenience sample</li> <li>-Small sample size</li> <li>-Retrospective self-report (survey was conducted in November 2019 and respondents recalled behaviors from December 2018)</li> <li>-Study does not assess the impact of time related trends unrelated to the policy</li> </ul>
<b>Outcome: User Modification</b>					
Chaiton et al., 2018	Ontario, Canada	Pre/post design with no control or comparison  Repeated longitudinal	<p>Telephone and online survey of baseline current smokers 16 years or older</p> <p>Baseline: September 12- December 31, 2016</p> <p>Follow up: February 2017</p> <p>Baseline n=325</p>	<ul style="list-style-type: none"> <li>One month after the sales restriction, 14.1% (n=29, 95% CI 10.0-19.6) reported having added menthol to cigarettes using flavor cards, oils, or papers or another reaction</li> </ul>	<ul style="list-style-type: none"> <li>+Longitudinal cohort</li> <li>+Temporal precedence of policy and post-survey</li> <li>+Probability sample supplemented with a convenience sample</li> <li>+Policy includes a menthol cigarette restriction</li> <li>-Small sample</li> <li>-Not clear how study authors defined menthol smokers</li> <li>-Different demographics for menthol smokers in Canada and US</li> </ul>

Reference (Authors, Year)	Policy Location	Study Design	Sample Characteristics	Key Findings	Key Strengths and Limitations
			Follow-up n=206		
Chaiton, Schwartz, Cohen, et al., 2020	Ontario, Canada	Pre/post design with no control or comparison  Cross-sectional with three post-policy points	Baseline Survey (of current past month smokers 16 years or older): September-October 2016  Follow-up: January 2017, January 2018, and January 2019  n=1309 (responded to 1 or more additive questions)	<ul style="list-style-type: none"> <li>Overall, 14.6% (n=294) of baseline daily menthol cigarette smokers reported using some sort of menthol additive after the policy, compared with 9.8% (n=702) of baseline occasional menthol cigarette smokers and 2.6% (n=313) of baseline non-menthol cigarette smokers (p&lt;0.001)</li> <li>The percent of baseline daily menthol smokers using flavor additives increased from 4.4% pre-policy in 2016 to 5.1% in 2017, and 12.5% in 2018, then dipped to 9.5% in 2019</li> </ul>	<p>+Pre/post study design with three follow up points</p> <p>-The statistical significance of year-over-year changes is not presented</p> <p>-Potential selection bias given the use of a convenience sample to supplement a nationally representative longitudinal cohort sample</p>

## Appendix C Table. Risk of Bias Assessment for RTD Evaluation Studies

Domain and Type of Bias	Definition
<b>Sources of Bias in the Selection of Participants</b>	
Sampling Bias	The selection of participants may not represent the underlying population.
Nonresponse Bias	Individuals that decline to participate or do not respond to a request to participate differ in a way that affects the representativeness of the study population.
Selection Bias	A type of bias that occurs after sampling of study participants. Independent or predictor variable is confounded in a way that influences the outcome. Characteristics of study group participants differed in a way that influences the outcome.
Exclusion Bias	Control or comparison groups differ because some participants were deemed ineligible and removed from the study population.
Attrition Bias	Control or comparison groups differ because participants are more likely to drop out of one of the groups (e.g., policy intervention group/area vs. control or comparison group/area) for various reasons. Loss of respondents to policy intervention group/area can produce artefactual effects if loss is systematically correlated with conditions.
Maturation	Participants in one control or comparison group, but not the other, are changing in terms of the outcome variable prior to the policy. Naturally occurring changes over time could be confused with a policy effect.
History	An event outside of the study affects one control or comparison group but not the other in a way that may affect the outcome variable. More specifically, events occurring concurrently with treatment the policy could cause the observed effect.
<b>Sources of Bias in Measurement and Procedures</b>	
Using Measures that are Not Valid	Key study variables are measured using items or scales that have not been established as valid.
Threats to Construct Validity	The measure of a construct is unable to accurately capture all of the characteristics of the construct.
Inaccurate Definition of Tobacco User Groups	Tobacco user groups are defined using inaccurate or incorrect criteria. Criteria supported by published research should be used.
Response Biases (including Social Desirability Bias, Mode Change Bias, Demand Characteristics, Coercion or Payment Bias, Confirmation Bias, Extreme responding, Halo effect, Demand characteristics etc.)	Cognitive Biases, such as, a participant may be reluctant to or are unwilling or unable to report an exposure accurately because of attitudes, beliefs, and perceptions because of social or contextual cues that affect their judgments and responses.
Recall Bias	A considerable length of time has taken place between assessment of an exposure or outcome and the time when the exposure or outcome took place.

Reporting Bias	Systematic differences between reported and unreported finding. Typically, this appears when only significant findings are reported.
Observer/Interviewer/Experimenter/Abstractor Bias/Expectancy Effects	Research staff may more thoroughly look for an exposure in one of the control or comparison groups compared to the other group.
Nondifferential and Differential Misclassification Bias	An error in measuring a variable that results in a difference between control or comparison groups (differential) that affects the findings. An error in measurement that affects control or comparison groups equally but affects the findings (nondifferential).
<b>Sources of Bias in Analysis</b>	
Categorization of Variables	A variable was categorized in a way that was either not appropriate based on the research question or was not described by the authors.
Addressing Missing Data in Analysis	Authors did not describe how they handled missing data to the extent that was necessary, did not attempt to assess the impact of missing data, or mishandled missing data.
Insufficient Accounting for Potential Confounders	There was confounding not controlled for in the study design or analysis.
Appropriate Statistical Tests	The statistical tests used to assess the main outcomes were not appropriate for the data.
Reporting of Results	The findings were not presented clearly or there was not consistency between the data presented and the summary of findings.

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## Appendix D Table. Summary of Conclusions on the Impact of Flavored Tobacco Sales Restrictions or Bans

Conclusion	Level of Evidence	Factors that Increase the Quality of Evidence	Factors that Reduce the Quality of Evidence	Citations for Studies Contributing to Conclusion
<b>Outcome: Tobacco Use of Young People</b>				
Decreases in Use of Tobacco Products among Young People After a Sales Restriction or Ban on Flavored Tobacco Products	Substantial Evidence	<ul style="list-style-type: none"> <li>• Almost all studies designed to establish temporality</li> <li>• All studies addressed specificity through statistical controls or control/comparison groups</li> <li>• Almost all studies showed substantial effects</li> <li>• Findings are consistent across studies of different policies in different locations using different study designs and data sources</li> </ul>	<ul style="list-style-type: none"> <li>• Unclear if Kingsley et al., 2019 and Yang et al., 2020 were designed to establish temporality</li> <li>• Kingsley et al., 2019 only study designed with control group</li> </ul>	Farley & Johns, 2017; Hawkins et al., 2021; Kingsley et al., 2019; Pearlman et al., 2019; Yang et al., 2020; Courtemanche et al., 2017
Immediate Increases Followed by Decreases -- in Use of Cigarettes and Menthol Cigarettes among Young People After US Flavored Cigarette Ban (Excluding Menthol)	Limited Evidence	<ul style="list-style-type: none"> <li>• Study designed to establish temporality and addressed specificity through statistical controls</li> </ul>	<ul style="list-style-type: none"> <li>• All relevant evidence is from one study of a national policy and population</li> </ul>	Rossheim et al., 2020
Increases in Use of Tobacco Products among Young People After a Sales Restriction or Ban on Flavored Tobacco Products	Limited Evidence	<ul style="list-style-type: none"> <li>• All studies addressed specificity through statistical controls or control/comparison groups</li> </ul>	<ul style="list-style-type: none"> <li>• Findings are not consistent across studies of different policies in different locations using different study designs and data sources</li> </ul>	Courtemanche et al., 2017; Kingsley et al., 2021; Friedman, 2021

			<ul style="list-style-type: none"> <li>Liu et al., 2022 reports Friedman, 2021 was not designed to establish temporality</li> </ul>	
<b>Outcome: Tobacco Use of Adults</b>				
Increases in Quit Attempts and Quitting by Adult Smokers After a Menthol Cigarette Sales Restriction	Substantial Evidence	<ul style="list-style-type: none"> <li>Almost all studies were designed to establish temporality and addressed specificity through statistical controls</li> <li>Almost all studies showed substantial effects</li> <li>Findings are consistent across studies of different policies in different locations using different study designs and data sources</li> </ul>	<ul style="list-style-type: none"> <li>No studies designed with control or comparison group</li> <li>Analytic sample size for outcome of interest in Yang et al., 2020 was small</li> </ul>	Chaiton et al., 2018; Chaiton, Nicolau, Schwartz, et al., 2020; Chaiton, Schwartz, Cohen, et al., 2021; Chung-Hall et al., 2021; Yang et al., 2020
Quitting Behaviors of Adult Current Cigarette Smokers in Residential Treatment Facilities for Substance Abuse After a Sales Restriction on Flavored Tobacco Products (Including Menthol) in San Francisco, California	Insufficient Evidence	<ul style="list-style-type: none"> <li>Designed to establish temporality and addressed specificity through statistical controls</li> </ul>	<ul style="list-style-type: none"> <li>No studies designed with control or comparison group</li> <li>Guydish et al., 2020's non-random sample is of adult current smokers in a residential treatment facility for substance abuse and findings not generalizable to general population or other residential treatment programs</li> </ul>	Guydish et al., 2020
Some Adult Menthol Cigarette Smokers Switched to Non-Menthol Cigarettes After a Menthol Cigarette Sales Restriction	Limited Evidence	<ul style="list-style-type: none"> <li>All studies were designed to establish temporality</li> <li>Chung-Hall et al., 2021 and Guydish et al., 2020</li> </ul>	<ul style="list-style-type: none"> <li>No studies designed with control or comparison group</li> <li>Guydish et al., 2020's non-random sample is of adult</li> </ul>	Chung-Hall et al., 2021; Chaiton et al., 2018; Guydish et al., 2020



		<p>addressed specificity through statistical controls</p> <ul style="list-style-type: none"> <li>Findings are consistent across studies of different policies in different locations using different study designs and data sources</li> </ul>	<p>current smokers in a residential treatment facility for substance abuse and findings not generalizable to general population or other residential treatment programs</p>	
Some Adult Menthol Cigarette Smokers Switched to Other Tobacco Products (e.g., E-Cigarettes, Cigars) After a Menthol Cigarettes Sales Restriction	Limited Evidence	<ul style="list-style-type: none"> <li>Studies designed to establish temporality</li> <li>Chaiton, Papadhima, Schwartz, et al., 2020 addressed specificity through statistical controls</li> </ul>	<ul style="list-style-type: none"> <li>Few studies examined switching to other tobacco products</li> <li>No studies designed with control or comparison group</li> <li>All relevant evidence is from studies of the same policy and population with similar study designs</li> </ul>	Chaiton, Papadhima, Schwartz, et al., 2020; Chaiton et al., 2018
Some Menthol and Other Flavored Cigarette Smokers Switched to Unflavored Tobacco After a Sales Restriction on Flavored Cigarettes (Excluding Menthol) and Flavored RYO Tobacco	Limited Evidence	<ul style="list-style-type: none"> <li>Study designed to establish temporality and addressed specificity through statistical controls</li> </ul>	<ul style="list-style-type: none"> <li>All relevant evidence is from a single study</li> <li>Study does not assess quit attempts or detect short term changes in smoking prevalence</li> </ul>	Zatoński et al., 2020
<b>Outcome: Sales of Tobacco Products</b>				
Decreases in Sales of Tobacco Products After a Sales Restriction or Ban on Flavored Tobacco Products	Conclusive Evidence	<ul style="list-style-type: none"> <li>All studies were designed to establish temporality and addressed specificity through statistical controls or control/comparison groups</li> <li>All studies showed substantial effects</li> </ul>		Chaiton et al., 2019; Brown et al., 2021; Chaiton, Schwartz, Shuldiner, et al., 2020; Farley & Johns, 2017; Rogers et al., 2017; Rogers et al., 2020; Gammon et al., 2021;

		<ul style="list-style-type: none"> <li>Findings are consistent across studies of different policies in different locations using different study designs and data sources</li> </ul>		Chaiton, Schwartz, Kundu, et al., 2021
Increases in Sales of Tobacco Products Not Subject to Sales Restriction After a Sales Restriction or Ban on Flavored Tobacco Products	Substantial Evidence	<ul style="list-style-type: none"> <li>All studies were designed to establish temporality</li> <li>Most studies addressed specificity through statistical controls or control/comparison groups</li> <li>All studies showed substantial effects</li> <li>Findings are consistent across studies of different policies in different locations using different study designs and data sources</li> </ul>		Chaiton et al., 2019; Chaiton, Schwartz, Shuldiner, et al., 2020; Brown et al., 2021; Farley & Johns, 2017; Delnevo & Hrywna, 2015
Increases in Sales of Products with Concept Flavor Names or Products in Which Flavor Status is Ambiguous	Substantial Evidence	<ul style="list-style-type: none"> <li>All studies were designed to establish temporality and addressed specificity through statistical controls or control/comparison groups</li> <li>Most studies showed substantial effects</li> <li>Findings are consistent across studies of different policies in different locations using different study designs and data sources</li> </ul>	<ul style="list-style-type: none"> <li>Search was not focused on concept flavors</li> </ul>	Chaiton et al., 2019; Brown et al., 2021; Rogers et al., 2020

<b>Outcome: Illicit Sales</b>				
Reports of Illicit Tobacco Product Sales Following a Flavored Tobacco Sales Restriction or Ban	Limited Evidence	<ul style="list-style-type: none"> <li>Findings are consistent across studies of different policies in different locations using different study designs and data sources</li> <li>Three studies addressed specificity through statistical controls (Chung-Hall et al., 2021; Guydish et al., 2020; Yang et al., 2020)</li> </ul>	<ul style="list-style-type: none"> <li>One study designed to establish temporality</li> <li>Most studies not designed to look specifically at illicit sales</li> <li>No studies designed with control or comparison group</li> <li>Guydish et al., 2020's sample is adult current smokers in a residential treatment facility for substance abuse and findings not generalizable to general population</li> <li>Measures in Chung-Hall et al., 2021 and Kock et al., 2021 did not allow for distinguishing between cigarettes purchased that were exempt from sales restriction</li> </ul>	Chung-Hall et al., 2021; Guydish et al., 2020; Kock et al., 2021; Soule et al., 2019; Stoklosa, 2019; Yang et al., 2020
<b>Outcome: Cross-Border Sales</b>				
Reports of Cross-Border Tobacco Product Sales Following a Flavored Tobacco Sales Restriction or Ban	Moderate Evidence	<ul style="list-style-type: none"> <li>Most studies addressed specificity through statistical controls or control/comparison groups</li> <li>Findings are mostly consistent across studies of different policies in different locations using different study designs and data sources</li> </ul>	<ul style="list-style-type: none"> <li>Measures in Chung-Hall et al., 2021 and Kock et al., 2021 did not allow for distinguishing between cigarettes purchased that were exempt from sales restriction</li> <li>Measure in Chaiton et al., 2018 does not distinguish between cross-border and online sales</li> </ul>	Chaiton et al., 2018; Chaiton, Nicolau, Schwartz, et al., 2020; Chung-Hall et al., 2021; Kock et al., 2021; Rogers et al., 2017; Rogers et al, 2020; Yang et al., 2020

			<ul style="list-style-type: none"> <li>• Rogers et al., 2017 found little evidence of cross-border sales</li> <li>• Search was not focused on cross-border sales</li> </ul>	
<b>Outcome: Online Sales</b>				
Reports of Online Tobacco Product Sales Following a Flavored Tobacco Sales Restriction or Ban	Limited Evidence	<ul style="list-style-type: none"> <li>• Most studies designed to establish temporality and addressed specificity through statistical controls</li> <li>• Findings are consistent across studies of different policies in different locations using different study designs and data sources</li> </ul>	<ul style="list-style-type: none"> <li>• Search was not focused on online sales</li> <li>• Measures in Chung-Hall et al., 2021 did not allow for distinguishing between cigarettes purchased that were exempt from sales restriction</li> <li>• Measure in Chaiton et al., 2018 does not distinguish between cross-border and online sales</li> </ul>	Chaiton et al., 2018; Chung-Hall et al., 2021; Yang et al., 2020
<b>Outcome: User Modification</b>				
Reports of Increased User Modifications of Tobacco Products after a Flavored Tobacco Sales Restriction	Limited Evidence	<ul style="list-style-type: none"> <li>• Studies designed to establish temporality</li> </ul>	<ul style="list-style-type: none"> <li>• Few studies examined increased user modification of tobacco products</li> <li>• Studies did not address specificity through statistical controls or control/comparison group</li> <li>• All relevant evidence is from studies of the same policy and population with similar study designs</li> <li>• Studies showed small effects</li> </ul>	Chaiton et al., 2018; Chaiton, Schwartz, Cohen, et al., 2020

## Appendix E: Individual Summaries of Each Article Reviewed

**Brown et al. (2021)** evaluated the effect of Ontario, Canada's menthol cigarette sales restriction (effective January 1, 2017) on tobacco product sales. The authors utilized a pre/post study design in Ontario, with British Columbia serving as a control province. British Columbia was selected as the control because it is the most populous Canadian province that did not have a menthol restriction during the study period. The data used for this analysis were customized Nielsen scanner data from January – June 2016 in the pre-period and from January – June 2017 in the post-period. Nielsen scanner data were collected from participating retail locations using UPC scanners. The study found that Ontario menthol cigarette sales decreased by 93.2% (596 to 40 packs per capita [per thousand people]) in the post period (6 months following policy), compared with a 2.3% decrease (696 to 679 packs per capita) in British Columbia. Menthol capsule cigarettes sales remained low in Ontario (<1% of total cigarette sales) but increased 6-fold in British Columbia. In Ontario, sales of non-menthol cigarettes and non-menthol RYO tobacco increased 0.4% and 9.4%, respectively, while sales of non-menthol smokeless tobacco and vaping products decreased, suggesting overall minimal product substitution. Additionally, sales of cigarettes with menthol suggestive descriptors (e.g., green, blue, silver, fresh) grew by 2.7% (4,705 to 4,829 packs per capita [per thousand people]) in Ontario compared to only a 2.6% decrease (4,154 to 4,044 per capita [per thousand people]) in British Columbia. Although the study did not assess illicit sales, the authors hypothesize that the 40 pack per capita (thousands) observed in Ontario in the post-period may have been due to an illegal sell down during 2017. Limitations include: the analysis did not include data on cigars sales; statistical testing of changes in tobacco sales from pre-policy to post-policy was not possible since the Nielsen data were aggregated projected sales volume for each UPC in the pre- and post-policy periods with no measure of estimation variance; the retail sales data did not include all retail outlets (e.g., tobacco specialty shops, vape stores, small grocery stores, First Nations retailers, or online retailers); it is unknown whether colors listed in Nielsen product descriptions reflect packaging text and/or color; and lack of assessment of changes in illicit/cross border sales.

**Chaiton et al. (2018)** conducted a survey assessing menthol smokers' behavioral response to Ontario's menthol cigarette sales restriction (effective January 1, 2017) one month following policy implementation. A pre/post study design without a control or comparison group was employed. Participants (n=325) were recruited through a random-digit dial of residential telephone numbers from September 12 to December 31, 2016. Eligible participants were Ontario residents aged 16 and older who had smoked at least one menthol cigarette in the past year and were past-month smokers. Participants were contacted for follow-up one month following implementation of the policy through an online survey on their actual short-term reaction to the policy and planned long-term reaction to the policy (response rate: 63.4%; n=206). The manuscript also reports on planned reaction to the policy, but details on how participants were surveyed before the policy are not described in the manuscript. One month after the sales restriction, 28.2% (n=51, 95% CI 22.0-35.2) of participants who reported their anticipated planned reaction to the policy reported having actually switched to or only using non-menthol cigarettes. Among participants who reported at baseline their anticipated reaction to the policy 29.1% (n=60, 95% CI 23.3-35.8) of participants attempted to quit smoking at follow-up, 29.1% (n=60, 95% CI 23.3-35.8) reported switching to other flavored tobacco products or e-cigarettes. Of those who made a quit attempt, 80.0% (n=16) who primarily smoked menthol cigarettes at baseline indicated that

the policy affected their decision to quit at least a little compared with 25.6% (n=10) who smoked menthol cigarettes only occasionally at baseline. At follow-up, a total of 12.1% (n=25, 95% CI 8.3-17.4) of participants reported not smoking. One month after the sales restriction, 14.1% (n=29, 95% CI 10.0-19.6) of menthol smokers reported use of contraband menthol (i.e., purchasing menthol cigarettes from a First Nations reserve, other province, other country, or online); a total of 35.1% (n=72, 95% CI 28.9-42.0) of participants reported using menthol from all sources in the past month. Additionally, 14.1% (n=29, 95% CI 10.0-19.6) reported adding menthol to cigarettes (using flavor cards, oils, or papers) or other reaction at follow-up. Limitations include lack of a control or comparison group and assessment of time related trends unrelated to the policy (e.g., policy was implemented January 1, 2017, a time when many smokers make quit attempts due to New Year resolutions).

**Chaiton et al. (2019)** examined the association of the federal Canadian flavored tobacco regulation restricting the sale cigarettes and all cigars under 1.4g (or in any cigar that had a filter or non-spiral wrap) with flavor additives (except menthol) with changes in cigar sales. The federal regulation was enacted on October 8, 2009. The authors used interrupted time series to examine trends in unit sales of flavored cigars during the 2004–2016 period, using equal periods of 6 years before and 6 years after enactment of the 2009 policy. The authors used seasonally corrected quarterly cigar wholesale data that is required to be reported by manufacturers to Health Canada under section 13 of the Government of Canada’s Tobacco Reporting Regulations. This analysis also examined trends in flavor descriptors over this time period. Only flavor descriptors (not the presence of flavorings or aromas) were used to classify the flavor status of cigar products. The authors found that overall cigar sales and sales of flavored cigars significantly decreased by 49.6 million units (95% CI -73.5 – 25.8,  $p < 0.001$ ) and 59.2 million units (95% CI -86.0 – -32.4,  $p < 0.001$ ) following enactment of the federal regulation. Sales of menthol cigars, which were not included in the restriction, increased after enactment of the regulation. Additionally, the study found an increase in sales of cigars with no flavor descriptors after enactment of the regulation, although this increase was not significant. The level of increase in unit cigar sales with descriptors other than flavors (e.g., color or ambiguous terms) (9.6 million units, 95% CI -1.3 – 20.5) after enactment of the regulation did not offset the decrease in flavored cigar sales (59.2 million units, 95% CI -86.0 – -32.4,  $p < 0.001$ ), suggesting that complete substitution with unflavored cigars did not occur. It is important to note that Ontario enacted comprehensive tobacco control legislation in 2010, which could have been driving overall changes observed. However, the authors conducted sensitivity analyses and found that the findings did not change, suggesting that the decreased sales can be attributed to the federal flavored tobacco policy rather than provincial initiatives. Additionally, it is possible that some of the increases in sales of cigars with color descriptor were concept flavored products. The authors note that the wholesale data may not accurately represent total consumption in smaller territories such as Prince Edward Island and the territories as wholesalers and retailers in small territories may receive their product from wholesalers in larger provinces.

**Chaiton, Nicolau, Schwartz, Cohen, Soule, Zhang, and Eissenberg (2020)** conducted a survey assessing smokers’ behavioral response to Ontario’s menthol cigarette sales restriction (effective January 1, 2017) one year following policy implementation. The authors used a pre/post study design without a control group. Participants were recruited through a random digit dial of residential telephone numbers from September to December 31, 2016 (n=1,026) and a supplemental convenience sample (n=772). Participants were contacted approximately one year after policy implementation (January-August 2018) to complete an online survey; those who did not complete the survey or have online access were

interviewed by telephone. A total of 913 participants completed both the pre and post survey. A higher proportion of menthol users, both daily and occasional, at baseline reported having quit smoking (24% and 20% vs 14%;  $p=0.014$ ) or having made a quit attempt (63% and 62% vs 43%;  $p<0.001$ ) than non-menthol smokers one year following policy implementation. Daily menthol smokers at baseline reported an average of 1.9 quit attempts (0.42 SE) since the policy compared with 1.7 (0.17 SE) attempts among occasional menthol smokers and 1.0 attempts (0.12 SE) among non-menthol smokers. Daily menthol smokers at baseline had significantly higher rate of reporting having quit smoking after the policy (adjusted RR 1.62; 95% CI 1.08-2.42,  $p<0.05$ ) compared with non-menthol smokers after controlling for smoking and demographic characteristics. After adjustment, the rate of occasional menthol smokers at baseline reporting having quit was a non-significant 1.09 (95% CI 0.74 to 1.62) times higher than the rate of non-menthol smokers reporting having quit. In the adjusted analyses, only the daily menthol smokers were more likely to have tried to quit than non-menthol smokers (adjusted RR 1.25; 95% CI 1.03-1.50,  $p<0.05$ ). Self-reported quitting behavior did not differ significantly by population subgroup. At follow-up, 0.3% of the non-menthol smokers at baseline, 5% of the occasional menthol users and 22% of the daily menthol users reported purchasing menthol cigarettes after the policy ( $p<0.001$ ). The primary source for purchasing menthol cigarettes was on First Nations reserves, but this purchasing pattern did not increase over time among prior daily menthol smokers (short-term follow-up: 21%; long-term follow-up: 21%). Limitations include lack of a control or comparison group and assessment of time related trends unrelated to the policy (e.g., policy was implemented January 1, 2017, a time when many smokers make quit attempts due to New Year resolutions). As with any longitudinal study, it is possible that participants lost to follow-up differ from those who participated in the study. Comparison of those with complete data versus baseline sample found that the complete sample varied by menthol status, education, and convenience or telephone sample. To address concerns about these differences the authors conducted sensitivity analysis using the intention to treat analysis that led to similar results and did not change study conclusions. It was not clear if the convenience sample was used to provide more information on specific groups relevant to the research question. Sample size of population subgroups were small and may not have been powered to detect changes.

**Chaiton, Papadhima, Schwartz, Cohen, Soule, Zhang, and Eissenberg (2020)** examined product substitution following Ontario's sales restriction (effective January 1, 2017) on menthol tobacco products except cigars over 6g and electronic cigarettes (which are not classified as tobacco products in Canada). The authors used a pre/post study design without a control or comparison group. From September through December 2016, a convenience sample of smokers was recruited via email ( $n=772$ ) using an existing registry, and by telephone ( $n=1026$ ) through a commercial list. Eligible participants were Ontario residents age 16+ who were current (past 30-day) cigarette smokers. Participants were contacted for follow-up from January 2018 (one year after the implementation of the policy) through August 30, 2018. Of the 1738 approached, 913 participants completed the follow-up survey. At baseline, participants were asked about menthol cigarette use and categorized as "daily menthol", "occasional menthol", or "non-menthol" smokers. At follow up, participants reported their use of menthol cigarettes as well as use of each type of other flavored or unflavored tobacco products, including cigars, pipes, smokeless (pinch, snuff, chew, snus), bidis, kreteks, hookah, e-cigarettes, or electronic vaping devices. The authors also assessed cigarette smoking quit attempts and continued abstinence at follow up. At follow up, 27% of follow up participants reported using menthol cigarettes since the beginning of the policy, with 0.3% among non-menthol users at baseline, 5% among occasional menthol users at

baseline, and 22% among daily menthol users at baseline ( $p < .001$ ). Daily and occasional menthol users at baseline were more likely to report a quit attempt (63% and 62% vs. 43%,  $p < .001$ ) or not smoking (24% and 20% vs 14%;  $p = .014$ ) than non-menthol users at baseline. Adjusted models showed that daily ( $n=187$ ) and occasional ( $n=420$ ) menthol cigarette smokers at baseline (vs. non-menthol smokers) were more likely to use flavored cigar products after the policy (adjusted RR = 1.53, 95% confidence interval, CI = 1.01- 2.31,  $p=0.042$ ; adjusted RR = 1.57, 95% CI = 1.06-2.30,  $p=0.023$ ). Occasional menthol cigarette smokers at baseline were more likely to use other tobacco products (adjusted RR = 1.25, 95% CI = 1.02-1.53,  $p=0.028$ ) or flavored alternative tobacco products (adjusted RR = 1.56, 95% CI = 1.09-2.24,  $p=0.016$ ) following the sales restriction. There was no significant difference in the post-policy use of flavored e-cigarettes among daily or occasional menthol smokers at baseline. Study limitations include the use of a convenience sample, limiting the generalizability of the findings; a lengthy follow-up period; and the continued availability of untaxed tobacco from First Nations reserves in most areas in Ontario.

**Chaiton, Schwartz, Shuldiner, Tremblay, and Nugent (2020)** evaluated the impact of Ontario's sales restriction (effective January 1, 2017) on menthol tobacco products on cigarette wholesale sales. The authors used interrupted time series to examine changes in sales of menthol and non-menthol cigarettes in Ontario and British Columbia, which served as a control province. Although British Columbia has the lowest smoking prevalence in Canada, British Columbia and Ontario share similar population demographic characteristics. The authors used seasonally adjusted, monthly wholesale data from October 2012 to September 2017; data are reported by manufacturers to each province under Canada's Tobacco Reporting Regulation. The study found no statistically significant change in menthol cigarette, non-menthol cigarette and overall cigarette sales in British Columbia in the month immediately following Ontario's menthol sales restriction. The authors also found a statistically significant decline in menthol cigarettes (55 million-unit sales (95% CI -78.5 - -31.5,  $p < 0.001$ )) in Ontario relative to British Columbia in the month immediately following the menthol sales restriction. Sales of all cigarettes declined in Ontario by 127.8 million cigarette unit sales (95% CI -208.2 - -47.4,  $p < 0.01$ ) relative to British Columbia in the month immediately following Ontario's menthol sales restriction. However, the authors observed a significant increase in the sales of all cigarettes driven by non-menthol cigarettes in Ontario (23.8 million units per month, 95% CI 10.2-37.4,  $p < 0.001$ ) relative to British Columbia during the post-policy period, suggesting a slight rebound effect. The authors noted that the study findings may not be directly comparable with the US. The menthol smoking population in Canada and the US differs; most menthol users in Canada are white, and most menthol smokers use the product occasionally. Nonetheless, the authors hypothesize that a sales restriction in the US would have a greater effect since the US has a greater proportion of menthol cigarette users.

**Chaiton, Schwartz, Cohen, Soule, Zhang, and Eissenberg (2020)** examined changes in the use of menthol additives after Ontario's menthol sales restriction (effective January 1, 2017). The authors used a pre/post study design without a control or comparison group. Current past month cigarette smokers aged 16 years and older living in Ontario completed a baseline survey in September-October 2016 and were contacted for follow up in January 2017, January 2018, and January 2019. At baseline, participants were categorized as "daily menthol", "occasional menthol", or "non-menthol" smokers. Questions about the use of additive cards, drops and oils to add menthol to tobacco were asked of daily and occasional menthol smokers at all time points, and of baseline non-menthol cigarette smokers in 2018 and 2019. A total of 1309 participants responded to at least one of the additive questions. The authors report that overall, 14.6% ( $n=294$ ) of baseline daily menthol cigarette smokers reported using some sort of additive



since the policy compared with 9.8% (n=702) of baseline occasional menthol cigarette smokers and 2.6% (n=313) of baseline non-menthol cigarette smokers ( $p < 0.001$ ). The percent of baseline daily menthol smokers using flavor additives increased from 4.4% pre-policy in 2016 to 5.1% in 2017, and 12.5% in 2018, then dipped to 9.5% in 2019; however, the statistical significance of year over year changes is not presented. In addition, flavor additive use was not significantly associated with making a quit attempt. Limitations include lack of control or comparison group, and potential selection bias given use of a supplemental convenience sample. In addition, while the authors report results on additive use “since the ban”, the data were collected at “all time points” (including baseline) for baseline daily and occasional menthol cigarette smokers; it is unclear whether the overall estimates reported for baseline daily and occasional menthol cigarette smokers in Table 1 include baseline and follow-up combined or follow up only.

**Chaiton, Schwartz, Cohen, Soule, Zhang, and Eissenberg (2021)** conducted a survey assessing smokers’ behavioral response to Ontario’s menthol cigarette sales restriction (effective January 1, 2017) two years following policy implementation. A pre/post study design without a control or comparison group was employed. Participants (n=1,821) were recruited through a random digit dial of residential telephone numbers (n= 1,064) from September to December 2016 and a supplemental convenience sample (n= 757). Participants were contacted approximately one and two years after policy implementation (January-August 2018 and 2019) to complete an online survey, those who did not complete the survey or have online access were interviewed by telephone. A total of 810 participants completed both the pre and post surveys. Two years post-policy, a higher proportion of menthol smokers, both daily and occasional, at baseline reported having quit smoking (12% and 10% vs. 3%;  $p < .001$ ) than non-menthol smokers. In regression analysis, daily menthol smokers had significantly higher likelihood of reporting having quit smoking (adjusted RR) 2.08; 95% CI 1.20–3.61;  $p < 0.01$ ) compared to non-menthol smokers, controlling for smoking and demographic characteristics. There was a significant increase in probability of reporting more quit attempts for baseline daily (adjusted RR 1.45; 95% CI 1.15-1.82,  $p < 0.01$ ) and occasional (adjusted RR 1.27; 95% CI 1.03-1.56,  $p < 0.05$ ) menthol smokers compared to non-menthol smokers. After adjustment for baseline smoking and demographic characteristics, there was no difference in rates of relapse by baseline menthol status. Exploratory analyses found that among those who reported smoking at year one, there was an interaction between menthol use at baseline, use of flavored products reported at year one, and likelihood of not smoking at year two (adjusted RR = 0.26; 95% CI 0.08 - 0.90,  $p < 0.05$ ). Limitations include lack of a control or comparison group and assessment of time related trends unrelated to the policy (e.g., policy was implemented January 1, 2017, a time when many smokers make quit attempts due to New Year resolutions). As with any longitudinal study, it is possible that participants lost to follow-up differ from those who participated in the study. This study used a supplemental convenience sample; it was not clear if the convenience sample was used to provide more information on specific groups relevant to the research question. Sample size of population subgroups were small and may not have been powered to detect changes. Compared to other studies from this cohort, a stronger measure of quitting was used in this study (i.e., defined as being smoke-free for six months at the two-year follow-up).

**Chaiton, Schwartz, Kundu, Houston, and Nugent (2021)** assessed the overall change in cigarette sales associated with the implementation of menthol cigarette bans in Canada between 2010 and 2018. The authors used wholesale cigarette sales data on the brand of tobacco product, number of units sold, package sizes, and the value of the units sold reported by manufacturers by province, and calculated net

unit cigarette sales for each province for each month between October 1, 2010, and December 31, 2018. Wholesale cigarette sales were converted to a measure representing the percentage change in sales from the same month in the previous year in that province. The authors performed interrupted time series regression analyses with a trend indicator representing the difference in slope after the bans and ran separate analyses by province. After the sales restrictions, sales of menthol cigarettes decreased to 0 in all provinces, and the overall percentage change in cigarette sales for the same month in the previous year was -4.6% (95% CI: -8.2% – -1.0%,  $p=0.02$ ). Wholesale cigarette sales decreased in all 10 provinces studied after the menthol cigarette sales restrictions and was statistically significant ( $p\leq 0.05$ ) in three provinces – Alberta, New Brunswick, and Saskatchewan. Limitations of the study include the exclusion of Canada's three territories, the heterogeneity of the ten provinces, and potential substantive differences in the policy language and implementation of the provincial bans. In addition, contraband cigarette sales were not included.

**Chung-Hall et al. (2021)** evaluated the impact of menthol cigarette sales restrictions in seven Canadian provinces (including Ontario) on cessation and smoking behaviors. The seven provinces represent 83% of the Canadian population. The study used longitudinal, nationally representative data from Canadian arm of the ITC Four Country Smoking and Vaping Survey from 2016 (Wave 1; pre-policy) and 2018 (Wave 2; post-policy). A prospective, pre/post study design was used with no control or comparison group. Sampling weights were calibrated to ensure that data are representative of the adult smoker and vaper population in Canada. The final analytic sample was comprised of 1,236 adult (18+) current smokers (138 menthol smokers; 1,098 non-menthol smokers) who completed both Wave 1 and Wave 2 surveys. Though 21.5% ( $n=30$ ) of pre-policy menthol smokers quit smoking cigarettes post-policy, most continued to smoke, with 59.1% ( $n=82$ ) switching to non-menthol cigarettes and 19.5% ( $n=27$ ) continuing to smoke menthol cigarettes. After the policy, pre-policy menthol smokers were more likely to have continued use of menthol cigarettes (adjusted OR=24.90, 95% CI 11.6-53.7,  $p<0.001$ ) and less likely to have used non-menthol cigarettes (adjusted OR=0.23, 95% CI 0.14-0.37,  $p<0.001$ ) than pre-policy non-menthol smokers. Pre-policy menthol smokers were more likely to have attempted to quit (tried to quit in past 18 months; adjusted OR=1.61; 95% CI 1.03-2.51;  $p<0.05$ ) and to have remained quit (quit >6 months before nationwide menthol ban and remained quit; adjusted OR=2.30; 95% CI 1.06-5.01;  $p<0.05$ ) post-policy than pre-policy non-menthol smokers. Non-White cigarette smokers were more likely than White cigarette smokers to make a quit attempt (adjusted OR=1.77, 95% CI 1.10-2.85,  $p<0.05$ ) post-policy. Additionally, pre-policy daily menthol smokers were more likely to have quit smoking (21.0% vs. 11.6%, adjusted OR=2.21, 95% CI 1.15-4.24) and to have long-term quit (12.7% vs. 5.2%, adjusted OR=2.81,  $p<0.05$ ) post-policy than pre-policy daily non-menthol smokers. For pre-policy menthol cigarette smokers who continued to use menthol cigarettes post-policy and who reported a menthol cigarette brand as their last purchase ( $n=13$ ), 54.7% (95% CI 28.6-78.4) reported buying them from a First Nations reserve, 31% (95% CI 12.3-58.9) from convenience stores, and 7.5% (95% CI 0.7-48.4) by internet. Limitations include inconsistent alignment of timing of data collection with provincial policies; post-policy data collection may have captured quit attempts that occurred prior to the menthol policies. Post-policy survey relied on self-reported cigarette brand last purchased to determine menthol vs. non-menthol smoker status, which could have resulted in misclassification. Additionally, the survey was not able to distinguish non-menthol smokers from occasional menthol smokers in the sample of non-menthol smokers, which could have impacted effect sizes; and the survey didn't assess use of menthol capsule cigarettes, thus it is possible that users of these products would have been classified as

non-menthol smokers. Also, the study was not able to determine the proportion of menthol cigarettes purchased by smokers post-policy that were contraband; and did not assess potential non-cigarette product substitution. Lastly, the study did not address pre- or post-policy concurrent use of product categories; cessation outcomes may have only applied to cigarettes vs. other tobacco or nicotine products.

**Courtemanche et al. (2017)** evaluated the impact of the 2009 federal flavored cigarette ban (effective September 22, 2009), excluding menthol, in the US on adolescent (aged 11-19) use of tobacco products. The authors used a cross-sectional pre/post design using data from the 1999, 2000, 2002, 2004, 2006, 2009, 2011, 2012, and 2013 NYTS, a school-based, nationally representative survey (N=197,834) of middle and high school students (pre-policy: 1999-2009; post-policy: 2011-2013). Several control variables were included in the regressions, including inflation adjusted tax-inclusive price indices for tobacco products as well as the youth (aged 16-19) unemployment rate. After the policy, the percent of students who reported smoking cigarettes in the past 30 days decreased by 34% (from 14.0% to 9.3%,  $p=0.003$ ). However, the proportion of cigarette smokers who typically smoked menthol cigarettes increased by 15.9% (45.3% to 52.5%,  $p=0.006$ ) and the proportion of students who reported past 30-day pipe smoking increased by 21.7% (from 2.3% to 2.8%,  $p=0.000$ ). The percent who reported any tobacco use (i.e., cigarette, cigars, SLT or pipe) in the past 30 days decreased by 19.6%, from 17.9% to 14.4% ( $p=0.011$ ). The policy was associated with a 17.1% reduction in the likelihood of being a cigarette smoker (OR=0.829,  $p<0.001$ ). Among cigarette smokers, the policy was also associated with 59% fewer cigarettes smoked per month ( $p=0.005$ ) and a 45% increase in likelihood of menthol cigarette use ( $p<0.001$ ). In terms of non-cigarette use, the policy was associated with increases in likelihood of cigar use (34.4%,  $p<0.001$ ) and pipe use (54.6%) ( $p<0.001$ ). Although the policy was associated with a 14.2% ( $p<0.001$ ) increased probability of using at least one non-cigarette product (cigars, SLT, or pipes), the policy was associated with a 6.1% (OR=0.939,  $p<0.001$ ) decrease in the probability of using any tobacco product. Limitations include challenges in estimating causal effect of a federal law, for example the inability to rule out changes in important tobacco use determinants that may have occurred between the end of the pre-policy and beginning of post-policy periods (i.e., 2009 to 2011). For example, the US federal ban on flavored cigarettes (excluding menthol) coincided with an increase in the federal excise tax for cigarettes, which may have contributed to the decrease in cigarette use and any tobacco use. Also, NYTS did not include questions on hookah and e-cigarette use until 2011 (the post-policy period), therefore those products were excluded from the analysis. Additionally, for the years analyzed, NYTS did not capture information on tobacco product flavor other than menthol cigarettes. Finally, the post-policy period was limited to three time points (i.e., 2011, 2012, and 2013), making it impractical to identify changes in both levels and trends.

**Delnevo and Hrywna (2015)** examined Kretek International, Inc.'s, the parent company behind Djarum clove cigars, introduction of clove-flavored cigars in anticipation of the federal ban on flavored cigarettes (excluding menthol), including clove cigarettes, in the US in September 2009. The authors reviewed industry documents from Kretek International that were obtained by the Committee on Energy and Commerce as well as news articles on events related to the "Kretek Clove Cigar." The authors also assessed sales trends for clove cigars following the ban using Nielsen's Convenience Track retail scanner database from 2009-2012, and 2006-2012 data on tobacco imports to the US from Indonesia (the world's top producer of clove cigarettes) obtained from the USDA Foreign Agricultural Service's Global Agriculture Trade System. Industry documents revealed that plans for clove cigar began in 2007 with the

goal of preparing “for a seamless transition from Djarum Clove cigarettes to Djarum Clove cigars in the event of FDA ban on clove.” The documents suggested that the cigar product’s filler was identical to the clove cigarette. The cigar product’s wrapper, which was homogenized tobacco leaf, would distinguish the product as a cigar. Djarum brand cigars account for the vast majority of clove cigars sold in the US. Unit sales of Djarum clove cigars increased from 444,192 units in 2009 to 6,750,665 million units in 2012. Additionally, tobacco imports to the US from Indonesia shifted from clove cigarettes to cigars between 2006-2012. Cigar imports increased dramatically after 2009, increasing to over 626 million sticks by 2012. Meanwhile, imports of clove cigarettes decreased from a high of 532 million sticks in 2008 to zero in 2010. The authors argue that failing to extend the cigarette flavor ban to cigars created opportunity for new products to replace flavored cigarettes.

**Farley and Johns (2017)** conducted an evaluation of New York City’s tobacco sales restriction of flavored other tobacco products (OTP) – i.e., flavored cigars, cigarillos, little cigars, chew, snuff, snus, tobacco, pipe tobacco, RYO tobacco, and dissolvables (excluding menthol, mint, or wintergreen flavor) (effective July 2010). Enforcement began in November 2010. The evaluation consisted of (1) an interrupted time series analysis of changes in flavored and non-flavored cigars, smokeless tobacco, and pipe/RYO sales, adjusted for inflation, before and after the sales restriction, and (2) a cross-sectional analysis of changes in youth (13-17 years) ever use of flavored tobacco products, any tobacco product use, and smoking prevalence before and after the sales restriction. The authors used a pre/post-design without a control or comparison jurisdiction. Sales data came from a non-random sample of 922 unique stores (range of 736 stores in 2008 to 868 stores in 2012) with annual sales of over US \$2 million. Following policy enforcement, sales of non-cigarette flavored tobacco products (i.e., flavored cigars, smokeless, and pipe/RYO) declined overall (-86.8% [from \$31,918.00 to \$4,227.07];  $p < 0.001$ ), as did flavored cigars (-86.2% [from \$27,403.52 to \$3,774.76];  $p < 0.001$ ) and flavored pipe/RYO (-91% [\$3,764.03 to \$334.70];  $p < 0.001$ ). Sales of non-flavored tobacco products showed a non-significant increase following enforcement of the New York City policy (18.83%,  $p = 0.066$ ). However, the changes in non-flavored (but including menthol/mint) product-specific sales for 1) cigars and 2) pipe/RYO both demonstrated significant increases of 5.17% ( $p = 0.003$ ) and 4.3% ( $p = 0.030$ ), respectively. Data from the 2010 and 2013 New York City YRBS, a probability-based cross-sectional self-administered survey representative of New York City public high school students, were used to examine changes in youth tobacco use. In 2010 data was collected from 1,800 students from 28 schools and in 2013 data was collected from 9,439 students from 2013 schools. The analytic samples in 2010 and 2013 were 1,708 and 8,841 respectively. In adjusted models, youth in 2013, which was after policy enforcement, had 37% lower odds of ever trying flavored tobacco products compared to youth in 2010, which was before policy enforcement (adjusted OR 0.63, 95% CI 0.52-0.77,  $p < 0.05$ ). Youth in 2013 also had 28% lower odds of using any type of tobacco product (adjusted OR 0.72, 95% CI 0.62-0.85,  $p = 0.025$ ) compared with youth in 2010. Limitations of the evaluation include: the non-random store sample for sales data, which did not include small, independent stores – the predominant tobacco retailers in New York City; the inability to capture Native American reservation and black market sales; challenges in correctly classifying flavored vs. non-flavored tobacco products using available product name descriptors; the inability to draw causal conclusions from cross-sectional YRBS data; and wording changes in the YRBS between 2010 and 2013, and the possible misinterpretation of flavored tobacco questions. Additionally, the observed declines in sales and youth tobacco use attributed to the policy may be limited if declines are also occurring in other non-policy jurisdictions.

**Friedman (2021)** estimated the association between San Francisco’s sales restriction on flavored tobacco product sales (enforcement January 2019; formal enforcement April 2019) and smoking among high school students younger than 18 years using data from the 2011-2019 YRBS biennial school district surveys. The authors used a pre/post design<sup>6</sup> with comparison to eight other school districts nationwide, with consideration towards districts with response rates  $\geq 60\%$ . The data set yielded an analytic sample of 100,695 high school students with 95,843 high school students with non-missing data on recent smoking. In the 2019 YRBS, youth cigarette smoking prevalence was 6.2% (95% CI 5.2-7.1) in San Francisco and 5.6% (95% CI 5.3-5.9) in other districts. The author reported a significant increase in cigarette use among high school students after the policy was observed in the San Francisco school district relative to other school districts. Specifically, they reported that the San Francisco’s flavor policy was associated with 2.24 times the odds of recent smoking among high school students relative to concurrent changes in other districts (adjusted OR; 95% CI 1.42-3.53;  $p=.001$ ). The authors also reported robustness checks adjusting for district-specific time trends (adjusted OR 2.32 [95% CI 1.45-3.70];  $p<.001$ ) and examined California districts only (adjusted OR 2.01 [95% CI 1.15-3.51];  $p=.01$ ). However, another study reported a methodological mistake with these findings: data collection for the 2019 YRBS in San Francisco occurred in Fall 2018, prior to when the San Francisco flavor restriction was enforced in April 2019 (Liu et al., 2022). Since data collection occurred before formal enforcement of the policy, findings from Friedman (2021) do not reflect the impact of the San Francisco flavored tobacco product sales restriction on youth cigarette use.

**Gammon et al. (2021)** examined the impact of San Francisco’s flavored tobacco product sales restriction on tobacco sales (effective July 21, 2018; enforcement January 2019; formal enforcement April 2019). The authors used an interrupted time series analysis to assess changes in unit sales of tobacco products in San Francisco and in two Californian cities without flavored tobacco sales restrictions (San Jose and San Diego). The authors used Nielsen retail scanner sales data from July 2015 through December 2019 and an interrupted time-series analysis to estimate within-city changes in average weekly unit sales of tobacco by comparing three time periods: prior to policy enactment (July 2015-July 2018), during policy enactment (July 2018-January 2019), and during policy enforcement (January 2019-December 2019). Using Nielsen’s provided flavor descriptor, the authors categorized flavors as tobacco/unflavored, menthol/mint, other explicit flavor (e.g., cherry) or concept-named flavor (e.g., “magic puff”). The authors graphed trends in sales by tobacco product and flavor category for San Francisco and control cities using models that estimated a regression line for the three time periods. Average weekly unit sales of flavored tobacco products overall decreased 96% from pre-policy to enforcement period in San Francisco ( $p<0.05$ ). Sales of menthol cigarettes (-96%), flavored cigars (-96%), flavored smokeless tobacco (-97%), and flavored ENDS (-100%) all significantly decreased to low levels from pre-policy to enforcement period ( $p<0.05$ ). In the control cities, average weekly sales of flavored tobacco products either decreased modestly or did not significantly change from pre-policy to enforcement period with the exception of flavored ENDS which increased in both control cities and for flavored smokeless tobacco which increased modestly in San Diego. Furthermore, average weekly total tobacco sales in San Francisco decreased 25% from pre-policy to enforcement ( $p<0.05$ ), suggesting that there was not complete substitution of tobacco/unflavored products for flavored products. Additionally, the proportion of explicit flavored (other than menthol/mint) product and menthol/mint sales significantly

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<sup>6</sup> While the author describes a pre/post design, Liu et al. (2022) found that the 2019 YRBS was conducted in Fall 2018 prior to when the flavor policy was enforced in April 2019 signifying it was a pre-only design.

decreased in San Francisco (from 6.9% to 0.3% and from 26.5% to 1.1%, respectively;  $p < 0.05$ ) but significantly increased San Jose and San Diego. The proportion of concept-named flavored product sales decreased for San Francisco (from 1.1% to 0.4%,  $p < 0.05$ ) and San Jose (from 1.2% to 0.7%,  $p < 0.05$ ) from the pre-policy to enforcement periods and did not change for San Diego. Overall, generalizability of these study findings is limited by the types of retailers included in Nielsen sales data. These data do not include online retailers or small stores, including small local retailers and specialty tobacco shops.

**Guydish et al. (2020)** evaluated the impact of a 2019 San Francisco sales restriction on flavored (including menthol) tobacco products on cigarette use in clients of two residential substance use treatment facilities (enforcement January 2019). The study utilized repeated cross-sectional purposive samples of participants from these facilities 6-months prior to policy enforcement (June 2018,  $n=160$ ), roughly 5-months post-policy enforcement (May 2019,  $n=102$ ), and 11-months (November 2019,  $n=120$ ) after enforcement, providing opportunity for pre/post analyses. All clients enrolled in the treatment program at the time of each data collection were eligible for participation and participation rate was high across the 3 waves (93%, 86%, and 85%, respectively). Respondents completed the survey anonymously using an iPad. Current smokers were less likely to think of quitting smoking in the next 30 days ( $OR=0.44$ , 95% CI 0.29-0.67,  $p < 0.001$ ) and report menthol as their usual cigarette ( $OR=0.80$ , 95% CI 0.72-0.90,  $p=0.0002$ ) at 5-months post-policy compared with pre-policy. Additionally, current smokers were less likely to have past-year quit attempt ( $OR=0.80$ , 95% CI 0.71-0.91,  $p < 0.001$ ) and only smoke menthol cigarettes in the past month ( $OR=0.19$ , 95% CI 0.18-0.19,  $p < 0.0001$ ) at 11-months post-policy compared to baseline. When asked the main reason why they may have reduced their smoking, very few smokers (6.8%;  $n=6$ ) said they reduced smoking because their preferred flavor or brand was not available. Among current menthol smokers, 16.7% ( $n=6$ ) reported “smoking less”; others reported smoking menthol the same as before ( $n=16$ ), switching to non-menthol ( $n=11$ ), or no impact ( $n=3$ ). It is important to note that 50% of menthol smokers ( $n=18$ ) reported recent purchase of menthol cigarettes in San Francisco 11-months post policy, providing evidence that sales of menthol cigarettes were likely still occurring. Study limitations include a cross-sectional design and a small sample of clients that was not selected at random from only two residential treatment programs. Therefore, findings are neither representative of people attending other residential treatment programs in San Francisco or elsewhere, nor are they generalizable to the overarching smoking population. Lastly, there may be bias in the self-reported compliance and retail purchase estimates.

**Hawkins et al. (2021)** examined the associations between county-level flavored tobacco product restrictions, tobacco 21 policies, and smoke-free laws prohibiting e-cigarettes with adolescent cigarette and e-cigarette use in Massachusetts using data from the 2011–2017 biennial Massachusetts YHS, a representative cross section of Massachusetts high school students. The analytical sample for cigarette use and e-cigarette use were 9,988 and 10,168 respectively. The authors used difference-in-differences models to link changes in tobacco-control policies to changes in tobacco use within and between counties. The authors reported that “counties with greater implementation of flavored tobacco product restrictions were associated with a decrease in the level of cigarette use among users (difference in difference incidence RR  $-1.56$ ; 95% CI  $-2.54 - -0.58$ ,  $p \leq 0.05$ )” with largest reductions among 14- and 18-year-olds. Flavored tobacco product restrictions also were associated with a reduction in adolescent e-cigarette use (difference in difference OR  $-0.87$ ; 95% CI  $-1.68 - -0.06$ ). The authors cite several limitations to this research, including: (1) There may have been other tobacco control activities that occurred over the study period that are not captured; (2) The YHS sampling strategy does not include

youth attending private or religious schools or not attending school; (3) The survey is cross-sectional, and therefore inability to draw causal conclusions; (4) The authors could not assess whether policies were in place within the actual municipality of each student's residence; and (5) The YHS question on e-cigarettes asks about any use, not the level of use, and does not include examples of current products commonly used by adolescents, which may underestimate use.

**Kingsley et al. (2019)** assessed the short-term impact of a flavored tobacco restriction in Lowell, Massachusetts (effective October 1, 2016), on flavored tobacco availability and youth perceptions/behaviors related to flavored tobacco use. The authors used a post design with a control community (Malden, Massachusetts) with no policy matched on demographics, retailer characteristics, and point-of-sale policies. Youth surveys were administered to public high school students in randomly selected 9<sup>th</sup>-12<sup>th</sup> grade classrooms in both communities at baseline (November 2016-January 2017 in Lowell (n=593), September 2016 in Malden (n=636)) and follow-up (May 2017 in Lowell (n=524), April 2017 in Malden (n=646)). The authors used a difference-in-difference multivariate linear probability model to assess the impact of the restriction on youth perceptions/behaviors related to flavored tobacco use, including current use of flavored and non-flavored tobacco products. Current youth use of any flavored (excluding menthol and mint) tobacco products decreased 2.4% (95% CI -6.2 – 1.3, p>0.05) in Lowell from baseline to follow-up and increased 3.3% (95% CI -0.3 – 6.9, p>0.05) in the control community, resulting in a significant difference of -5.7% between the communities (95% CI -10.7 - -0.7, p=0.03). Current youth use of any non-flavored (including menthol and mint) tobacco products decreased 1.9% (95% CI -5.5 – 1.7, p>0.05) in Lowell from baseline to follow-up and increased significantly in the control community by 4.3% (95% CI 0.9 – 7.8, p<0.05), resulting in a significant difference of -6.2% between the communities (95% CI -11.0 - -1.4, p=0.01). Study limitations include the inability to draw causal relationships from cross-sectional survey data; the implementation of baseline surveys in Lowell 1-3 months after policy implementation, which may underestimate the effect of the policy on change in tobacco product use from baseline to follow-up in Lowell; difference in baseline data collection periods between the two communities, and limited sample sizes for some survey questions.

**Kingsley et al. (2021)** assessed the impact of flavored tobacco restrictions in Attleboro, Massachusetts (effective January 2016) and Salem, Massachusetts (effective March 2017) on access to, awareness, and use of tobacco among high school students, compared to the control community of Gloucester (with no policy). Surveys were administered at baseline (December 2015) to students in randomly selected classrooms in the sole public high school in each municipality; and at follow-up (January/February 2018) to a census of students in each school (Attleboro baseline n=1413 and follow-up n=1565; Salem baseline n=480 and follow-up n=620; Gloucester baseline n=539 and follow-up n=629). Three focus groups (one in each municipality) were also conducted in March and May 2019 with (purposely sampled) high school-aged students. Difference-in-difference multivariate linear probability models were used to analyze survey data. Current use of flavored (excluding menthol) and nonflavored/menthol tobacco increased from baseline to follow-up in all three municipalities, although increases from baseline to follow-up were significantly smaller in the combined municipalities with flavored tobacco restrictions than in the control (flavored [excluding menthol] tobacco use difference in difference estimates: -9.4%, 95% CI: -14.2% - -4.6%, p=0.000; nonflavored/menthol tobacco use difference in difference estimates: -6.3%, 95% CI: -10.8% - -1.8%, p=0.006). There were significantly smaller increases in current use of flavored e-cigarettes and flavored smokeless tobacco in both municipalities with flavored tobacco restrictions compared to the control. Based on focus group data, students in Attleboro reported visiting

other localities outside their municipality more often than students in Salem and the control municipality. Students in municipalities with flavored tobacco restrictions agreed that it would be harder for a younger sibling or friend to get a flavored tobacco product in their municipality now compared to when they were that age. Study limitations include: awareness outcomes were collected only at follow-up; analyses did not control for multiple comparisons, so some significant outcomes may have emerged by chance alone; only one focus group was conducted in each municipality, so it is not clear whether thematic saturation was reached; and the authors did not collect data on retailer compliance with flavored tobacco restrictions, so the differential impact of the policy between adopting municipalities could have been due in part to differences in compliance.

**Kock et al. (2021)** examined the prevalence of menthol cigarette smoking after the EU ban was implemented in England in May 2020 by sociodemographic and smoking characteristics. Data used for the analysis were from repeated monthly cross-sectional surveys of a representative sample of current smokers (18 years and older) in England (unweighted  $n=2,681$  and weighted  $n=2,908$ ) between July 2020 and June 2021. Sources of purchase of menthol cigarettes in the past 6 months were also collected. The weighted proportion of menthol cigarette use was calculated each month according to smoking characteristics (e.g., quit motivation, cigarette dependence), sociodemographic characteristics (e.g., age, gender, ethnicity), and sources of purchase. Chi-squared statistics were used to describe the strength of the relationship between menthol cigarette smoking status and the specified variables. Between July 2020 and June 2021, 15.7% (95% CI: 14.5 – 17.1) of current smokers reported smoking menthol cigarettes. Trend analyses suggest no initial change followed by a possible reduction in menthol cigarette use across April–June 2021. The most popular sources of menthol cigarette purchases in the past 6 months were newsagent/off license/corner shops, supermarkets, and petrol garage shops. Sources of purchase were similar between July–December 2020 and January–June 2021 with the exception of declines in buying abroad (14.2% vs. 10.4%,  $p=0.01$ ) and buying from friends (12.3% vs. 4.2%,  $p=0.005$ ). Past-6-month purchases of menthol cigarettes from any illicit or cross-border source declined from 30.1% in the last 6 months of 2020 to 17.5% in the first 6 months of 2021 ( $p=0.006$ ). Limitations of the study include an absence of measures on menthol smoking before the ban was implemented, and a study measure of flavored cigarette use that excludes menthol flavored accessories (e.g., flavored capsules, filter tips, cards) that are exempt from the ban. Further limitations relate to the self-reported menthol smoking and past-6-month source of purchase, which may be subject to recall bias. Additionally, findings regarding decline in purchase from any illicit or cross-border source may reflect the impact of COVID-19-related restrictions which were more restrictive in late 2020/early 2021 compared with summer/autumn of 2020.

**Pearlman et al. (2019)** evaluated the impact of Providence, Rhode Island's sales restriction on flavored (excluding menthol) tobacco products (and price promotions for all tobacco products) on youth tobacco use (effective January 2013). Specific tobacco products subject to the flavor component of the policy were not explicitly defined in the paper. The authors used a cross sectional, pre/post study design; there was no control or comparison group. Self-reported data on adolescents' current use of tobacco products were obtained from the 2012 (pre-policy) ( $n=2,150$ ), 2016 (post-policy) ( $n=2,062$ ), and 2018 (post-policy) ( $n=2,223$ ) Annie E. Casey Evidence2Success Providence YES, a cross-sectional census survey that collects information in classrooms from all 10th and 12th grade students. The paper neither describes participation rates nor demographic composition of the sample, within or across years. In 2012, 3.2% (95% CI 2.4-4.0) of high school students reported having tried smoking cigarettes in the past 30 days. By



2016, that percentage had increased to 7.6% (95% CI 6.3-9.0), however, by 2018, it decreased to 3.0% (95% CI 2.1-3.8), only 0.2% less than pre-policy level. Between 2016 and 2018, the percentage of high school students who tried any tobacco product in the past 30 days declined significantly, from 22.2% (95% CI 20.0-24.3) to 12.1% (95% CI 10.5 to 13.7); cigars and cigarillos use decreased from 7.1% (95% CI 5.7-8.5) to 1.9% (95% CI 1.2-2.6); e-cigarettes use declined from 13.3% (95% CI 11.4 to 15.1) to 6.6% (95% CI 5.3–7.8); and hookah use decreased from 13.5% (95% CI 11.6-15.3) to 7.7% (95% CI 6.4-9.2). Retail availability and enforcement data also analyzed as part of this study suggest that rigorous retail education and compliance monitoring contributed to changes in tobacco use among youth, and despite this, concept-flavored tobacco products remained an issue post-policy. Major limitations for the population health survey include that the questions about tobacco products other than cigarettes were only asked in post-policy years (i.e., 2016 and 2018); and flavor-related data were not captured for any year. Additionally, post-policy data were for 3 and 5 years after the policy was implemented, thereby introducing possibility that contextual factors beyond the policy itself could have impacted behavior change. Furthermore, the flavor policy was implemented concurrently with restrictions on price promotions and could have confounded the findings.

**Rogers et al. (2017)** examined the impact of New York City's policy restricting the sale of non-cigarette flavored tobacco products (effective July 2010) on tobacco product sales. The New York City sales restriction excludes products with menthol, mint, or wintergreen flavor and e-cigarettes. The authors used Nielsen retail scanner 4-week data from January 2010 to January 2014 to assess changes in sales of flavored cigars, flavored smokeless tobacco, and flavored loose tobacco (RYO), in New York City and in a control area before and after policy implementation. Changes in total cigars (both flavored and non-flavored) before and after policy implementation were also assessed. The control area consisted of ten non-New York City counties surrounding the city, where retailers were not subject to the New York City sales restriction. In New York City, sales of all flavored tobacco products combined (-27.1%), and sales of flavored cigars (-22.3%), flavored smokeless tobacco (-97.6%), and flavored RYO (-42.5%) declined at policy implementation. Policy implementation was associated with an immediate significant 11.6% decrease in total cigar sales in New York City ( $p < 0.05$ ); a non-significant 6.4% decrease was observed in the control area and a non-significant 2.1% increase in sales was observed nationally. Average sales of all cigars in New York City decreased by 7.4% ( $p < 0.01$ ) from pre- to post-policy while average sales of all cigars increased 9.8% ( $p < 0.01$ ) in the control area and 12% nationally ( $p \geq 0.05$ ) from pre- to post-policy. These data suggest that New York City consumers did not appear to substitute non-flavored cigars for flavored cigars. The authors conclude that there was little evidence of cross-border sales; a significant increase in unit sales of flavored products was not observed. Generalizability of these study findings is limited by the types of retailers included in Nielsen sales data; Nielsen uses proprietary methods to project sales from certain types of retail outlets; these data do not include specialty stores such as vape stores, online sales, or retailers making less than \$2 million in yearly sales.

**Rogers et al. (2020)** examined the effects of Providence, Rhode Island's restriction on the sale of all flavored non-cigarette tobacco products (cigars, smokeless tobacco, loose tobacco, and e-cigarettes with nicotine) (effective January 3, 2013). Menthol, mint, and wintergreen flavors were exempt from this policy. The authors used interrupted time series regression and Nielsen retail scanner data from January 2012 to December 2016 to assess weekly changes in unit sales of all flavored non-cigarette tobacco products and flavored cigars in Providence, Rhode Island and a comparison area consisting of all localities in the rest of the state of Rhode Island. The authors also assessed changes in unit sales of all

non-cigarette tobacco products and all cigars. The study found that in Providence, average weekly unit sales declined significantly from pre- to post-policy for all flavored non-cigarette products and for flavored cigars (both -51%,  $p < 0.01$ ); in the rest of the state, average weekly unit sales of these increased (both by 10%,  $p < 0.01$ ). The decrease in sales of all products from pre- to post-policy in Providence was driven by a 93% ( $p < 0.01$ ) decrease in sales of explicit flavored cigars; no change in sales of explicit flavored cigars was observed in rest of the state. However, average weekly unit sales of cigars labelled with concept flavor names increased significantly in both Providence and the rest of the state from pre- to post-policy (74% and 119%, respectively,  $p < 0.01$ ). Despite the increase in concept flavor-named cigar sales, overall flavored cigar sales still decreased 31% ( $p < 0.01$ ) from pre- to post-policy in Providence. The authors report some evidence of product substitution of tobacco-flavored cigars for flavored cigars following policy implementation; unit sales of tobacco-flavored cigars increased in Providence, while sales of tobacco-flavored cigars decreased in the rest of the state (11.3%, -19.5% respectively). The authors also note that the increase in share sales of flavored cigars (explicit and concept combined) from pre-policy to post-policy in the rest of state could suggest cross-border purchasing of flavored cigars by Providence consumers following policy implementation. Generalizability of these study findings is limited by the types of retailers included in Nielsen sales data; for example, these data do not include sales from tobacco specialty shops, groceries with small sales volume, vape shops, and online sources. The flavor categorization approach used in this study relied on interpretation of Nielsen provided product descriptors, manufacturer information, and online consumer comments, which may have resulted in misclassification of flavors. Furthermore, this study did not control for the effect of a Providence policy implemented in 2013 that prohibits price discounting and redemption of coupons for tobacco products.

**Rossheim et al. (2020)** evaluated the impact of the 2009 federal ban on flavored cigarettes, excluding menthol, in the US (effective September 22, 2009) on cigarette and menthol cigarette use by youth (aged 12-17), young adults (aged 18-25), adults (aged 26-49) and older adults (aged 50+). The study employed a quasi-experimental design incorporating elements of both interrupted time series analysis and difference in difference designs. Cross-sectional, quarterly data from the National Survey on Drug Use and Health (NSDUH), a nationally representative in-home survey, from 2002-2017 (all quarters and all years) ( $n=893,226$ ) was used. The 31 quarters before September 22, 2009 represented pre-ban and the 33 quarters after September 22, 2009 represented post-ban. Older adults (50 and over) were used to provide an indicator of general smoking trends over time. The authors report on the impact of the policy in the quarter immediately following policy implementation and in the entire post-policy period. Overall, the policy was associated with significant immediate increases and reductions over time in youth and young adult use of any cigarettes and menthol cigarettes compared to older adults. For example, among youth (aged 12-17), there was a 17% increase in the odds of reporting any cigarette smoking in the past 30 days immediately after policy implementation ( $OR=1.17$ , 95% CI 1.07-1.29,  $p < 0.001$ ) compared to pre-policy, and a 2.2% reduction in the entire post-policy period ( $OR=0.98$ , 95% CI 0.97-0.98,  $p < 0.001$ ) over the pre-policy trend. Similarly, there was an immediate 33% increase in the odds of reporting menthol cigarette use in the past 30 days ( $OR=1.33$ , 95% CI 1.15-1.54,  $p < 0.001$ ), followed by an additional 3.6% reduction in the odds each quarter ( $OR=0.96$ , 95% CI 0.96-0.97,  $p < 0.001$ ) over the pre-policy trend. Among young adults (aged 18-25), there was a 9% immediate increase in the odds of reporting any cigarette smoking in the past 30 days ( $OR=1.09$ , 95% CI 1.03-1.16,  $p=0.0047$ ), followed by an additional 1.2% reduction in the odds of cigarette smoking each quarter

thereafter (OR=0.99, 95% CI 0.99-0.99,  $p < 0.001$ ) over the pre-policy trend. Additionally, there was an estimated immediate increase of 29% in the odds of young adults reporting any menthol cigarette smoking in the past 30 days (OR=1.29, 95% CI 1.19-1.41,  $p < 0.001$ ), followed by a 2.6% reduction in the odds of menthol cigarettes smoking each quarter (OR=0.97, 95% CI 0.97-0.98,  $p < 0.001$ ) over the pre-policy trend. Among adults (aged 26-49), while there was not a statistically significant increase in the odds of past 30-day cigarette use immediately following the policy, there was a statistically significant though very small decrease of 0.6% in likelihood of cigarette use for each quarter thereafter (OR=0.994, 95% CI 0.992-0.997;  $p < .001$ ). Additionally, there was an estimated 17% immediate increase in the odds of past 30-day menthol cigarette smoking (OR=1.17, 95% CI 1.06-1.30],  $p < .001$ ), with no corresponding reduction for each quarter thereafter. No statistically significant changes in the odds of past 30-day cigarette smoking and past 30-day menthol cigarette smoking, both immediately after the policy or for each quarter thereafter, were found among older adults (aged 50 and up). Overall, in 2017, the predicted probability of youth and young adult cigarette smoking were reduced by 43% and 27%, respectively, compared to the model predicted probability in absence of the policy. The predicted probability of menthol use was reduced by 60% and 55% for youth and young adults, respectively. Limitations include the possibility that other changes in the tobacco environment during the study timeline may have affected cigarette use. Additionally, because NSDUH data do not contain items assessing all tobacco products used over time, tobacco products other than menthol and non-menthol cigarettes used, including the use of multiple tobacco products, was not examined in the present study. Lastly, the results of this study do not provide insight on the temporary increase in cigarette use among youth and young adults after the policy.

**Soule et al. (2019)** studied menthol smokers' reactions to the menthol flavored cigarette policy implemented in Ontario on January 1, 2017. Using an existing cohort of 1,003 past year menthol smokers recruited in late 2016, the authors invited (in April 2017) a randomly selected subset of 130 participants age 18+ to participate in an online concept mapping (CM) study comprised of: (1) brainstorming, (2) sorting, and (3) rating. Fifty-seven participants enrolled in the study (43% response rate) and completed a brainstorming prompt about how the menthol cigarette policy affected them or specific actions they had taken in response to it. Three researchers independently reviewed the brainstormed statements (N = 198), identified some for removal, and created a final list (N=79). Brainstorming participants and an additional 20 eligible individuals randomly selected from the same cohort were invited to complete the sorting and rating tasks at the study website. Thirty-eight participants grouped statements with similar content (sorting); 47 rated each statement based on a prompt regarding how the menthol cigarette policy affected them or specific actions they had taken in response to it. Mean statement ratings were averaged for all statements within each cluster and mean cluster ratings were compared between sample menthol cigarette smoking status subgroups using t-tests. Overall, seven statement clusters describing reactions to menthol policy were identified (in order from highest to lowest mean rating): 1) thoughts about the policy (e.g., included negative reactions to the policy such as believing the policy took away personal rights and freedoms), 2) perceiving the policy as ineffective (e.g., included perceptions that the policy would not stop people from smoking cigarettes), 3) emotional reactions to the policy (e.g., described feelings of sadness or missing menthol cigarettes or their taste as a result of the policy), 4) smoking non-menthol cigarettes (e.g., described various aspects of non-menthol smoking including switching from menthol to non-menthol cigarettes, not enjoying the taste of non-menthol, and not enjoying smoking as much), 5) smoking cessation or reduction (e.g.,

described how policy was associated with self-reported smoking cessation or reduction), 6) alternative menthol cigarette purchasing behaviors (e.g., described perceptions of illegal menthol cigarette sales and buying menthol cigarettes in alternative locations) and 7) alternative tobacco use behaviors (e.g., described using other tobacco products as replacement for menthol cigarettes). Of the statements about alternative menthol cigarette purchasing behaviors, the statement “I believe [the policy] has increased the presence of ‘black-market’ menthols” had the highest rating in the cluster ( $M = 4.94$ ) while the statement “I have purchased illegal/black market menthol cigarettes” was rated lower ( $M = 2.79$ ). Despite the policy, almost half reported smoking menthol cigarettes at least rarely (46.3%). Study limitations include questions about the generalizability of the results to a US population, whose menthol smokers are different from those in Canada; the different context of menthol cigarette smoking in the US vs. Canada; the availability of menthol in other products such as e-cigarettes, which may affect the reactions and efficacy of an implemented menthol policy in other jurisdictions; and small sample size.

**Stoklosa (2019)** examined the number of illicit seized cigarette products from 2007 to 2018 in Nova Scotia to determine whether there was an increase in seized illicit cigarette products after Nova Scotia’s 2015 menthol policy. Seized cigarettes are reported to the Audit and Enforcement unit of the Provincial Tax Commission, Service of Nova Scotia and include data on the total number of illicit cigarettes seized in Nova Scotia in each fiscal year; the data cover seizures made by Nova Scotia’s law enforcement and seizures made by other Canadian law enforcement agencies. The study found that the amount of seized illicit cigarettes declined significantly from greater than 60,000 cartons in 2007-2008 to less than 10,000 cartons in 2017-2018. Although the bulk of the decline in illicit cigarettes seized occurred before the menthol policy, the authors found that in the recent years after the menthol ban, seizure volume remained stable; there was no statistically significant difference in the number of illicit cigarettes seized before and after the menthol policy ( $t=-0.71$ ,  $p=0.55$ ). The author noted that according to local authorities, “the enforcement efforts in Nova Scotia have not declined during the period from 2014 to 2018 and, in fact, they intensified in some areas.” Additionally, the authors noted that according to local authorities there were only a few small seizures of menthol cigarettes in the year following the policy, and there were no further seizures of menthol cigarettes after the first year.

**Yang et al. (2020)** evaluated the impact of San Francisco’s flavored tobacco sales restriction (enforcement January 2019; formal enforcement April 2019) on young adults’ tobacco use behaviors (aged 18-34). The restriction covered all flavored e-cigarettes (other than tobacco flavor), menthol cigarettes, and other non-tobacco flavored tobacco products. This was a retrospective study that collected data at only one point in time. Self-report data were collected from participants recruited via MTurk in November 2019, after the policy was enforced in January 2019. Inclusion criteria for participants ( $n=247$ , ages 18-24  $n=62$ , ages 25-34  $n=185$ ) were: age 18–34 years; lived, worked or studied in the city of San Francisco from one month before the policy went into effect (December 2018) until the time of the survey (November 2019) without interruption; ever used any tobacco product including cigarettes, e-cigarettes, cigars, hookah/waterpipe, pipes, smokeless/dissolvable tobaccos from December 2018 until the time of the survey; and  $\geq 90\%$  approval rating from previous MTurk tasks. Participants self-reported whether they had used at least once both before the policy (during December 2018) and currently (during the past 30 days) (in November 2019 at time of data collection) any of the following products: cigarettes; e-cigarettes; cigars (including cigars, cigarillos, and little cigars; hookah/waterpipe; and/or smokeless/dissolvable tobacco. Participants were also asked how/where they typically obtained them, and about their subjective reaction to the flavor policy (e.g., try to

quit/reduce the use of tobacco product, was able/unable to quit/reduce the use, stock up flavored products before the policy, buy flavored products from illegal sellers after the policy). The prevalence of using any tobacco products (both overall and flavored) decreased by 17.7 percentage points (95% CI -27.5 - -8.0;  $p < 0.01$ ) from 100% to 82.3% among the 18-24 age group and by 7.6 percentage points (95% CI -11.4 - -3.7;  $p < 0.01$ ) among the 25-34 age group. Among 18–24-year-olds, the overall cigarette prevalence increased by 9.7 percentage (95% CI -1.3 - 20.7;  $p < 0.1$ ). Overall cigar prevalence decreased among the 18-24 age group by 9.7 percentage points (95% CI -20.7 - 1.3;  $p < 0.1$ ); flavored cigar use also decreased by 12.9 percentage points (95% CI 23.7 - -2.1;  $p < 0.05$ ) among this age group. Among 18-24-year-olds, use of non-flavored smokeless/dissolvable tobacco product use decreased by 4.8 percentage points (95% CI -10.3 - 0.7;  $p < 0.1$ ). The overall ENDS use prevalence decreased by 9.2 percentage points (from 60.0% to 50.8%) (95% CI, -15.4 - -3.0;  $p < 0.01$ ) among 25-34-year-olds. The prevalence of using flavored (including menthol; it is not clear from the article whether this includes tobacco-flavored) e-cigarettes decreased by 11.3 percentage points (95% CI -22.7 - 0.07;  $p < 0.1$ ) among those 18-24 years and by 8.1 percentage points (95% CI -14.7 - -5.0;  $p < 0.05$ ) among those 25-34 years. . Use prevalence of tobacco-flavored e-cigarettes decreased by 8.1 percentage points (95% CI -16.4, 0.3;  $p < 0.1$ ) among the 18-24 age group, and flavored (other than menthol and tobacco) e-cigarette use decreased by 8.1 percentage points (95% CI -13.5 - -2.7;  $p < 0.01$ ) among the 25-34 age group. Those who smoked menthol cigarettes pre-policy were nearly 55 times more likely to have smoked menthol cigarettes post-policy as compared to those who had not smoked menthol cigarettes pre-policy (95% CI 19.47 - 154.70;  $p < 0.01$ ). Similarly, those who had used flavored e-cigarettes and flavored cigars pre-policy were over 15 times (OR=15.28, 95% CI 7.02 - 33.23;  $p < 0.01$ ) and 5 times (OR=5.71, 95% CI 2.02 - 16.16;  $p < 0.01$ ), respectively, more likely to have used them post-policy as compared to those who had not used them pre-policy. Among the 20 respondents who reported exclusive use of menthol cigarettes before the policy, 5% (n=1) reported having quit all tobacco use after the policy while 70% (n=14) reported having maintained exclusive use of menthol cigarettes. Among a sample of 61 respondents who reported using menthol cigarettes in addition to other tobacco products before the policy, 3.3% (n=2) quit use of all tobacco products after the policy, while 73.8% (n=45) reported having maintained use of tobacco products (including menthol cigarettes). The proportions of e-cigarettes, cigarettes, and cigars obtained over the Internet or through the mail increased post-policy, and the proportions obtained from retailers outside of San Francisco also increased overall. However, the overall distribution was only significantly different for e-cigarettes ( $< 0.001$ ), not for cigarettes or cigars. A small percentage of young adults reported purchasing flavored tobacco products illegally in San Francisco (5.3%) and purchasing flavored tobacco products online (15.4%) post-policy. Limitations include use of a relatively small convenience sample, and that the survey was conducted in November 2019 and required that participants recall behaviors from December 2018, thus participants may not have been able to precisely recall their past tobacco use patterns. Lastly, it is possible that contextual factors beyond the policy (e.g., 2019 EVALI) could have affected tobacco use behaviors.

**Zatoński et al. (2020)** used longitudinal data from the EUREST-PLUS ITC Europe Surveys (n=19,691 from eight EU member states) to assess changes in 1) the prevalence of cigarette use by flavor and 2) smoking status, cessation behaviors and cigarette flavor preferences following the Tobacco Products Directive (TPD) 2016 ban on cigarettes and RYO with characterizing flavors, but before the 2020 ban on menthol cigarettes. To assess changes in prevalence of the usual flavor of cigarettes smoked between pre- and post-TPD, the authors used data from all respondents who provided valid information on their flavor of cigarettes smoked pre- and/or post-TPD (n=16,534) to estimate prevalence of usual flavor of cigarettes

smoked pre- and post-TPD; analyses controlled for sex, age and smoking status at wave of recruitment. To assess changes in smoking status, as well as cessation behaviors and cigarette brand preference between pre- and post-TPD, only respondents participating in both waves were included (n=5612). The authors found small but significant declines in the weighted prevalence of menthol (by 0.94%,  $p=0.041$ ) and other flavored cigarette use (by 1.32%,  $p<0.001$ ) following the 2016 ban, driven largely by the menthol and flavored cigarette smokers switching to unflavored tobacco (rather than quitting). About 52% of menthol cigarette smokers continued to smoke menthol cigarettes and 22.8% switched to unflavored tobacco. Among other flavored cigarette smokers, 11% continued to smoke other flavors and about 62% switched to unflavored tobacco. Cigarette consumption declined between waves, but there was no statistically significant difference in decline between menthol and flavored cigarette smokers and unflavored tobacco smokers on smoking and cessation behaviors in the pooled sample of all countries. The study has several limitations, including loss-to-follow-up in several countries, which could result in selection bias; and a lack of additional measures to assess quit attempts and detect short-term changes in smoking prevalence.

## Section 2: Consumers' Product Choices and Intended Use Behaviors If Menthol Cigarettes Became Unavailable

## Consumers' Product Choices and Intended Use Behaviors If Menthol Cigarettes Became Unavailable

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## Abbreviations

6E	6 European Country Survey
aOR	Adjusted Odds Ratio
aRR	Adjusted Relative Risk Ratio
CI	Confidence Interval
DCE	Discrete Choice Experiment
ETM	Experimental Tobacco Marketplace
HTP	Heated Tobacco Product
IARC	International Agency for Research on Cancer
ITC	International Tobacco Control Policy Evaluation Project
LCCs	Little Cigars and Cigarillos
MTurk	Amazon Mechanical Turk
NASEM	National Academies of Sciences, Engineering, and Medicine
NRT	Nicotine Replacement Therapy
OR	Odd Ratio
RR	Relative Risk
RTI	Research Triangle International
U.S.	United States of America

## Executive Summary

We reviewed 18 peer-reviewed articles relevant to consumers' behavioral intentions and product preferences if menthol was prohibited as a characterizing flavor in cigarettes. The studies reviewed indicate that most menthol cigarette smokers will quit smoking or switch to non-menthol cigarettes. Menthol cigarette smokers who quit smoking may quit tobacco product use entirely or switch to some other tobacco product. Menthol cigarette smokers' behavior after implementation of a menthol cigarette ban will likely depend on the availability of other tobacco products.

**The evidence reviewed suggests that a plurality of menthol cigarette smokers would try to quit smoking.** This is particularly evident in behavioral intention studies (D'Silva, 2015; D'Silva et al., 2021; Guillory et al., 2020; O'Connor et al., 2012; Pearson et al., 2012; Rose et al., 2019; Wackowski et al., 2014; Wackowski et al., 2015; Wackowski et al., 2018; Zatoński et al., 2018). The greatest percentage of participants in five of eight survey studies that included a quit smoking response option indicated that they would quit smoking in response to a menthol cigarette ban (D'Silva et al., 2015; Guillory et al., 2020; O'Connor et al., 2012; Pearson et al., 2012; Wackowski et al., 2014). Findings from experimental marketplace studies and discrete choice experiments (DCEs) were more equivocal, possibly because they focus on individual product choices rather than behavior patterns. Greater percentages of menthol cigarette smokers declined to purchase tobacco products in an experimental marketplace where menthol cigarettes were banned (38.9%) and all menthol tobacco products were banned (45.0%) than when there was no ban on menthol cigarettes (30.7%) (Guillory et al., 2019). Still, more participants bought a tobacco product than not (Guillory et al., 2019). In a policy simulation based on a DCE, approximately 20% of participants were predicted to choose neither cigarettes nor e-cigarettes but instead "none of these" across policy conditions where non-menthol cigarettes were available and the availability of tobacco, menthol, and sweet/fruit e-cigarettes was varied (Buckell et al., 2019); still, most smokers prefer cigarettes or e-cigarettes to no tobacco product in DCEs (Buckell & Sindelar, 2019; Shang et al., 2020).

**The evidence reviewed suggests that menthol cigarette smokers who do not quit smoking will likely switch to non-menthol cigarettes.** Intention to switch to non-menthol cigarettes was the most frequently selected intention in two of eight survey studies that included this as a response option (Rose et al., 2019; Wackowski et al., 2015) and the second most frequently selected intention in five of the remaining six survey studies (D'Silva et al., 2015; Guillory et al., 2020; Pearson et al., 2012; Wackowski et al., 2014; Zatoński et al., 2018). In two experimental marketplace studies and a DCE with policy simulation, close to half of menthol cigarette smokers selected non-menthol cigarettes as substitutes for menthol cigarettes (Buckell et al., 2019; Denlinger-Apte et al., 2021; Guillory et al., 2020). Three DCEs similarly found that cigarette smokers prefer cigarettes to e-cigarettes, suggesting that more menthol cigarette smokers would substitute with non-menthol cigarettes than would substitute with e-cigarettes in the event of a menthol cigarette ban (Buckell & Sindelar, 2019; Shang et al., 2020).

**The evidence reviewed suggests that menthol cigarette smokers who do not quit smoking or switch to non-menthol cigarettes will switch to some other tobacco product, including products that potentially pose less harm than cigarettes.** Given differences in the tobacco marketplace over time reflected in study options, it is difficult to determine what tobacco products other than cigarettes menthol cigarette smokers would use in the event of a menthol cigarette ban. There is evidence that menthol cigarette smokers will choose e-cigarettes (Buckell et al., 2019; D'Silva et al., 2015; Guillory et

al., 2020; Shang et al., 2020; Wackowski et al., 2015), or cigars, little cigars, and cigarillos (Denlinger-Apte et al., 2021; Guillory et al., 2020; O'Connor et al., 2012; Wackowski et al., 2018). A relatively small percentage of menthol cigarette smokers indicate intent to use some other unspecified tobacco product in response to a hypothetical menthol cigarette ban (D'Silva et al., 2015; O'Connor et al., 2012; Rose et al., 2019; Wackowski et al., 2014; Wackowski et al., 2015). Some menthol cigarette smokers may dual use non-menthol combusted tobacco products and menthol-flavored non-combusted tobacco products (such as e-cigarettes) in the event of a ban (Denlinger-Apte et al., 2021; Guillory et al., 2020; Pacek et al., 2019).

**The studies reviewed suggest that most menthol cigarette smokers intend to quit tobacco use in the event of a menthol cigarette ban. For menthol cigarette smokers who do not quit tobacco use, these studies of behavioral intentions and product preferences suggest the plurality will likely substitute with non-menthol cigarettes and some will likely substitute with other tobacco products. The availability of substitute tobacco products in the marketplace will influence menthol cigarette smokers' behaviors and product choices.**

## Purpose

This document evaluates (1) consumers' behavioral intentions in response to a hypothetical menthol cigarette ban and (2) consumers' choices among various tobacco products (i.e., in DCEs or experimental marketplaces) to inform an assessment of menthol cigarette smokers' potential responses to a menthol cigarette product standard. This review addresses the following research questions:

1. What are cigarette smokers' and non-smokers' self-reported behavioral intentions in scenarios with hypothetical menthol cigarette sales restrictions, bans, or product standards?
  - a. Specifically, what behaviors do menthol cigarette smokers intend to do if menthol cigarettes are unavailable in the U.S. tobacco market?
2. How does menthol flavor and product type affect cigarette smokers' and non-smokers' product selections in DCEs and experimental tobacco marketplaces?

## Methods

### Eligibility Criteria

We used the following eligibility criteria to search for and identify scientific articles for inclusion in this review:

- Years considered: All
- Language: English
- Publication status: Peer-reviewed published or in-press journal articles, full-text available
  - o We excluded conference abstracts, reports, and review articles
- Studies conducted in any geographic location; focus on United States
- Studies in any demographic population (e.g., youth, adults); focus on current menthol cigarette smokers
- Study designs that capture behavioral intentions (e.g., survey, focus groups); DCEs and experimental marketplace studies that capture product preferences
- Content:

- o Choice Studies: Quantitative experimental or quasi-experimental studies (e.g., DCEs, experimental marketplaces) of consumers' choices from a set of tobacco products that includes menthol cigarettes (or participants' own cigarettes, which could be menthol).
- o Intention Studies: Studies of consumers' behavioral intentions in response to hypothetical menthol cigarette sales restrictions, bans, or product standards.

### Information Sources and Search Strategy

We searched PubMed, Web of Science, and Embase on December 16, 2021 for scientific publications that fit the eligibility criteria. We used two search queries for each database:

1. The Choice Query focused on DCEs (i.e., studies that present participants a series of choices among different products to elicit consumers' preferences) and experimental marketplace studies that included menthol cigarettes as a product option.
2. The Intentions Query focused on people's behavioral intentions in response to hypothetical menthol cigarette bans.

The search queries were not identical for all databases, as we refined the search iteratively across databases to locate all potentially relevant articles without pulling many articles that did not meet inclusion criteria. **Table 1** displays the search terms used and the number of results retrieved by database.

*Table 1: Search Strings Employed on December 16, 2021 to Identify Choice and Intention Studies Relevant to Menthol Tobacco Product Sales Restrictions, by Database*

Database and N for each database deduplicated for the two queries	Topic	Search String	Results
PubMed (N = 396)	Choice	(Menthol OR Cigarette* OR tobacco) AND ("discrete choice" OR "behavioral economics" OR "behavioral economic" OR "experimental marketplace" OR "purchase task" OR "purchase tasks" OR "choice architecture" OR "decision task" OR "decision architecture")	272
	Intentions	Menthol AND Cigarette* AND (Ban OR Bans OR "Product Standard" OR restriction* OR hypothetical)	129

Database and N for each database deduplicated for the two queries	Topic	Search String	Results
Web of Science (N = 335)	Choice	(TS=((Menthol AND (Cigarette* OR tobacco) AND ("discrete choice" OR "behavioral economics" OR "behavioral economic" OR "experimental marketplace" OR "purchase task" OR "purchase tasks" OR "choice architecture" OR "decision task" OR "decision architecture"))) ) AND LA=(English)	15
	Intentions	(TS=(Menthol AND Cigarette* AND (Ban OR Bans OR "Product Standard" OR restriction* OR prohibit* OR hypothetical OR regulation* OR policy OR policies))) AND LA=(English)	334
Embase (N = 390)	Choice	menthol AND (cigarette* OR tobacco) AND ('discrete choice' OR 'behavioral economics' OR 'behavioral economic' OR 'experimental marketplace' OR 'purchase task' OR 'purchase tasks' OR 'choice architecture' OR 'decision task' OR 'decision architecture')	13
	Intentions	Menthol AND Cigarette* AND (Ban OR Bans OR "Product Standard" OR restriction* OR prohibit* OR hypothetical OR regulation* OR policy OR policies OR intention* OR "anticipated response")	389

### Article Selection

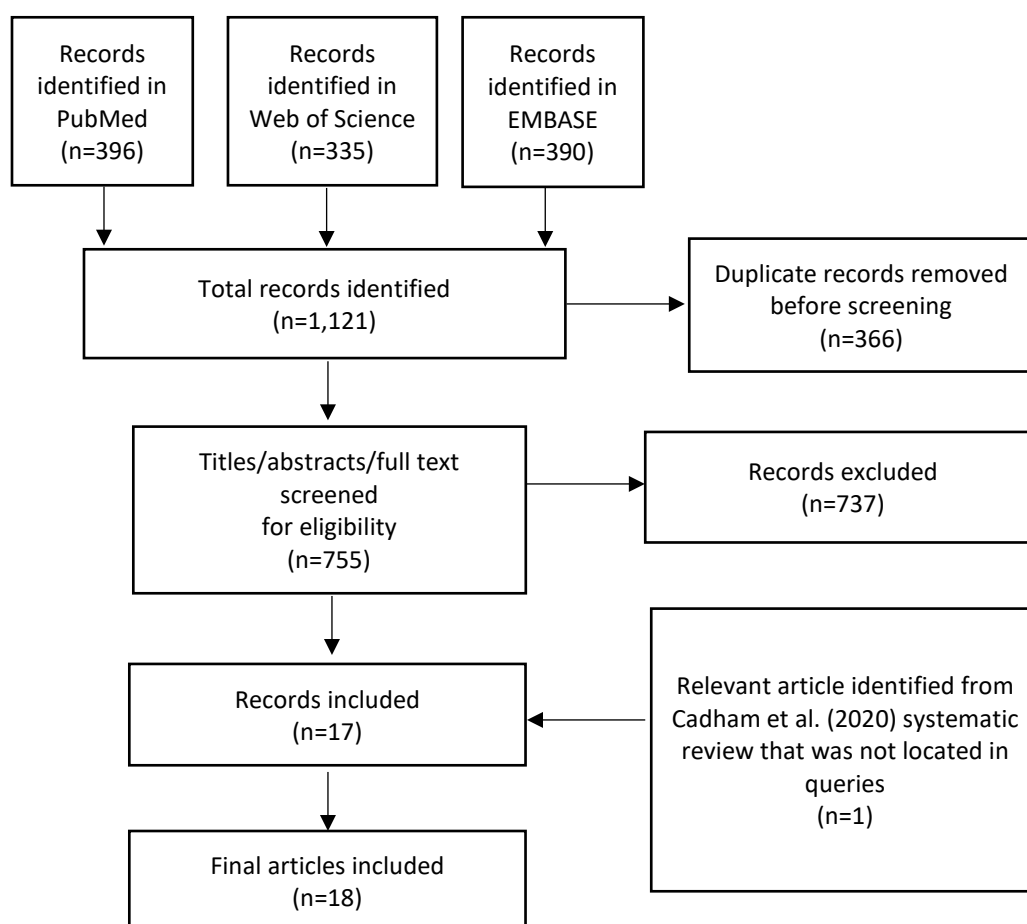
**Table 1** shows the number of articles located by query. After de-duplication across databases, 755 unique citations remained (see **Figure 1**). Two independent reviewers conducted an initial screening of titles, abstracts, and full texts (where needed) to determine inclusion or exclusion of each publication. The reviewers then discussed and reconciled their decisions, resulting in 17 publications selected for inclusion. The reviewers assessed references included in a scoping review identified through the search queries (Cadham et al., 2020) and identified one additional article that met inclusion criteria, bringing the final number of included publications to 18. One publication assessed both behavioral intentions and product choices. We present a diagram of the article selection process in **Figure 1**.

- Eleven articles assessed consumers' behavioral intentions if menthol cigarettes were no longer available.
- Eight articles assessed consumers' product choices in studies that included menthol cigarettes or their own brand of cigarettes.
  - Four studies were DCEs conducted with tobacco users in the United States.
  - Two studies were experimental marketplace studies conducted with menthol cigarette smokers in the United States.
  - Two DCEs that met inclusion criteria sampled adolescents in Mexico and Guatemala where cigarettes are available in flavors other than menthol and most menthol cigarettes are capsule based. We summarized these studies but did not use them when evaluating the level of evidence for each outcome.

## Results of Article Selection

We present a diagram of the article selection process in **Figure 1**.

*Figure 1: Article Selection Process*



## Data Extraction and Analysis

We developed Appendices B and C to support a consistent approach to data extraction and analysis. To inform assessment of the strength of evidence, we developed Appendix B “Summary of

Behavioral Intention, Product Preference, and Experimental Marketplace Studies Relevant to a Menthol Cigarette Ban,” which describes characteristics and findings of each study included in the review organized by outcome of interest (i.e., behavioral intention, product choice, experimental marketplace purchases). For each study included in the review, we included the date of data collection, study design, sample characteristics, key findings, and key strengths and limitations.

To describe study design, the following components were assessed and indicated in Appendix B: 1) whether the study used interviews or focus groups, survey, discrete choice experiment, or experimental marketplace; 2) whether the design used comparison conditions; 3) the number of choice sets participants viewed (for DCEs); and 4) whether data collection was cross-sectional or longitudinal.

To assess strengths and limitations, consistent with the approach employed in multiple rigorous systematic literature reviews, we considered the study design, study population, sample selection, sample size, setting, data collection, study measures, and data analysis (National Academies of Sciences, Engineering, and Medicine [NASEM], 2018; Guyatt et al., 2008; Schünemann et al., 2013; Porta, 2008; International Agency for Research on Cancer [IARC], 2008). The review team qualitatively assessed each study included in the review for risk of bias, specifically, threats to internal and external validity/generalizability. Internal validity refers to the degree to which a study is free from bias or systematic error and can draw conclusions about cause-and-effect relationships (Porta, 2008; IARC Handbooks of Cancer Prevention, 2008). External validity refers to the degree to which study findings can be generalized to other settings or populations (Porta, 2008; IARC Handbooks of Cancer Prevention, 2008).

For example, studies using an experimental design with a control/comparison were considered to have higher internal validity than a single group design because of their between-group components (IARC, 2008). Reviewers evaluated the degree to which study findings can be generalized to make inferences about the possible impact of a ban on menthol cigarettes in the United States. Studies examining behavioral intentions in the event of a menthol cigarette ban or experimental scenarios where menthol cigarettes were not available with a U.S. sample were considered to have higher external validity than studies that did not use a U.S. sample. Studies that use probability-based sampling (e.g., simple random, stratified random) were also considered to have higher external validity than studies that use purposive or convenience sampling.

Next, we synthesized the body of evidence for each outcome. When evaluating the strength of the body of evidence, the review team followed the level of evidence framework and approach used in NASEM’s Public Health Consequences of E-Cigarettes report (NASEM, 2018). In addition to considering the strengths and limitations of each study, described above, we considered consistency of findings across studies, and directionality of study findings; and the extent to which findings were replicated in other studies using different study designs and populations (triangulation). Each conclusion by the review team was assigned a level of evidence category rating using the NASEM framework (language was adapted slightly as shown below in italics to be appropriate for a review of behavioral intention, produce preference, and experimental marketplace studies):

- **Conclusive evidence:** -There are many supportive findings from good-quality controlled studies (including randomized and non-randomized *experiments*) with no credible opposing findings. -A firm conclusion can be made, and the limitations to the evidence, including chance, bias, and confounding factors, can be ruled out with reasonable confidence.

- Substantial evidence: There are several supportive findings from good-quality observational studies or *experiments* with few or no credible opposing findings. -A firm conclusion can be made, but minor limitations, including chance, bias, and confounding factors, cannot be ruled out with reasonable confidence.
- Moderate evidence: There are several supportive findings from fair-quality studies with few or no credible opposing findings. A general conclusion can be made, but limitations including chance, bias, and confounding factors, cannot be ruled out with reasonable confidence.
- Limited evidence: There are supportive findings from fair-quality studies or mixed findings with most favoring one conclusion. A conclusion can be made, but there is significant uncertainty due to chance, bias, and confounding factors.
- Insufficient evidence: There are mixed findings or a single poor study. No conclusion can be made because of substantial uncertainty due to chance, bias, and confounding factors.
- No available evidence: *Outcome of interest* has not been studied at all. No conclusion can be made.

Appendix C “Summary of Conclusions on Behavioral Intentions, Product Preferences, and Experimental Marketplace Purchases Relevant to a Menthol Cigarette Ban” shows the level of evidence category rating assigned to each conclusion by the review team, organized by outcome of interest. The table also shows, for each conclusion, factors that led to a higher rating of the quality of evidence, and factors that led to a lower rating of the quality of evidence. Citations of studies included in the review that support each conclusion are also listed in the table.

## Review of Literature

### Behavioral Intentions in Response to Hypothetical Menthol Cigarette Bans

Eleven studies examined current cigarette smokers’ behavioral intentions in response to a hypothetical menthol cigarette ban (D’Silva et al., 2015; D’Silva et al., 2021; Guillory et al., 2020; O’Connor et al., 2012; Pacek et al., 2019; Pearson et al., 2012; Rose et al., 2019; Wackowski et al., 2014; Wackowski et al., 2015; Wackowski et al., 2018; Zatoński et al., 2018).

Nine behavioral intention studies used self-reported survey data. One study examined adult menthol cigarette smokers’ behavioral intentions after participants had completed an experimental marketplace study (Guillory et al., 2020). All studies were conducted with a U.S. sample except for Zatoński et al. (2018) that examined European adult current menthol cigarette smokers’ behavioral intentions. All studies used one wave of cross-sectional data except for Rose et al. (2019) that surveyed a longitudinal cohort every six months from 2011-2016. The earliest survey studies reviewed that captured behavioral intention used data collected in 2010 (O’Connor et al., 2012; Pearson et al., 2012) and the most recent used data collected in 2018 (Guillory et al., 2020).

Two studies used qualitative methods to gather data. D’Silva et al. (2021) used in-depth semi-structured interviews to examine 27 African American adult daily cigarette smokers’ anticipated responses to a proposal that would restrict menthol cigarette sales to tobacco shops and liquor stores in Minnesota. Wackowski et al. (2018) conducted six focus groups in New Jersey with young adult current cigarette smokers who usually smoked a menthol brand to examine their awareness and perceptions of menthol cigarette regulation.

### Evidence of Intent to Quit Smoking in Response to a Menthol Cigarette Ban



Eleven studies provided evidence that some (estimates from 16.0%-64.4%) current menthol cigarette smokers intend to quit smoking in the event of a menthol cigarette ban. Survey studies documented that in response to a menthol cigarette ban:

- 36.6% of adult menthol cigarette smokers surveyed in 2018 would try to quit smoking (Guillory et al., 2020).
- Approximately 25% (estimated from bar graph) of young adult dual users of menthol cigarettes and e-cigarettes surveyed in 2017 indicated they would quit using cigarettes (Pacek et al., 2019).
- 23.5% of young adult menthol cigarette smokers surveyed from 2011-2016 indicated they would quit smoking and not use any other product (Rose et al., 2019).
- 16.0% (95% CI = 13.3, 19.2) of adult menthol cigarette smokers in Europe surveyed in 2016 indicated that they would quit smoking entirely (Zatoński et al., 2018).
- 28.4% of adult menthol cigarette smokers surveyed in April 2014 indicated they would quit smoking and not use any other product (Wackowski et al., 2015).
- 46.4% (95% CI = 37.9, 54.9) of Minnesota adult menthol cigarette smokers surveyed in 2014 indicated intent to quit smoking (D'Silva et al., 2015).
- 64.4% of young adult menthol cigarette smokers surveyed in 2011 indicated that they would quit smoking and not use any other tobacco products (Wackowski et al., 2014).
- 36.5% of adolescent and young adult menthol cigarette smokers surveyed in 2010 would try to quit smoking and 14.7% indicated that they would be able to quit smoking (O'Connor et al., 2012).
- 38.9% (95% CI = 33.0, 45.2) of adult menthol cigarette smokers surveyed in 2010 would try to quit (Pearson et al., 2012).

African American menthol cigarette smokers were particularly likely to report intentions to quit in the event of a menthol cigarette ban. Survey studies documented that in response to a menthol cigarette ban:

- African American menthol cigarette smokers were more than twice as likely to report an intention to quit (76.0%; 95% CI = 57.6, 94.3) compared to White menthol cigarette smokers (30.3%; 95% CI = 21.7, 38.9) (RR = 2.5; 95% CI = 1.7, 3.6,  $p < .001$ ) (D'Silva et al., 2015).
- Non-Hispanic African American young adult menthol cigarette smokers were more likely to report they would quit smoking (aOR = 2.16, 95% CI = 1.31, 3.55) than non-Hispanic White young adult menthol cigarette smokers (Rose et al., 2019).
- Black menthol cigarette smokers (47.4%; 95% CI = 29.9, 65.5) had a significantly higher prevalence of reporting intention to quit smoking and not use any other tobacco product than White menthol cigarette smokers (17%, 95% CI = 8.6, 30.9) (Wackowski et al., 2015).
- Intention to completely quit tobacco use in the event of a menthol cigarette ban was most prevalent among Black menthol cigarette smokers (79.3%; 95% CI = 63.1, 89.6) (Wackowski et al., 2014).

Qualitative studies also indicate that African American and Black menthol cigarette smokers report intending to quit smoking in response to a menthol cigarette ban.

- During in-depth interviews with African American adult daily cigarette smokers, some participants intended to quit cigarette smoking in response to a proposed menthol cigarette sales restriction, especially participants who were contemplating quitting (D'Silva et al., 2021).
- A focus group study documented that participants, particularly Black participants, believed a menthol cigarette ban may help them quit smoking (Wackowski et al., 2018).

*Evidence of Intent to Switch to Non-Menthol Cigarettes in Response to a Menthol Cigarette Ban*

Ten studies provided evidence that fewer than 50% (estimates from 14.7%-45.9%) of menthol cigarette smokers intend to switch to non-menthol cigarettes in the event of a menthol cigarette ban. Survey studies documented that in response to a menthol cigarette ban:

- 27.7% of adult menthol cigarette smokers surveyed in 2018 indicated they would switch to non-menthol cigarettes (Guillory et al., 2020).
- 32.3% of young adult menthol cigarette smokers surveyed from 2011-2016 indicated that they would most likely switch to non-menthol cigarettes (Rose et al., 2019).
- 20.0% (95% CI = 16.9, 23.4) of adult menthol cigarette smokers in Europe surveyed in 2016 indicated that they would switch to another brand (ostensibly a non-menthol brand) (Zatoński et al., 2018).
- 45.9% of adult menthol cigarette smokers surveyed in April 2014 indicated they would switch to non-menthol cigarettes (Wackowski et al., 2015).
- 26.6% (95% CI = 19.0, 34.1) of Minnesota adult menthol cigarette smokers surveyed in 2014 indicated that they would switch to non-menthol cigarettes (D'Silva et al., 2015).
- 18.4% (95% CI = 13.3, 24.8) of young adult menthol cigarette smokers surveyed in 2011 indicated that they would switch to non-menthol cigarettes (Wackowski et al., 2014).
- 14.7% of adolescent and young adult menthol cigarette smokers surveyed in 2010 indicated they would switch to another cigarette brand (ostensibly a non-menthol brand). Alternatively, 17.1% would not consider using a non-menthol cigarette (O'Connor et al., 2012).
- 25.2% (95% CI = 20.0, 31.3) of adult menthol cigarette smokers surveyed in 2010 indicated they would switch to a non-menthol brand and try to quit, and 12.5% (95% CI = 8.7, 17.7) indicated they would switch to a non-menthol brand (Pearson et al., 2012).

Qualitative studies also indicate that some menthol cigarette smokers would switch to non-menthol cigarettes in response to a menthol cigarette ban.

- In response to a proposal that would restrict menthol cigarette sales to tobacco shops and liquor stores, some participants stated that they intend to try non-menthol cigarettes (D'Silva et al., 2021).
- Some participants who participated in focus groups for those who did not identify as Black said they would switch to non-menthol cigarettes in response to a menthol cigarette ban (Wackowski et al., 2018).

Subgroup analyses suggest that some demographic groups may have higher prevalence of intention to switch to non-menthol cigarettes in the hypothetical event of a menthol cigarette ban.

- Most Asian young adult menthol cigarette smokers surveyed in 2011 (62.0%; 95% CI = 12.8, 71.9) indicated they would switch to non-menthol cigarettes (Wackowski et al., 2014).

#### Evidence of Intent to Switch to Menthol E-Cigarettes in Response to a Menthol Cigarette Ban

Three studies provided evidence that few menthol cigarette smokers intend to switch to menthol e-cigarettes in the event of a menthol cigarette ban. Few studies provided “switch to menthol e-cigarettes” as a response option, likely because many of the studies were conducted prior to increased prominence of e-cigarettes in the marketplace. Survey studies documented that in response to a menthol cigarette ban:

- Young adult dual e-cigarette users and menthol cigarette smokers surveyed in 2017 indicated intent to increase e-cigarette use in response to a menthol cigarette ban rather than increase cigarette use, but this trend was not statistically significant ( $\chi^2(1,126) = 3.06, p = 0.080$ ) (Pacek et al., 2019).
- 15.1% of adult menthol cigarette smokers surveyed in April 2014 indicated they would switch to menthol e-cigarettes (Wackowski et al., 2015).
- 12.3% (95% CI = 6.3, 18.3) of Minnesota adult menthol cigarette smokers surveyed in 2014 indicated they would switch to menthol e-cigarettes (D’Silva et al., 2015).

Higher percentages of Black non-Hispanic (23%, 95% CI = 10.6, 42.7) and White non-Hispanic (18.3; 95% CI = 10.7, 29.5) menthol cigarette smokers indicated intent to switch to menthol e-cigarettes compared to Hispanic menthol cigarette smokers (0.7%; 95% CI = 0.1, 5.0) (Wackowski et al., 2015).

#### Evidence of Intent to Switch to Some Other Menthol or Non-Menthol Tobacco Product in Response to a Menthol Cigarette Ban

Five studies provided evidence that few menthol cigarette smokers intend to switch to some menthol or other flavored tobacco product (i.e., non-cigarette) in response to a menthol cigarette ban. Studies documented that in response to a menthol cigarette ban:

- 25.5% of adult menthol cigarette smokers surveyed in 2018 indicated they would switch to “other menthol or flavored tobacco product” (i.e., other than non-menthol cigarettes) (Guillory et al., 2020).
- Several Black focus group participants, including those who said they would quit smoking, indicated they would likely go back to using Black & Mild cigars or use them more frequently than they currently did (Wackowski et al., 2018).
- 2.8% (95% CI = 0.4, 5.2) of Minnesota adult menthol cigarette smokers surveyed in 2014 indicated they would switch to “some other menthol tobacco product” (i.e., other than menthol e-cigarettes or non-menthol cigarettes) (D’Silva et al., 2015).
- 17.6% of adolescent and young adult menthol cigarette smokers surveyed in 2010 indicated they may try menthol flavored smokeless tobacco (O’Connor et al., 2012).
- 11.8% of adolescent and young adult menthol cigarette smokers surveyed in 2010 indicated they may switch to cigars that are flavored (O’Connor et al., 2012).

Four survey studies also provided evidence few menthol cigarette smokers intend to switch to some other tobacco product (i.e., non-cigarette) of unspecified flavor in response to a menthol cigarette ban. Survey studies documented that in response to a menthol cigarette ban:

- On average, 10.7% of young adult menthol cigarette smokers surveyed from 2011-2016 indicated intent to switch to some other tobacco product (i.e., other than non-menthol cigarette). Switching to some other product as a response significantly positively increased over time ( $b = 0.71$ ;  $p = 0.01$ ) (Rose et al., 2019).
- 3.9% of adult menthol cigarette smokers surveyed in April 2014 indicated they would switch to some other tobacco product (i.e., other than non-menthol cigarettes or menthol e-cigarettes) (Wackowski et al., 2015).
- 1.5% (95% CI = 0.0, 3.8) of Minnesota adult menthol cigarette smokers surveyed in 2014 indicated they intend to switch to some other non-menthol tobacco product (i.e., other than non-menthol cigarettes) (D’Silva et al., 2015).
- 15.7% of young adult menthol cigarette smokers surveyed in 2011 indicated they would switch to some other tobacco product (i.e., other than nonmenthol cigarettes) (Wackowski et al., 2014).

Further, there was some evidence that specific subgroups of menthol cigarette smokers had greater intentions to switch to some other tobacco product (i.e., non-cigarette) of unspecified flavor in response to a menthol cigarette ban. Survey studies documented that in response to a menthol cigarette ban:

- Intent to “switch to some other product” was more likely among respondents who had used a non-cigarette tobacco product in the past 30 days compared to those who had not (aOR = 2.09, 95% CI = 1.03, 4.24) and Hispanic participants compared to non-Hispanic White participants (aOR = 2.01, 95% CI = 1.16, 3.49) (Rose et al., 2019).
- Intent to “switch to other tobacco product” (i.e., other than non-menthol cigarettes) was most prevalent among Hispanic young adult menthol cigarette smokers surveyed in 2011 (34.6%, 94% CI = 15.0, 61.4) (Wackowski et al., 2014).
- Intent to “switch to other tobacco product” (i.e., other than non-menthol cigarettes) was more prevalent among menthol cigarette smokers who indicated concurrent use of other tobacco products (35.5%; 95% CI = 19.1, 55.7) than those who reported no other tobacco product use (5.5%; 95% CI = 2.6, 11.4%) (Wackowski et al., 2014).

#### Evidence of Intent to Access Menthol Cigarettes Despite a Menthol Cigarette Ban

Three studies provided evidence that some menthol cigarette smokers intend to access menthol cigarettes despite a menthol cigarette ban. Survey studies documented that in response to a menthol cigarette ban:

- 27.3% (95% CI = 23.7, 31.3) of adult menthol cigarette smokers in Europe surveyed in 2016 indicated that they would find a way to get the banned product regardless (Zatoński et al., 2018).

- 5.8% (95% CI = 1.8, 9.7) of Minnesota adult menthol cigarette smokers surveyed in 2014 indicated that they would buy menthol cigarettes online and 2.7% (95% CI = 0.0, 6.0) indicated that they would buy menthol cigarettes from another country (D’Silva et al., 2015)
- 24.1% of adolescent and young adult menthol cigarette smokers surveyed in 2010 indicated they would find a way to buy a menthol brand and 10.6% indicated that they would “add menthol myself” (O’Connor et al., 2012).

#### Evidence of Intent to Change the Amount Smoked in Response to a Menthol Cigarette Ban

Three studies provided evidence that some menthol cigarette smokers intend to change the amount they smoke in response to a menthol cigarette ban. Survey studies documented that in response to a menthol cigarette ban:

- 17.6% (95% CI = 14.5, 21.1) of adult menthol cigarette smokers in Europe surveyed in 2016 indicated that they would reduce the amount they smoke (Zatoński et al., 2018).
- Approximately 30% (estimated from bar graph) of young adult dual users of menthol cigarettes and e-cigarettes surveyed in 2017 indicated they would use cigarettes less often, approximately 20% would use the same amount, and approximately 20% would use more cigarettes (Pacek et al., 2019).
- 27.1% of adolescent and young adult menthol cigarette smokers surveyed in 2010 indicated that they would “smoke less than I do now,” 21.2% “continue to smoke about the same as I do now,” and 7.6% would “smoke more than I do now” (O’Connor et al., 2012).

#### Evidence of Uncertain or Unspecified Intentions in Response to a Menthol Cigarette Ban

Six studies provided evidence that menthol cigarette smokers were uncertain how they would respond to a menthol cigarette ban or indicated intent to engage in a behavioral response not captured by response options (i.e., other). Survey studies documented that in response to a menthol cigarette ban:

- 8.6% of adult menthol cigarette smokers surveyed in 2018 indicated “don’t know” and 1.3% indicated “other” (Guillory et al., 2020).
- 14.8% (95% CI = 12.0, 18.0) of adult menthol cigarette smokers in Europe surveyed in 2016 indicated “don’t know” and 4.3% (95% CI = 2.8, 6.5) indicated they would “do something else” (Zatoński et al., 2018).
- An average of 30.8% of young adult menthol cigarette smokers across survey waves from 2011-2016 selected a “don’t know” response. Non-Hispanic African American participants (aOR = 1.81; 95% CI = 1.13, 2.88) were more likely to indicate “don’t know” than non-Hispanic White participants (Rose et al., 2019).
- 6.7% of adult menthol cigarette smokers surveyed in April 2014 indicated they would do something else (i.e., “other”) (Wackowski et al., 2015).
- 1.5% of young adult menthol cigarette smokers surveyed in 2011 indicated that they did not know what they would do or would do something else (Wackowski et al., 2014).
- 28.2% of adolescent and young adult menthol cigarette smokers surveyed in 2010 did not know what they would do (O’Connor et al., 2012).

### Summary and Conclusion

There is variation in behavioral intentions across studies, likely due to the use of different survey instruments, changes in the tobacco marketplace over time, and sample characteristics. Still, across most survey studies the greatest percentage of menthol cigarette smokers indicated intent to quit or try to quit smoking in the event of a menthol cigarette ban (D’Silva et al., 2015; Guillory et al., 2020; O’Connor et al., 2012; Pearson et al., 2012; Wackowski et al., 2014). In other survey studies, the greatest percentage of menthol cigarette smokers indicated intent to switch to non-menthol cigarettes in the event of a menthol cigarette ban (Rose et al., 2019; Wackowski et al., 2015). Lower percentages of menthol cigarette smokers indicated intent to use other menthol or non-menthol tobacco products, including e-cigarettes, cigars, or smokeless tobacco in the event of a menthol cigarette ban (D’Silva et al., 2015; Guillory et al., 2020; O’Connor et al., 2012; Wackowski et al., 2014; Wackowski et al., 2015). In several studies, some participants indicated uncertain behavioral intentions in response to a menthol cigarette ban (Guillory et al., 2020; O’Connor et al., 2012; Rose et al., 2019; Wackowski et al., 2014; Zatoński et al., 2018).

### Discrete Choice Experiments examining U.S. Adults’ Tobacco Product Choices related to Menthol

Six studies used DCEs to examine tobacco product preferences and included menthol cigarettes as product choices (Barrientos-Gutierrez et al., 2020; Buckell et al., 2019; Buckell & Sindelar, 2019; Monzón et al., 2021; Shang et al., 2020; Yang et al., 2021).

Four studies sampled U.S. (1) adult smokers and recent quitters (Buckell et al., 2019), (2) young adults who had ever used cigarettes or e-cigarettes (Buckell & Sindelar, 2019), (3) adult smokers who had ever used or “had not ruled out” e-cigarette use (Shang et al., 2020), and (4) adult e-cigarette users (Yang et al., 2021). Researchers often reported subgroup analyses. We focus on reporting findings relevant to menthol cigarette smokers’ preferences. The earliest DCE that collected product preferences relevant to menthol cigarettes was conducted in late 2016 (Buckell & Sindelar, 2019) and the most recent used data collected in 2020 (Yang et al., 2021).

The remaining two studies assessed product preferences of youth in Mexico (Barrientos-Gutierrez et al., 2020) and Guatemala (Monzón et al., 2021). These countries have markedly different tobacco marketplaces than the United States and so we did not include them in drawing conclusions about product preferences (i.e., **Table 3**). We summarize findings of these studies in Appendix A and **Table 2**.

### Evidence of Tobacco Users’ Product Preferences Driven by Product Type

Four studies provided evidence that tobacco users prefer their usual tobacco product type. Generally, cigarette smokers prefer cigarettes and e-cigarette users prefer e-cigarettes. DCEs documented that:

- Adult cigarette smokers and recent quitters preferred cigarettes to e-cigarettes (multiple  $ps < 0.01$ ) (Buckell et al., 2019).
- Young adults who had ever tried cigarettes or e-cigarettes (64% used cigarettes and 38% used e-cigarettes in past 30 days) preferred cigarettes to e-cigarettes (multiple  $ps < 0.001$ ) (Buckell & Sindelar, 2019).

- Current e-cigarette users preferred e-cigarettes to cigarettes (multiple  $ps < 0.01$ ). Never or less frequent use of cigarettes was associated with greater preferences for e-cigarettes over cigarettes. Differences in participant preferences across product types were substantially larger than differences across flavors (Yang et al., 2021).
- Cigarette smokers preferred cigarettes to e-cigarettes or none of the product options (multiple  $ps < 0.05$ ) (Shang et al., 2020).

#### Evidence of Tobacco Users' Preferences Driven by Flavor

Four studies provided evidence of tobacco users' flavor preferences. Generally, tobacco users prefer tobacco products in the flavor they usually use (e.g., menthol cigarette smokers prefer menthol flavor). However, sample composition and subgroup definitions complicate integrating findings across studies. Further, some studies report findings as a combination of product type (cigarette or e-cigarette) and flavor, and studies suggest product type may be more influential than flavor for product choice (Yang et al., 2021); therefore, we avoid using data where analyses conflate these variables.

Three studies documented that cigarette smokers (most of whom smoke non-menthol cigarette) prefer tobacco flavored products compared to menthol flavored products. DCEs documented that:

- A latent class analysis grouped young adults who had ever tried cigarettes or e-cigarettes into "prefer smoking" and "prefer vaping" groups. The "prefer smoking" group preferred tobacco flavor to menthol flavor ( $p = 0.018$ ) (Buckell & Sindelar, 2019).
- Cigarette smokers preferred tobacco-flavored e-cigarettes over menthol-flavored e-cigarettes (Shang et al., 2020). Compared with tobacco flavor, menthol flavor significantly reduced the probability that cigarette smokers would choose e-cigarettes regardless of regression model type: mixed logit regression ( $p < 0.001$ ), nested regression ( $p < 0.01$ ), and multinomial regression ( $p < 0.05$ ) (Shang et al., 2020).
- Adult cigarette smokers' and recent quitters' e-cigarette flavor preferences, in order, were tobacco, fruit/sweet, and menthol (Buckell et al., 2019).

Two studies documented that menthol cigarette smokers (Shang et al., 2020) and adult e-cigarette users (Yang et al., 2021) prefer menthol flavored tobacco products. DCEs documented that:

- Menthol cigarette smokers preferred menthol-flavored e-cigarettes compared to tobacco-flavored e-cigarettes in a subgroup analysis (Shang et al., 2020).
- Participants in two DCEs significantly preferred menthol flavored tobacco products compared to tobacco flavored products (Yang et al., 2021). Adult e-cigarette users ([DCE one:  $p < 0.05$ ] [DCE two:  $p < 0.01$ ]), adult never cigarette smokers who used flavored e-cigarettes at least once per week ( $p < 0.001$ ), and adults who used flavored e-cigarettes at least once per week and reported using open-system e-cigarettes with non-tobacco and non-menthol flavors ( $p < 0.01$ ) significantly preferred menthol flavored tobacco products compared to tobacco flavored products.

Two studies documented no significant difference in preference for menthol flavored or tobacco flavored products (Buckell & Sindelar, 2019; Yang et al., 2021).

- A latent class analysis grouped young adults ages 18-22 who reported ever trying cigarettes or e-cigarettes into “prefer smoking” and “prefer vaping” groups. The “prefer vaping” group did not significantly prefer menthol flavor to tobacco flavor ( $p = 0.077$ ). This is congruent with findings for the whole sample where there was no significant difference in the choice of menthol flavor compared to tobacco flavor among young adults ages 18-22 who reported ever trying cigarettes or e-cigarettes ( $p = 0.213$ ) (Buckell & Sindelar, 2019).
- Adults who used flavored e-cigarettes at least once per week and were daily cigarette smokers ( $p > .05$ ), weekly smokers ( $p > .05$ ), or former smokers ( $p > .05$ ) did not significantly prefer menthol flavored tobacco products to tobacco flavored products (Yang et al., 2021).

#### Evidence Tobacco Users Will Not Use Tobacco Products if Their Preferred Option is Not Available

Few participants selected the opt-out option (i.e., selecting none of the products presented in a trial) in DCEs. It is unclear whether participants’ “opt-out” choices indicate whether they would not use any tobacco products or whether they would continue using their current product of choice.

- Few adult cigarette smokers (0.9% and 1.8% of participants who were/were not randomized into the incentive compatibility condition) selected none of the products for all 12 trials (Shang et al., 2020).
- In policy simulations based on a DCE, researchers predicted approximately 20% of adult cigarette smokers and recent quitters would not select a tobacco product rather than selecting cigarettes or e-cigarettes. Overall, however, adult cigarette smokers and recent quitters significantly preferred non-menthol cigarettes to no product ( $p < .01$ ) (Buckell et al., 2019).
- 5% of a sample of young adults who had ever tried cigarettes or e-cigarettes selected no product for all trials. These participants indicated little or no intention to use cigarettes or e-cigarettes. Further, this study defined latent groups and found that a “prefer vaping” group preferred no product to cigarettes ( $p < .001$ ), suggesting that tobacco users who do not prefer cigarettes do not intend to use cigarettes if their preferred product is not available (Buckell & Sindelar, 2019).

#### Evidence of Smokers’ Preferences Given Different Marketplace Options

One study conducted a DCE with adult cigarette smokers and recent quitters (Buckell et al., 2019). Researchers used participants’ responses to estimate the probability that respondents would choose cigarettes, e-cigarettes, or no product under different regulation scenarios. Generally, in scenarios where menthol cigarettes are banned, the predicted product choice percentage for cigarettes was lower than scenarios where menthol cigarettes were allowed. Specifically, in scenarios where menthol cigarettes are banned, predicted product shares varied from 40.0%-47.9% for cigarettes, 29.6%-41.3% for e-cigarettes, and 18.8%-22.4% for “none of these.” In scenarios where menthol cigarettes are allowed, predicted product choice shares ranged from 45.2%-53.3% for cigarettes, 26.4%-37.5% for e-cigarettes, and 17.2%-21.4% for “none of these.”

#### Summary and Conclusion

In discrete choice experiments, overall, menthol cigarette smokers prefer cigarettes and menthol flavor compared to e-cigarettes and tobacco flavor (Buckell et al., 2019; Buckell & Sindelar, 2019; Shang et al., 2020; Yang et al., 2021). Tobacco-flavored cigarette smokers prefer tobacco flavored



products to menthol flavored products (Buckell & Sindelar, 2019; Shang et al, 2020). However, menthol-flavored cigarette smokers prefer menthol-flavored products to tobacco-flavored products (Shang et al., 2020) as do adult users of e-cigarettes (Yang et al., 2021). Some studies that used diverse tobacco product user groups did not have significant findings for flavor preference (Buckell & Sindelar, 2019; Yang et al., 2021). Flavor preferences may not be homogenous across groups with diverse product use behaviors. DCE opt-out options are ambiguous and may not capture if menthol cigarette smokers intend to quit tobacco use rather than substitute other tobacco products. Finally, when used to model product shares under different regulation scenarios, a menthol cigarette ban generally reduced product shares for cigarettes (Buckell et al., 2019).

### Experimental Tobacco Marketplace Studies

Two studies used experimental marketplace designs to observe menthol cigarette smokers' product purchases in simulated conditions of menthol sales restrictions. Experimental tobacco marketplaces (ETMs) are simulated marketplaces where researchers can manipulate tobacco product characteristics, availability, and price (Denlinger-Apte et al., 2021). Denlinger-Apte et al. (2021) used an ETM that included cigarettes, little cigars and cigarillos (LCCs), smokeless tobacco, e-cigarettes (flavors restricted to menthol, mint, and tobacco), and nicotine replacement therapy (gum and patches). Menthol cigarette smokers participated in two sessions with multiple trials per session. Researchers altered menthol cigarette price across trials within sessions and the availability of menthol LCCs across sessions. Participants completed a three-day field assessment where they could only use the products that they purchased in a trial where menthol cigarettes were prohibitively expensive. Guillory et al. (2020) assigned menthol cigarette smokers to one of four experimental conditions that affected menthol tobacco products in an ETM where menthol cigarette smokers could purchase tobacco products (cigarettes, LCCs, smokeless tobacco, e-cigarettes, and nicotine gum) and other convenience store items (e.g., candy, gum, and soda) during one experimental session. In both studies participants could purchase multiple products.

#### Menthol Cigarette Smokers Purchase Non-Menthol Cigarettes in Simulated Conditions

Two ETM studies demonstrated that menthol cigarette smokers purchased non-menthol cigarettes when menthol cigarettes were unavailable or prohibitively expensive:

- Menthol cigarette smokers purchase non-menthol cigarettes more frequently when menthol cigarettes are unavailable. Menthol cigarette smokers were significantly less likely to buy cigarettes in a scenario with a hypothetical menthol cigarette ban (49.3% bought non-menthol cigarettes) compared to a scenario with no menthol cigarette ban (59.3% of participants bought cigarettes overall, and 50.3% of participants bought menthol cigarettes) (OR = 0.67, 95% CI = 0.48, 0.92,  $p = 0.014$ ) (Guillory et al., 2020).
- Significantly more menthol cigarette smokers purchased a cigarette brand different from their usual brand in the menthol cigarette ban condition (60.6%) compared to the no ban condition (31.4%) (OR = 3.40, 95% CI = 2.14, 5.41,  $p < 0.001$ ) (Guillory et al., 2020)
- As the price of their usual brand menthol cigarettes increased, more menthol cigarette smokers bought non-menthol cigarettes of their usual brand (2.4% bought non-menthol cigarettes when menthol cigarettes were priced lowest and menthol LCCs were not available; 43.9% bought non-menthol cigarettes when menthol cigarettes were priced highest and menthol LCCs were not available) (Denlinger-Apte et al., 2021).

- Non-menthol cigarettes are the strongest substitutes for menthol cigarettes, as indicated by their higher cross-elasticity of demand. When menthol cigarettes became prohibitively expensive and menthol LCCs were not available, participants substituted non-menthol cigarettes ( $\beta = 0.59$ , 95% CI = 0.08, 1.11) and cigarillos ( $\beta = 0.62$ , 95% CI = 0.19, 1.04), menthol e-cigarettes ( $\beta = 0.13$ , 95% CI = 0.08, 0.18), and snus ( $\beta = 0.27$ , 95% CI = 0.04, 0.50) (Denlinger-Apte et al., 2021). When menthol cigarettes became prohibitively expensive and menthol LCCs were available, participants substituted non-menthol cigarettes ( $\beta = 0.65$ , 95% CI = 0.34, 0.96), menthol little cigars ( $\beta = 0.39$ , 95% CI = 0.08, 0.70), and menthol e-cigarettes ( $\beta = 0.26$ , 95% CI = 0.17, 0.35) (Denlinger-Apte et al., 2021).

#### Menthol Cigarette Smokers Purchase E-Cigarettes in Simulated Conditions

Two ETM studies demonstrated that some participants, particularly those who had used a non-cigarette tobacco product within the past 12 months, purchased menthol e-cigarettes when menthol cigarettes were unavailable or prohibitively expensive:

- Across scenarios, 20-25% of participants purchased a combination of non-menthol cigarettes and menthol e-cigarettes (Denlinger-Apte et al., 2021). Participants were menthol cigarette smokers who had used a non-cigarette tobacco or nicotine product at least once during the past 12 months.
- When menthol cigarettes were priced prohibitively high, 68.3% or 70.7% of participants purchased menthol e-cigarettes (in scenarios where menthol LCCs were/were not available), followed by non-menthol cigarettes (43.9/36.6%), non-menthol cigarillos (7.3/22.0%), menthol cigarettes (9.8/17.1%), and other products at lower percentages (Denlinger-Apte et al., 2021).
- Adult menthol cigarette smokers' purchase of non-cigarette tobacco products, including e-cigarettes, LCCs, smokeless tobacco, and nicotine replacement therapy (NRT) gum, did not significantly differ in scenarios with and without menthol sales restrictions, with 16.1-17.4% of participants selecting non-cigarette tobacco products across conditions. Across conditions, 5.0-6.7% selected e-cigarettes that came in tobacco, menthol, mint, and other flavor (Guillory et al., 2020).

#### Menthol Cigarette Smokers Do Not Purchase Any Tobacco Products in Simulated Conditions

Two ETM studies found very different percentages of menthol cigarette smokers chose not to purchase a tobacco product in scenarios where menthol cigarettes were unavailable or prohibitively expensive. Denlinger-Apte et al. (2021) required participants to abstain from tobacco and NRT use for three days if they did not purchase a tobacco or NRT product from the ETM. Guillory et al. (2020) did not include a field assessment. The difference in real-world consequences may have impacted study results.

- 30.7% of adult menthol cigarette smokers in the no ban condition; 31.8% in the green replacement of menthol cigarette condition; 38.9% in the menthol cigarette ban condition; and 45.0% in the all menthol tobacco product ban condition did not purchase tobacco products (Guillory et al., 2020).
- All participants purchased either a tobacco or NRT product during all trials, even though participants could have chosen to abstain from use and receive their account balance instead of using tobacco or nicotine products (Denlinger-Apte et al., 2021).

## Summary and Conclusion

In experimental tobacco marketplace studies, nearly half of menthol cigarette smokers purchased non-menthol cigarettes when menthol cigarettes were unavailable or prohibitively expensive (Denlinger-Apte et al., 2021; Guillory et al., 2020). Some menthol cigarette smokers purchase menthol-flavored e-cigarettes when menthol cigarettes were unavailable, but the percentage varied widely across studies and likely depends on past use of a non-cigarette tobacco product (Denlinger-Apte et al., 2021; Guillory et al., 2020). The percentage of menthol cigarette smokers who did not purchase any tobacco products was greatest when menthol cigarettes and all menthol products were banned (Guillory et al., 2020).

## Limitations

Limitations of this review include the possibility of publication bias; we only include articles written in English, and we excluded studies that were not peer reviewed. We did not have access to raw data for any study to perform independent statistical analyses. However, we do not have reason to believe that these concerns would impact our conclusions. The behavioral intention and ETM studies reviewed primarily report the percentage of participants who selected each response option; when reported, information about statistical significance is often secondary; therefore, publication bias is unlikely to affect conclusions drawn. DCEs include multiple factors that change across trials and may have low publication bias concerns because researchers are likely able to successfully publish a DCE if even one factor is statistically significant. Further, articles published in a language other than English may be of limited use in understanding U.S. population behavioral intentions, choices, and preferences. While we are aware of one report on behavioral intentions that was not peer reviewed and so did not meet inclusion criteria (Hartman, 2011), the report's findings were congruent with the conclusions of this review.

We reviewed all studies that met inclusion criteria, regardless of when the research was conducted or published. The tobacco marketplace has evolved rapidly with changes in product type availability, changes in tobacco product technology, and changes in tobacco product characteristics. Concurrently, the public's awareness (Nyman et al., 2018), harm perceptions (Huang et al., 2019), and expectations (Correa et al., 2019) of tobacco products have fluctuated. Additionally, tobacco regulations have changed at the federal, state, local, tribal, and territorial levels. These factors likely influence menthol cigarette smokers' reported behavioral intentions and product preferences. Currency of data impacts the utility and interpretation of the reviewed studies for anticipating menthol cigarette smokers' behaviors in the event of a menthol cigarette sales ban.

Further, several studies had small sample sizes, used convenience samples, or used data from non-U.S. populations or populations sampled from limited U.S. geographic regions. Some study designs (e.g., focus groups) are only feasible with small samples sizes and lack of generalizability is an understood tradeoff for gains in contextually rich data. Still, participants who self-select to participate in such studies may differ from the population of U.S. adults who smoke menthol cigarettes. Additionally, some study aims were regionally specific, but these study findings may still inform U.S. population findings. Lastly, we included data from one study that used a non-U.S. population but strongly caveat the generalizability of this data where warranted. Overall, sample characteristics impact the extent to which study findings can be generalized to the population of U.S. menthol cigarette smokers.

All studies reviewed in this section used participant self-report data. Demand effects, social desirability, and cognitive biases (e.g., availability bias, framing effects) can affect self-report data and pose threats to internal validity. For example, social desirability bias is a tendency to select certain response options to be viewed favorably by others. This is a particular concern for studies where researchers are present during data collection. Availability bias may affect responses to survey items that include an “other” option because such unspecified options may be less salient to participants. Researcher selection of response options or product choices and attributes impacts participants’ responses. Threats to internal validity due to cognitive biases and participants’ motivations impact data differently depending on study design, survey design, and study implementation.

Studies that examine behavioral intentions in response to hypothetical scenarios have substantial threats to external validity. Participants’ reported behavioral intentions may or may not predict actual behavior. People may not accurately comprehend hypothetical menthol cigarette bans or may be unable to accurately predict how they would behave in a hypothetical scenario. Studies that assess behavioral intentions in response to hypothetical menthol cigarette bans may be particularly susceptible to social desirability and availability biases.

DCEs have strong internal validity; researchers can causally link changes in product preferences to changes in product attributes. However, DCEs are artificial scenarios and external validity concerns may limit the applicability of results. DCEs capture participants’ preferences for product attributes, but do not directly capture behavioral intention. DCEs include only a subset of product types and attributes to reduce participant burden and maintain data integrity and interpretability. Most studies reviewed only included cigarettes and e-cigarettes as product choices (Buckell et al., 2019; Buckell & Sindelar, 2019; Shang et al., 2020), though one study included heated tobacco products (Yang et al., 2021). These studies may not represent realistic preferences in the U.S. tobacco marketplace where many types of tobacco products are available. DCEs assume that relative probabilities for choices of product options are not affected by the absence of other product options in the study (OECD, 2018); however, this may not be true for tobacco products. Further, most DCEs include an option for participants to opt out of a trial (e.g., choose neither product offered). However, it is unclear whether choosing “none of these” indicates that a participant would quit tobacco use given the product options, select a product not offered as an option, or do something else. In DCEs, opt-out options generally capture preferences for the status quo compared to the alternative options offered (OECD, 2018); however, this interpretation does not apply to DCE studies of tobacco product choice because opt-out does not indicate the status quo of selection of the participants’ preferred tobacco product. In most studies reviewed, participants’ choices did not have consequences, with the exception of Shang et al. (2020) where a subset of participants were told they would receive \$100 worth of their chosen product for one trial or \$100 cash. No DCE allowed participants to test products. Therefore, while DCEs provide information on product preference, they do so within a limited set of behavioral options which participants may not have experience with and that do not impact participants. However, DCEs may be less susceptible to social desirability biases due to a lower likelihood of participants’ perceiving a “right” answer.

Experimental tobacco marketplace studies may address some of the limitations of DCEs and studies of behavioral intentions. Experimental tobacco marketplace studies include many product choices and in the case of one study, involved a real-world assessment of product use where participants could only use products purchased in the experimental marketplace, mimicking conditions of a realized menthol cigarettes sales ban. However, product choices in experimental marketplace

studies may still not represent product choices in the event of a menthol cigarette sales ban due to the short period of assessment and use of hypothetical experimental conditions, such as limited product options or unrealistic marketplace presentations.

Despite these limitations, studies of behavioral intentions in response to hypothetical scenarios, DCEs, and ETM studies can provide useful insight about the range of behaviors that people may engage in if menthol cigarettes are no longer available in the marketplace. The studies reviewed suggest that if menthol cigarettes are no longer available, most menthol smokers intend to try to quit smoking or use non-menthol cigarettes. Some menthol smokers intend to use alternative tobacco products (such as e-cigarettes or LCCs), dually use cigarettes and alternative tobacco products, or continue to try to obtain menthol cigarettes. The multiple study designs reviewed are complementary and consistently support these conclusions.

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## Appendix A: Article Summaries

### Behavioral Intentions in Response to Hypothetical Menthol Cigarette Bans

**D’Silva et al. (2015)** conducted cross-sectional analyses using 2014 Minnesota Adult Tobacco Survey data from N = 1,158 adult (aged 18+) current menthol cigarette smokers residing in Minnesota. Analysts applied Minnesota sampling weights based on sampling frame and demographic characteristics to obtain population level estimates. Participants who indicated they smoked menthol cigarettes responded to the item, “If menthol cigarettes were no longer sold in U.S. stores, would you quit smoking?” If participants responded “no”, they received a follow-up question to indicate what they would do, with response options switch to non-menthol cigarettes, switch to some other non-menthol tobacco product, switch to menthol e-cigarettes, switch to some other menthol tobacco product, buy menthol cigarettes online, or buy menthol cigarettes from another country. In the event of a hypothetical U.S. menthol cigarette sales ban, 46.4% (95% CI = 37.9, 54.9) of menthol cigarette smokers indicated they intend to quit smoking, 26.6% (95% CI = 19.0, 34.1) of menthol cigarette smokers would switch to non-menthol cigarettes, 12.3% (95% CI = 6.3, 18.3) would switch to menthol e-cigarettes, 5.8% (95% CI = 1.8, 9.7) would buy menthol cigarettes online, 2.8% (95% CI = 0.4, 5.2) would switch to some other menthol tobacco product, 2.7% (95% CI = 0.0, 6.0) would buy menthol cigarettes from another country, 1.5% (95% CI = 0.0, 3.8) would switch to some other non-menthol tobacco product. Among African American menthol cigarette smokers, 76.0% (95% CI = 57.6, 94.3) intend to quit smoking in the event of a US menthol cigarette sales ban compared to 30.3% (95% CI = 21.7, 38.9) of White menthol cigarette smokers, indicating that African American menthol cigarette smokers are more than twice as likely as White menthol cigarette smokers to report intending to quit (RR = 2.5, 95% CI = 1.7, 3.6,  $p < .001$ ).

**D’Silva et al. (2021)** conducted in-depth semi-structured interviews in June–September 2017 with N = 27 African American adult (aged 25+) smokers residing in the Minneapolis–St. Paul area of Minnesota. Participants must have smoked daily for 5+ years. Within this sample, 96% of people smoked Newport cigarettes. Researchers asked participants how menthol sales restrictions might influence their smoking and purchasing behaviors, following a summary of regional menthol sales restrictions under consideration at the time of the study which restrict menthol tobacco sales to adult-only tobacco shops and liquor stores. Participants stated that they intend to acquire menthol cigarettes where available at tobacco shops and liquor stores, get help from friends to acquire menthol cigarettes, purchase menthol cigarettes from other cities or bootleg sources, try non-menthol cigarettes, reduce their cigarette use, or quit cigarette smoking. Participants frequently cited changes in cost as a concern and potential motivation to reduce or quit cigarette use, including an increased cost of transportation to acquire menthol cigarettes.

**O’Connor et al. (2012)** assessed behavioral intentions in response to a hypothetical scenario where menthol is removed from cigarettes using a cross-sectional web-based survey completed in July 2010 that included a validated purchase task simulation. Participants (N = 417) were adolescent (aged 14-17)

and adult (aged 18-25,  $\geq 26$ ) current cigarette smokers recruited through a consumer panel. Of the respondents,  $n = 170$  were menthol cigarette smokers. In response to the hypothetical scenario, 36.5% of menthol cigarette smokers indicated they would try to quit smoking, 28.2% didn't know what they would do, 27.1% would smoke less, 24.1% would find a way to buy a menthol brand, 21.2% continue to smoke about the same as they do now, 17.6% may try smokeless tobacco that comes in menthol, 17.1% would not consider using a non-menthol cigarette, 14.7% would switch to another cigarette brand, 14.7% would be able to quit smoking, 11.8% might switch to cigars that are flavored, 10.6% would add menthol themselves, and 7.6% would smoke more than they do now. Respondents could select one or more reactions.

**Pacek et al. (2019)** conducted an online survey on Qualtrics assessing menthol cigarette smokers' behavioral intentions in response to the prompt, "Imagine that e-cigarettes available in the United States are like they are today BUT only non-menthol regular cigarettes are available (i.e., menthol cigarettes are no longer available)." Participants ( $N = 240$ ) were recruited on Amazon Mechanical Turk (MTurk) from June 20-22, 2017. Eligible participants were U.S. residents aged 18-29 who had smoked cigarettes for at least 3 months and one day in the past week, used e-cigarettes for at least 3 months and one day in the past week, and received at least a 95% approval rating from previous MTurk tasks. Approximately half (52.5%;  $n = 126$ ) were menthol cigarette smokers. In response to a hypothetical menthol cigarette ban, participants' responses indicated no statistical differences for intending to quit cigarettes ( $\sim 25\%$ ; estimated from bar graph) versus quit e-cigarettes ( $\sim 17\%$ ); no statistical difference for intending to reduce cigarette use ( $\sim 32\%$ ) versus reduce e-cigarette use ( $\sim 25\%$ ); and no statistical difference for intending to maintain the same cigarette use ( $\sim 21\%$ ) versus maintain the same e-cigarette use ( $\sim 23\%$ ). While not statistically significant, participants' responses indicated a trend to increase e-cigarette use ( $\sim 30\%$ ) versus increase cigarette use ( $\sim 19\%$ ) ( $\chi^2(1, N = 126) = 3.06, p = 0.080$ ). Using e-cigarettes on a greater number of days during the past week (adjusted Relative Risk Ratio = 1.51; 95% CI = 1.11, 2.07), intentions to quit e-cigarette use (aRR = 6.08; 95% CI = 1.51, 24.46), and greater Fageström Test for Nicotine Dependence scores (aRR = 1.42; 95% CI = 1.03, 1.97) were associated with increased likelihoods of quitting versus maintaining cigarette use in the event of a menthol cigarette ban. Using cigarettes on a greater number of days during the past week was associated with decreased likelihood of quitting versus maintaining cigarette use in the event of a menthol cigarette ban (aRR = 0.58; 95% CI = 0.41, 0.83). Smoking more cigarettes per day was associated with an increased likelihood of increased versus maintained cigarette use in the event of a menthol cigarette ban (aRR = 1.22; 95% CI = 1.01, 1.46).

**Pearson et al. (2012)** assessed behavioral intentions in the hypothetical scenario where menthol cigarettes were no longer available using a cross-sectional online survey drawn from a nationally representative online cohort of adults. Participants ( $N = 2,649$ ) were never, former, and current smokers aged 18+;  $n = 465$  (37%) of current smokers were menthol cigarette smokers. If menthol cigarettes were no longer available, 38.9% (95% CI = 33.0, 45.2) of menthol cigarette smokers indicated they would try to quit, 25.2% (95% CI = 20.0, 31.3) indicated they would switch to a non-menthol brand and try to quit, and 12.5% (95% CI = 8.7, 17.7) indicated they would switch to non-menthol brand. Menthol cigarette smokers with at least one quit attempt in the past three months were significantly more likely to indicate they would try to quit in the event of a menthol cigarette ban (aOR = 2.04, 95% CI = 1.00, 4.15) than those who had no quit attempt in the past three months. Menthol cigarette smokers who intended to quit in the next six months were significantly more likely to indicate they would switch to a non-



menthol brand and try to quit (aOR = 3.32, 95% CI = 1.35, 8.17), or switch to a non-menthol brand (aOR = 0.27, 95% CI = 0.09, 0.82) than those who were not interested in quitting.

**Rose et al. (2019)** conducted a longitudinal survey online assessing participants behavioral intentions in the hypothetical scenario where “menthol cigarettes were no longer sold.” Participants (N = 806) were recruited through the Truth Initiative Young Adult Cohort which is a national sample drawn from an online panel recruited via address-based sampling of the U.S. population. Participants included in analyses were young adult (aged 18-34) past 30-day menthol cigarette smokers. Researchers surveyed participants every six months resulting in N = 1,963 observations. In response to a hypothetical menthol cigarette ban, at most waves, the greatest percentage of respondents would switch to non-menthol cigarettes (average = 32.3%) or did not know what they would do if menthol cigarettes were unavailable (average = 30.8%). On average, 23.5% across waves indicated that they would quit smoking and not use any other products; 10.7% indicated that they would switch to some other tobacco product. Switching to some other product significantly increased over time from 7.4% in 2011 to 13.2% in 2016 ( $b = 0.71$ ;  $p = 0.01$ ). Menthol smokers who were Non-Hispanic African American (vs. Non-Hispanic White), female (vs. male), and had less than a high school education (vs. at least some college) were more likely to say they would quit smoking if menthol cigarettes were unavailable.

**Wackowski et al. (2014)** assessed behavioral intentions in the hypothetical scenario that menthol cigarettes were no longer sold using data from the 2011 National Young Adult Health Survey, a national stratified random-digit-dial cell-phone survey of adults aged 18-34. There were N = 2,871 respondents who were current smokers; n = 619 were current menthol cigarette smokers. If menthol cigarettes were no longer sold, 65.7% (95% CI = 56.2, 74.1) of menthol cigarette smokers indicated that they would quit smoking and not use any other products, 18.4% (95% CI: 13.3, 24.8) indicated they would switch to non-menthol cigarettes, 16.0% (95% CI = 9.2, 26.3) indicated they would switch to some other tobacco product, and 1.5% of respondents indicated they did not know what they would do or that they would do something else (i.e., none of the above). Intention to completely quit tobacco use in the event of a menthol cigarette ban was most prevalent among Black menthol cigarette smokers (79.3%; 95% CI = 63.1, 89.6) while most Asian menthol cigarette smokers (62.0%; 95% CI = 42.8-71.9) indicated they would switch to non-menthol cigarettes. Intention to switch to another type of tobacco product was most prevalent among Hispanics (34.6%, 94% CI = 15.0, 61.4). Intention to switch to another tobacco product was more prevalent among menthol cigarette smokers who indicated concurrent use of other tobacco products (35.5%; 95% CI = 19.1, 55.7) than those who reported no use of other tobacco products (5.5%; 95% CI = 2.6, 11.4%).

**Wackowski et al. (2015)** assessed behavioral intentions in the hypothetical scenario that menthol cigarettes were no longer sold using an online cross-sectional survey administered in April 2014. Eligible participants were adult (aged 18+) current smokers recruited from a nationally representative research panel. Among participants (N = 519), 36.3% were menthol cigarette smokers. For menthol cigarette smokers, if menthol cigarettes were no longer sold, 45.9% indicated they would switch to non-menthol cigarettes, 28.4% indicated that they would quit smoking and not use any other product, 15.1% indicated they would switch to menthol e-cigarettes, 6.7% indicated they would do something else (i.e., “other”), and 3.9% indicated they would switch to some other tobacco product. Older smokers (aged 45+; 40.1%; 95% CI = 27.7, 54.0) and Black menthol cigarette smokers (47.4%, 95% CI = 29.9, 65.5) had a significantly higher prevalence of indicating they would quit tobacco use altogether than younger (20.0%, 95% CI = 10.5, 34.6) and White menthol cigarette smokers (17%, 95% CI = 8.6, 30.9),

respectively. Higher percentages of Black (23%, 95% CI = 10.6, 42.7) and White (18.3%; 95% CI = 10.7-29.5) menthol cigarette smokers said they would switch to menthol e-cigarettes compared to Hispanic menthol cigarette smokers (0.7%; 95% CI = 0.1, 5.0).

**Wackowski et al. (2018)** conducted six in-person focus groups from December 2014 to March 2015 in New Jersey, U.S. with a convenience sample of N = 45 adult (aged 18-24) current smokers who usually smoke a menthol brand of cigarettes. Three groups were composed of Black participants and three general groups were composed of participants who identified with racial and ethnic categories other than Black. As one prompt, the focus group moderator asked participants “what do you think you would do if menthol cigarettes were no longer sold in the United States?” Some participants in the general groups stated they would switch to non-menthol cigarettes in response to a hypothetical menthol cigarette ban. More participants, including participants in the Black groups, expressed that switching to non-menthol cigarettes would not be “worth it” and stated that a menthol cigarette ban may help them quit smoking. Several Black participants indicated they would return to using or increase their frequency of use of Black & Mild cigars, including participants who stated they intended to quit smoking in the event of a menthol cigarette ban. Some participants who used e-cigarettes indicated that they would continue to use e-cigarettes in the event of a menthol cigarette ban. Participants viewed smokeless tobacco as “gross” and no participants indicated that they intended to switch to smokeless tobacco in the event of a menthol cigarette ban.

**Zatoński et al. (2018)** assessed behavioral intentions in the hypothetical event of a ban on current smokers’ preferred cigarette brand. Data were from the 2016 International Tobacco Control Policy Evaluation Project (ITC) 6 European Country Survey (6E). Participants (N = 10,760; 7.2% menthol cigarette smokers) were adult (aged 18+) current cigarette smokers in Germany, Hungary, Poland, Romania, Spain, and England. Researchers conducted the survey using face-to-face computer-assisted personal interviews except for surveys in England and the Netherlands, which they conducted via internet surveys. Across countries, 20% (95% CI = 16.9, 23.4) of menthol cigarette smokers indicated they would switch to another brand following a hypothetical ban on the sale of their preferred cigarette brand, 27.3% of menthol cigarette smokers (95% CI = 23.7, 31.3) would find a way to get the banned product regardless, 17.6% (95% CI = 14.5, 21.1) indicated they would reduce the amount they smoked, and 16% (95% CI = 13.3, 19.2) indicated they would quit altogether. Among menthol cigarette smokers, 14.8% (95% CI = 12.0, 18.0) indicated that they do not know what they would do and 4.3% (95% CI = 2.8, 6.5) indicated that they would do something other than the options offered.

### Discrete Choice Experiments examining U.S. Adults’ Product Choices

**Buckell, Marti, & Sindelar (2019)** assessed adult smokers’ and recent quitters’ product choices using a DCE. Participants (N = 2,031) were recruited through Qualtrics. In a DCE, participants chose their top two preferred products from 4 product options composed of e-cigarettes and cigarettes; participants could select “none of these” as their preferred option. Products differed by flavor, health impact, amount of nicotine, and price. Researchers estimated participant product choice in the event of menthol cigarette and flavored e-cigarette bans. The greatest reduction in cigarette selection occurred in the scenario where menthol cigarettes were banned and menthol and fruit/sweet e-cigarettes allowed: 40.0% of respondents selected cigarettes, 41.3% of respondents selected e-cigarettes, and 18.8% of respondents selected no product. The greatest increase in cigarette selection occurred in the scenario where menthol cigarettes were allowed and menthol and fruit/sweet e-cigarettes were banned: 53.5% of respondents

selected cigarettes, 26.4% of respondents selected e-cigarettes, and 20.2% of respondents selected no product. In a scenario where menthol cigarettes were banned, menthol e-cigarettes were allowed, and fruit/sweet e-cigarettes were banned<sup>7</sup>: 45.8% of respondents selected cigarettes, 32.8% of respondents selected e-cigarettes, and 21.4% of respondents selected no product. In a scenario where menthol cigarettes and menthol and fruit/sweet e-cigarettes were banned: 47.9% of respondents selected cigarettes, 29.6% of respondents selected e-cigarettes, and 22.4% of respondents selected no product. In a scenario where menthol cigarettes and menthol e-cigarettes were banned and fruit/sweet e-cigarettes were allowed: 41.7% of respondents selected cigarettes, 38.3% of respondents selected e-cigarettes, and 19.4% of respondents selected no product. Heterogeneity in product choice was noted by participant demographics.

**Buckell & Sindelar (2019)** assessed product choices of U.S. young adults (N = 2,003) aged 18–22 years who ever tried cigarettes or e-cigarettes. Researchers recruited participants on Qualtrics in November 2016 – May 2017. The sample matched the 2015 National Health Interview Survey by age, gender, education, and census region. In a DCE, participants could choose between cigarettes or e-cigarettes that differed by flavors, short-term health risks to self, secondhand smoke risks, and price. Participants preferred cigarettes to e-cigarettes, and preferred fruit and candy flavors to tobacco flavor. Latent class analysis found that participants could be grouped into categories of “prefer smoking” and “prefer vaping.” The “prefer smoking” group preferred tobacco to all other flavors (menthol and fruit showed a significant coefficient) and the “prefer vaping” group preferred all flavors to tobacco (fruit and candy showed a significant coefficient).

**Shang et al. (2020)** assessed product choices of U.S. adult smokers (N = 1,154), 76% of whom were daily smokers who used e-cigarettes or had “not ruled out future use” of e-cigarettes. Researchers recruited participants in 2017 through an online panel. Participants chose among their own cigarettes, two e-cigarette products whose attributes varied across tasks, or none in a DCE. E-cigarette features differed by flavor, nicotine strength, price, relative harm, and effectiveness for helping smokers quit. Researchers told half of the participants that one participant would be randomly selected to receive \$100 of their product of choice or \$100 cash (in reality, one participant received \$100 cash). Researchers weighted analyses to represent the U.S. adult smoker population. Compared with tobacco flavor, menthol flavor significantly reduced the probability of choosing e-cigarettes. Fruit, candy, sweet, and other flavors, compared with tobacco flavor, also significantly reduced the probability of choosing e-cigarettes in some analyses. Although the overall results suggest that smokers do not prefer menthol-flavored e-cigarettes, stratified analyses indicate that this finding represents smokers of tobacco-flavored cigarettes and that smokers of menthol cigarettes do prefer menthol-flavored e-cigarettes. Marginal willingness to pay for a tobacco flavor e-cigarette over a menthol flavor e-cigarette is \$3.37. These findings indicated that smokers prefer e-cigarette flavors that are the same as their cigarette flavors (i.e., tobacco or menthol) and that there is heterogeneity in smokers’ preference for e-cigarette flavors as a result.

**Yang et al. (2021)** conducted two online DCEs in 2020 with a convenience sample of N = 2,642 adult (aged 18+) current flavored e-cigarette users with ≥ 90% approval rating from previous MTurk tasks. Most participants smoked cigarettes, with 41% of participants identifying as daily smokers and 47% as weekly smokers. DCE product choice options were cigarettes, open-system e-cigarettes, closed-system

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<sup>7</sup> We noted an error in Table 4 of the published version of Buckell et al. (2019) in which the authors describe this scenario as allowing rather than banning menthol combusted cigarettes.

e-cigarettes, and heated tobacco products (HTPs). Participants could choose “none” in each trial if they would not select any of the available product options. Products in each trial varied by flavor, nicotine level, and price; with the two studies differing in flavor options for open-system e-cigarettes to mimic flavored e-cigarette policy options. Participants preferences by device showed preferences in order of open-system e-cigarettes, closed-system e-cigarettes, combusted cigarettes, and HTPs, with notable preference for e-cigarettes. Older adults had lower preference for e-cigarettes and HTPs compared to younger and middle-aged adults. Participants who never or infrequently used cigarettes had higher preference for e-cigarettes compared to cigarettes compared to daily smokers. Further, availability of non-tobacco and non-menthol flavors appears to be a larger factor in tobacco product choice for never-smokers compared to current and former smokers.

### Experimental Marketplace Study Examining Adults' Product Choices

**Denlinger-Apte et al. (2021)** assessed adult menthol cigarette smokers' (N = 40) product purchases using an experimental tobacco marketplace (ETM) behavioral economics task. Eligible participants smoked at least five cigarettes per day, reported a menthol brand as their favorite, and used a non-cigarette tobacco or nicotine product at least once during the past 12 months. Researchers recruited participants in Providence, Rhode Island. Cigarettes, little cigars and cigarillos (LCCs), smokeless tobacco, e-cigarettes (flavors restricted to menthol, mint, and tobacco), and nicotine replacement therapy (gum and patches) were available from an online store. Participants participated in two sessions during which researchers altered menthol cigarette price across trials within sessions and the availability of menthol LCCs across sessions. Participants were able to purchase products in the ETM and received products purchased for use during a three-day field assessment, in which they were to only use the products purchased from the ETM. Researchers told participants they would receive products to try from a random trial; however, participants always received the products they purchased from the trial in which menthol cigarettes were most expensive. Researchers modeled cigarillos and little cigars separately rather than as a combined LCC category. When menthol cigarettes were at their highest price, in conditions with/without menthol LCCs available: 68.3/70.7% of participants purchased menthol e-cigarettes; 43.9/36.6% of participants purchased non-menthol cigarettes; 7.3/22.0% of participants purchased non-menthol cigarillos; 9.8/17.1% of participants purchased menthol cigarettes. When the price of menthol cigarettes increased, people were more likely to substitute non-menthol cigarettes than menthol little cigars or cigarillos. Many participants purchased multiple product types from the ETM during a trial. The most common combination was non-menthol cigarettes and menthol e-cigarettes with 20-25% of participants purchasing this combination. Less than 13% of participants purchased tobacco flavored e-liquid pods. Making menthol cigarettes prohibitively expensive when menthol LCCs were available increased participants' likelihood of choosing non-menthol cigarettes ( $\beta = 0.65$ , 95% CI = 0.34, 0.96), followed by menthol little cigars ( $\beta = 0.39$ , 95% CI = 0.08, 0.70), and menthol e-cigarettes ( $\beta = 0.26$ , 95% CI = 0.17, 0.35) ( $\beta$ s represent cross-price elasticity). When menthol LCCs were not available, making menthol cigarettes prohibitively expensive increased participants' likelihood of choosing non-menthol cigarettes ( $\beta = 0.59$ , 95% CI = 0.08, 1.11) and cigarillos the most ( $\beta = 0.62$ , 95% CI = 0.19, 1.04), followed by menthol e-cigarettes ( $\beta = 0.13$ , 95% CI = 0.08, 0.18) and snus ( $\beta = 0.27$ , 95% CI = 0.04, 0.50). When menthol LCCs were available, the most frequently purchased alternative products were menthol e-cigarettes (29.3–70.7% of participants), non-menthol cigarettes (2.4–43.9%), and menthol cigarillos (9.8–29.3%) depending on the menthol cigarette price. When menthol LCCs were not available, the most frequently purchased alternative products were menthol e-cigarettes (46.3–70.7%), non-menthol cigarettes (0–39.0%), and non-menthol cigarillos (0–22.0%). No participants opted to

abstain from using tobacco products during the field trial, even though doing so would have allowed them to receive their account balances at their final visit.

**Guillory et al. (2020)** conducted an experimental marketplace study assessing menthol cigarette smokers' purchases in response to four experimental conditions that affected menthol tobacco product availability. A cross-sectional experiment with a "no ban" control group was employed. Participants completed a shopping task in one of four versions (experimental conditions) of the RTI iShoppe virtual store: (1) no ban, (2) replacement of menthol cigarettes and ads with green replacement versions (product packaging does not say menthol and says green), (3) menthol cigarette ban, and (4) all menthol tobacco product ban. Participants navigated the virtual store and used a \$15 or \$20 budget to purchase anything they wanted in the store (such as candy, gum, soda, and tobacco products). Participants in all conditions except no ban were shown a text reminder of the hypothetical scenario (no menthol products or green versions) when they selected any tobacco product for purchase. Participants also completed a survey in which they indicated how they would respond to a hypothetical menthol cigarette ban. Researchers recruited participants (N = 1,197) through Lightspeed's online convenience panel in May 2018. Eligible participants were adults aged 18 and older who reported smoking menthol cigarettes every day or some days. Recruitment met quotas based on past 30-day menthol smoking rates (50% White, non-Hispanic, 30% Black, non-Hispanic and 20% Hispanic). In addition to smoking menthol cigarettes, 53% of participants reported current e-cigarette use, 27% reported current LCC use, and 26% reported current smokeless tobacco use. Participants in the menthol cigarette ban (OR=0.67, 95% CI 0.48 to 0.92) and all menthol product ban conditions (OR=0.60, 95% CI 0.43 to 0.83) were less likely to purchase cigarettes of any type than participants in the no ban condition. The most common response from participants across conditions to a survey item on how a hypothetical menthol cigarette ban would affect their smoking was that they would try to quit (34%-39% range across conditions). Other responses were switch to non-menthol cigarettes (26.0-29.4%), switch to other flavored or menthol tobacco product (21.6%-27.8%), other (0.7-2.7%), and don't know (7.7-9.7%).

#### Discrete Choice Experiments with Samples of Adolescents in Mexico and Guatemala

**Barrientos-Gutierrez et al. (2020)** assessed which brand of cigarettes early adolescents (N = 4,251; aged 12–14) reported that they were most likely to smoke using a DCE where flavor (including menthol) and capsules were product features that varied across trials. Researchers recruited participants from middle schools in the three largest cities in Mexico in 2016. Most participants did not smoke and were not susceptible to smoking. The presence of flavor capsules and menthol-flavored tobacco increased interest in trying. There was a statistically significant interaction between tobacco flavor and flavor capsules such that menthol tobacco was perceived as relatively unappealing in cigarettes without flavor capsules; however, menthol enhanced interest in trying cigarettes with flavor capsules.

**Monzón et al. (2021)** examined Guatemalan high school students' (N = 2,038; aged 13-18) product choices when products varied by product type (e-cigarettes, HTP, cigarettes), brand, nicotine content and flavor (cherry, berry, menthol, and tobacco flavor choices for cigarettes). Researchers recruited participants from eight private schools in Guatemala City in 2019. The DCE was conducted via a self-administered, pencil and paper survey. Participants indicated which product they were most and least interested in trying. Product type accounted for almost 90% of variation in choices (i.e., participants were more interested in e-cigarettes and less interested in trying HTPs compared to cigarettes). Menthol

flavor was associated with increased interest in trying, however participants were less interested in trying menthol cigarettes compared to regular cigarettes.

## Appendix B: Summary of Behavioral Intentions or Product Preferences Studies Relevant to a Menthol Cigarette Ban

Table 2: Summary of Behavioral Intentions or Product Preferences Studies Relevant to a Menthol Cigarette Ban

Reference (Authors & Year)	Date data collected	Study Design	Sample Characteristics	Key Findings	Key Strengths/Limitations
<b>Behavioral Intentions in response to a hypothetical menthol cigarette ban</b>					
D'Silva et al., 2021	June–September 2017	In-depth semi-structured interviews  Cross-sectional	N = 27 African American adult (aged 25+) daily cigarette smokers sampled from the Minneapolis–St. Paul area of Minnesota, United States	In response to a proposed menthol sales restriction that would restrict menthol cigarette sales to tobacco shops and liquor stores, participants stated that they intend to acquire menthol cigarettes where available at tobacco shops and liquor stores, get help from friends to acquire menthol cigarettes, purchase menthol cigarettes from other cities or bootleg sources, try non-menthol cigarettes, reduce their cigarette use, or quit cigarette smoking.	+ Provides detailed information on thought processes regarding behavioral intention in response to a menthol cigarette sales restriction.  - Sales restriction discussed was not a menthol cigarette ban but a restriction on where menthol cigarettes could be sold.

Reference (Authors & Year)	Date data collected	Study Design	Sample Characteristics	Key Findings	Key Strengths/Limitations
D'Silva et al., 2015 <sup>8</sup>	2014	Survey  Cross-sectional	N = 1,158 adult menthol cigarette smokers from the Minnesota Adult Tobacco Survey	<p>If menthol cigarettes were no longer sold in the United States, 46.4% (95% CI = 37.9, 54.9) of menthol smokers indicated they intend to quit smoking, 26.6% (95% CI = 19.0, 34.1) of menthol smokers would switch to non-menthol cigarettes; 12.3% (95% CI = 6.3, 18.3) would switch to menthol e-cigarettes; 5.8% (95% CI = 1.8, 9.7) would buy menthol cigarettes online, 2.8% (95% CI = 0.4, 5.2) would switch to some other menthol tobacco product, 2.7% (95% CI = 0.0, 6.0) would buy menthol cigarettes from another country, and 1.5% (95% CI = 0.0, 3.8) would switch to some other non-menthol tobacco product.</p> <p>African American menthol cigarette smokers were more than twice as likely to report an intention to quit in the event of a ban (76.0%, 95% CI = 57.6, 94.3) compared to their White</p>	<p>+ Sampling weight applied based on sampling frame and demographic characteristics to obtain population level estimates.</p> <p>- Participants were first asked if they would quit smoking if menthol cigarettes were no longer sold in U.S. stores. Those who responded “no,” they would not quit smoking, were asked what they would most likely do.</p> <p>- While participants may have answered that they would quit smoking, they may have intended to use some other tobacco product as a substitute for or to help them quit smoking.</p>

<sup>8</sup> D'Silva et al., 2015 was located through a review of articles cited in Cadham et al., 2020 and did not appear in any database searches.



Reference (Authors & Year)	Date data collected	Study Design	Sample Characteristics	Key Findings	Key Strengths/Limitations
				counterparts (30.3%, 95% CI = 21.7, 38.9) (RR = 2.5, 95% CI = 1.7, 3.6, $p < .001$ ).	
Guillory et al., 2020 <sup>9</sup>	May 2018	Experimental Marketplace  Survey  Cross-sectional	N = 1,197 U.S. adult menthol smokers aged 18+  n = 209 in the menthol cigarette ban condition	Among all participants, 36.6% indicated they would try to quit smoking if menthol cigarettes were banned; 27.7% indicated they would switch to non-menthol cigarettes; 25.5% indicated they would switch to other menthol or flavored tobacco product; 8.6% indicated “don’t know,” and 1.34% selected other.	+ Participants were sampled using quotas designed to match sample characteristics with demographics of U.S. menthol cigarette smokers.  - Participants completed the survey after completing a shopping task in an experimental marketplace. - Response options were limited. It is unclear what products or flavors participants who selected “switch to other menthol or flavored tobacco product”

<sup>9</sup> Guillory et al.2020 appears twice in this summarizing table because they reported data on behavioral intentions collected via survey and responses to an experimental marketplace task.

Reference (Authors & Year)	Date data collected	Study Design	Sample Characteristics	Key Findings	Key Strengths/Limitations
					would use. It is also unclear what selection of “other” indicates. A substantial percentage of participants (23-29% across conditions) selected “Don’t Know.”
O’Connor et al., 2012	July 2010	Survey  Cross-Sectional	N = 417 adolescent (aged 14-17) and adult (aged 18+) current cigarette smokers  n = 170 menthol smokers	In response to removal of menthol from cigarettes, 36.5% of menthol smokers indicated they would try to quit smoking, 28.2% didn’t know what they would do, 27.1% would smoke less, 24.1% would find a way to buy a menthol brand, 21.2% continue to smoke about the same as they do now, 17.6% may try smokeless tobacco that comes in menthol, 17.1% would not consider using a non-menthol cigarette, 14.7% would switch to another cigarette brand, 14.7% would be able to quit smoking, 11.8% might switch to cigars that are flavored, 10.6% would add	+ Survey included adolescent and young adult smokers.  - Participants who “only” or “usually” smoked menthol cigarettes were categorized as menthol smokers. Participants who smoke “half menthol, half non-menthol,” usually smoked non-menthol, and smoked only non-menthol were categorized as non-menthol smokers. 18 participants (3.8%) gave no answer to this question and were excluded from further analyses.

Reference (Authors & Year)	Date data collected	Study Design	Sample Characteristics	Key Findings	Key Strengths/Limitations
				menthol themselves, 7.6% would smoke more than they do now. Respondents could select one or more reactions.	
Pacek et al., 2019	2017	Survey  Cross-sectional	N = 240 young adult (aged 18-29) dual cigarette and e-cigarette users from Amazon Mechanical Turk in the United States  n = 126 (52.5%) menthol smokers.	Menthol cigarette users intended to increase e-cigarette use in response to a menthol cigarette ban rather than increase cigarette use, but this trend was not statistically significant ( $\chi^2(1, N=126) = 3.06, p=0.080$ ).	- Only assessed anticipated tobacco product use for cigarettes and e-cigarettes, anticipated use of additional tobacco products was not assessed.

Reference (Authors & Year)	Date data collected	Study Design	Sample Characteristics	Key Findings	Key Strengths/Limitations
Pearson et al., 2012	June 2010	Survey  Cross-sectional	N = 2,649 never, former, and current cigarette smokers aged 18+  n = 465 menthol cigarette smokers	If menthol cigarettes were no longer available, 38.9% (95% CI – 33.0, 45.2) of menthol smokers indicated they would try to quit, 25.2% (95% CI = 20.0, 31.3) indicated they would switch to a non-menthol brand and try to quit, and 12.5% (95% CI = 8.7, 17.7) indicated they would switch to a non-menthol brand.	+ Participants randomly sampled from a nationally representative cohort that covers populations with and without Internet access with oversampling of Hispanics and African Americans. + Applied post-stratification weights to adjust for the probability of selection into the sample. + Included demographic variables in all multivariable analyses. + Low level of missing data (less than 2%).
Rose et al., 2019	2011-2016; every 6 months	Survey  Longitudinal	N = 806 young adult (aged 18-34) menthol cigarette smokers from the Truth Initiative Young Adult Cohort	In response to a menthol cigarette ban, 32.3% stated they would most likely switch to non-menthol cigarettes, 30.8% indicated they do not know what they would do, 23.5% would quit smoking and not use any other product, and 10.7% would switch to some other tobacco product.  African Americans, women, those with less than a high school education, and those with any quit intention were	+ U.S. national sample with survey weights accounting for complex study design and nonresponse and robust variance estimators. + Longitudinal study that tracked changes in the percentage of participants selecting each response option over time.  - Sample refreshed at each wave so lack of complete follow-up data.

Reference (Authors & Year)	Date data collected	Study Design	Sample Characteristics	Key Findings	Key Strengths/Limitations
				more likely to say they would quit smoking.	- Did not include information about individuals who may have already quit or switched or did not respond to one or more survey waves.
Wackowski et al., 2018	December 2014 to March 2015	Focus groups  Cross-sectional	N = 45 adult (ages 18-24) current smokers who usually smoke a menthol brand of cigarettes from New Jersey, United States	Some participants in the general (i.e., all races and ethnicities other than Black) groups said they would switch to non-menthol cigarettes in response to a menthol cigarette ban.  More participants, particularly in the Black groups, said that a menthol cigarette ban may help them quit smoking because switching to non-menthol cigarettes would not be "worth it."  Several Black participants, including those who said they would quit smoking, indicated they would likely go back to using Black & Mild cigars or use them more frequently than they currently did.	+ 3 groups conducted exclusively with Black young adults moderated by an African American facilitator.
Wackowski et al., 2015	April 2014	Survey  Cross-	N = 519 adult (aged 18+) current cigarette smokers	If menthol cigarettes were no longer sold, 45.9% of menthol smokers indicated they would	+ Participants were recruited from a nationally representative panel.

Reference (Authors & Year)	Date data collected	Study Design	Sample Characteristics	Key Findings	Key Strengths/Limitations
		sectional	36.3% (n = 187) were menthol cigarette smokers	<p>switch to non-menthol cigarettes, 28.4% indicated they would quit smoking and not use any other product, 15.1% indicated they would switch to menthol e-cigarettes, 6.7% indicated they would do something else (i.e., "other"), and 3.9% indicated they would switch to some other tobacco product.</p> <p>Older smokers (aged 45+; 40.1%; 95% CI = 27.7, 54.0) and Black menthol cigarette smokers (47.4%, 95% CI = 29.9, 65.5) had a significantly higher prevalence of choosing quitting altogether than younger (20.0%, 95% CI = 10.5, 34.6) and White menthol cigarette smokers (17%, 95% CI = 8.6, 30.9), respectively.</p> <p>Higher percentages of Black (23%, 95% CI = 10.6, 42.7) and White (18.3%; 95% CI = 10.7-29.5) menthol smokers said they would switch to menthol e-cigarettes compared to Hispanic menthol smokers</p>	+ Applied post-stratification weight to adjust for non-coverage and nonresponse.

Reference (Authors & Year)	Date data collected	Study Design	Sample Characteristics	Key Findings	Key Strengths/Limitations
				(0.7%; 95% CI = 0.1, 5.0).	
Wackowski et al., 2014	2011	Survey  Cross-sectional	N = 2,871 young adults (aged 18-34)  n = 619 menthol cigarette smokers	<p>If menthol cigarettes were no longer sold, 64.4% of menthol cigarette smokers indicated that they would quit smoking and not use any other products, 18.4% would switch to non-menthol cigarettes, 15.7% indicated they would switch to some other tobacco product, and 1.5% indicated that they did not know what they would do or would do something else.</p> <p>Intention to completely quit tobacco use in the event of a menthol cigarette ban was most prevalent among Black menthol cigarette smokers (79.3%; 95% CI = 63.1, 89.6) while most Asian menthol cigarette smokers (62.0%; 95% CI = 42.8-71.9) indicated they would switch to non-menthol cigarettes. Intention to switch to another type of tobacco product was most prevalent among Hispanic participants</p>	<p>+ Random-digit dial survey. + Nationally representative sample stratified by U.S. census regions, sample weights applied to adjust for nonresponse and varying probabilities of selection. + Applied sample weights to adjust for nonresponse and the probability of selection into the sample.</p> <p>- Small sample size of menthol smokers for use in analysis of menthol-related behavioral intentions by different subcategories.</p>

Reference (Authors & Year)	Date data collected	Study Design	Sample Characteristics	Key Findings	Key Strengths/Limitations
				(34.6%, 94% CI = 15.0, 61.4). Intention to switch to another tobacco product was more prevalent among menthol cigarette smokers who indicated concurrent use of other tobacco products (35.5%; 95% CI = 19.1, 55.7) than those who reported no other tobacco product use (5.5%; 95% CI = 2.6, 11.4%).	
Zatoński et al., 2018	2016	Survey  Cross-sectional	N = 10,760 adult (aged 18+) current smokers  7.2% smoked menthol cigarettes	In the event of a ban on menthol flavoring in cigarettes, 27.3% (95% CI: 23.7, 31.3) of menthol smokers indicated that they would find a way to get the banned product regardless, 20.0% (95% CI: 16.9, 23.4) indicated that they would switch to another brand, 17.6% (95% CI: 14.5, 21.1) indicated that they would reduce the amount they smoke, 16.0% (95% CI: 13.3, 19.2) indicated that they would quit smoking entirely, 4.3% (95% CI: 2.8, 6.5) indicated they would “do something else,” and 14.8% (95% CI: 12.0, 18.0) indicated “don’t know.”	+ Nationally representative of the countries surveyed. Data from the International Tobacco Control Policy Evaluation Project (ITC) 6 European Country Survey (6E).  - Respondents based in Europe. - Participants completed the survey in the presence of a researcher in some countries but not others, which may have led to differential effects of social desirability bias on study findings. - Lengthy survey may have contributed to a large percentage of respondents



Reference (Authors & Year)	Date data collected	Study Design	Sample Characteristics	Key Findings	Key Strengths/Limitations
					choosing don't know or other responses.
<b>Product Choice in Discrete Choice Experiments</b>					
Buckell et al., 2019	No date given	Labelled Choice Best-Best Discrete Choice Experiment  Cross-sectional  Each participant viewed 12 choice sets	N = 2,031 U.S. adult cigarette smokers and recent quitters aged 18-64	Participants preferred cigarettes to e-cigarettes.  E-cigarette flavor preferences, in order, were tobacco, fruit/sweet, and menthol.  Flavored product ban scenarios were simulated. Results suggest that the effect of a menthol cigarette sales restrictions on smokers' product selections depends on the availability of menthol and sweet/fruit flavored e-cigarettes. Specific results available in Appendix A.	+ Respondents matched to proportions of smokers in regional/demographic quotas using data from the 2014 Behavioral Risk Factor Surveillance System based on six regions, gender, and age bands.  + Large national dataset of current and former adult smokers.  + Conducted robustness checks and sensitivity analyses.  + Examined alternative bans in the United States in cigarettes and e-cigarettes and the impact on the choice of both products and opt-out "none."
Buckell & Sindelar, 2019	November 2016-May 2017	Discrete Choice Experiment	N = 2,003 U.S. young adults aged 18-22 who had ever tried cigarettes or e-cigarettes (64% used	A latent class analysis grouped participants into categories of "prefer smoking" and "prefer vaping." The "prefer smoking" group preferred tobacco flavor	+ Sample was matched to quotas derived from the 2015 National Health Interview Survey by age, gender, education, and census region.

Reference (Authors & Year)	Date data collected	Study Design	Sample Characteristics	Key Findings	Key Strengths/Limitations
		<p>Cross-sectional</p> <p>Each participant viewed 8 choice sets</p>	<p>cigarettes and 38% used e-cigarettes in past 30 days)</p>	<p>to menthol and fruit-flavor. The “prefer vaping” group did not significantly prefer menthol flavor to tobacco flavor.</p> <p>The “prefer vaping” group preferred no product to cigarettes.</p> <p>Participants preferred cigarettes to e-cigarettes</p> <p>5% of participants selected no product for all trials.</p>	<p>+ Results robust to sensitivity analyses.</p>
Shang et al., 2020	2017	<p>Labelled Choice Discrete Choice Experiment</p> <p>Cross-sectional</p> <p>Each participant viewed 12 choice sets</p>	<p>N = 1,154 U.S. adult smokers who used e-cigarettes or had “not ruled out future use” of e-cigarettes.</p>	<p>Smokers prefer cigarettes to e-cigarettes or none of the product options.</p> <p>Smokers of tobacco-flavored cigarettes do not prefer menthol-flavored e-cigarettes.</p> <p>Smokers of menthol-flavored cigarettes prefer menthol-flavored e-cigarettes.</p> <p>0.9% and 1.8% of participants who were and were not randomized into the incentive compatibility condition,</p>	<p>+ Used a “potentially real” choice where half of participants were informed one randomly selected respondent would receive \$100 worth of the product they chose for a randomly selected choice or cash.</p> <p>+ Models controlled for individual-level sociodemographic characteristics.</p> <p>+ Regressions weighted to represent the U.S. adult smoker population.</p>

Reference (Authors & Year)	Date data collected	Study Design	Sample Characteristics	Key Findings	Key Strengths/Limitations
				respectively, selected no product for all 12 trials.	
Yang et al., 2021	2020	Labelled Choice Discrete Choice Experiment  Cross-sectional  Each participant viewed 15 choice sets	N = 2,642 U.S. adult (aged 18+) current flavored (tobacco, menthol, or other) e-cigarette users with $\geq$ 90% approval rating from previous Amazon Mechanical Turk tasks  41% were daily smokers; 47% weekly smokers	Participants who never or infrequently used cigarettes had higher preference for e-cigarettes compared to cigarettes compared to daily smokers.  Availability of non-tobacco and non-menthol flavors appears to be a larger factor in tobacco product choice for never-smokers compared to current and former smokers. Adults who used e-cigarettes at least once per week and were daily smokers, weekly smokers, or former smokers did not significantly prefer menthol flavored tobacco products compared to tobacco flavored products.	+ DCE conducted twice: once where tobacco and menthol flavors were available for e-cigarettes and once where they were not available.  - Study focused on understanding choice of e-cigarette type and heated tobacco products rather than menthol smoker's choices when menthol cigarettes are unavailable.  - Data were collected during the COVID-19 pandemic, which may have been impacted findings.
Barrientos-Gutierrez et al., 2020	2016	Discrete Choice Experiment  Cross-sectional	N = 4,251 adolescents aged 12-14 in Mexico	Participants had greater interest in trying menthol-flavored cigarettes than "regular" (i.e., tobacco) flavored cigarettes.  Menthol flavor enhanced interested in trying cigarettes	+ Used cognitive interviews to pretest student understanding of the discrete choice experiment task.  - Respondents based in Mexico.

Reference (Authors & Year)	Date data collected	Study Design	Sample Characteristics	Key Findings	Key Strengths/Limitations
		Each participant viewed 8 choice sets		with flavor capsules, but menthol was relatively unappealing in cigarettes without flavor capsules.	- Respondents were youth and the majority were tobacco product never-users.
Monzón et al., 2021	2019	Best-Worst Discrete Choice Experiment  Cross-sectional  Each participant viewed 4 choice sets	N = 2,038 high school students aged 13-18 in Guatemala	Menthol flavor was associated with increased interest in trying, however participants were less interested in trying menthol cigarettes compared to regular cigarettes.	+ Attributes were presented on packaging designs based on actual product packaging designs to ensure believability of the presentations.  - Respondents based in Guatemala. - Respondents were youth and most were tobacco product never-users or current non-users.
<b>Experimental Marketplace Purchases</b>					
Denlinger-Apte et al., 2021	No date provided	Experimental Tobacco Marketplace  Comparison conditions (i.e., menthol LCCs available or not)  Repeated 8 times under two	N = 40 menthol smokers aged 18+ who used a non-cigarette tobacco or nicotine product at least once during the past 12 months recruited from Rhode Island, United States	When the price of menthol cigarettes increased, people were more likely to substitute non-menthol cigarettes than menthol little cigars or cigarillos.  When menthol cigarettes were at their highest price, in conditions with menthol LCC availability/without menthol LCC availability	+ Participants were told they would be given the products they purchased during one of their eight shopping trips to use during the field assessment.  - Products available in the marketplace were restricted to menthol, mint and tobacco flavors but other tobacco products are available in a variety of flavors.

Reference (Authors & Year)	Date data collected	Study Design	Sample Characteristics	Key Findings	Key Strengths/Limitations
		marketplace conditions  Cross-sectional		<ul style="list-style-type: none"> <li>68.3/70.7% of participants purchased menthol e-cigarettes</li> <li>43.9/36.6% of participants purchased non-menthol cigarettes</li> <li>7.3/22.0% of participants purchased non-menthol cigarillos</li> <li>9.8/17.1% of participants purchased menthol cigarettes</li> <li>Participants purchased other products at lower percentages</li> </ul> <p>All participants purchased either a tobacco or nicotine replacement therapy product during trials.</p>	<ul style="list-style-type: none"> <li>Participants who purchased e-liquid from the marketplace were loaned the e-cigarette device. In the real world, the additional cost of buying an e-cigarette device could be a barrier to use.</li> <li>Results may not generalize to menthol smokers who exclusively use cigarettes.</li> <li>Product sampling may decrease external validity because in reality smokers may not have the option to try alternative products prior to purchasing them.</li> </ul>
Guillory et al., 2020	May 2018	Experimental Marketplace  Control condition (i.e., no ban)  Comparison conditions (i.e., green replacement	N = 1,197 U.S. adult menthol smokers aged 18+	Participants in the menthol cigarette ban (OR=0.67, 95% CI 0.48 to 0.92) and all menthol product ban conditions (OR=0.60, 95% CI 0.43 to 0.83) were less likely to purchase cigarettes of any type than participants in the no ban condition.	<ul style="list-style-type: none"> <li>+ Participants were sampled using quotas designed to match sample characteristics with demographics of U.S. menthol cigarette smokers.</li> <li>-Text prompts intended to maximize the manipulation may have reduced ecological validity and influenced survey responses.</li> </ul>

Reference (Authors & Year)	Date data collected	Study Design	Sample Characteristics	Key Findings	Key Strengths/Limitations
		condition, menthol cigarette ban condition, all menthol ban condition)  Cross-sectional		The percentage of participants who did not purchase tobacco products was 45% in the all menthol tobacco product ban condition, 38.9% in the menthol cigarette ban, 31.8% in the green replacement of menthol cigarettes, and 30.7% in the no ban condition.	- No manipulation check to ensure that participants read instructions for navigating the virtual store.

*Notes: We only include weaknesses and strengths specific to each study in this table. We discuss limitations pertinent to each study type (i.e., behavioral intentions elicited via survey, focus group, or interview, discrete choice experiments, experimental marketplace studies) in the limitations section.*

## Appendix C: Summary of Conclusions on Behavioral Intentions or Product Preferences Relevant to a Menthol Cigarette Ban

*Table 3: Summary of Conclusions on Behavioral Intentions or Product Preferences Relevant to a Menthol Cigarette Ban*

Outcome	Conclusion	Level of Evidence	Factors that Increase the Quality of Evidence	Factors that Reduce the Quality of Evidence	Studies Contributing to Conclusion
<b>Behavioral Intentions</b>					
Behavioral intention to quit smoking	Some menthol smokers intend to quit smoking in response to a menthol cigarette ban.	Moderate Evidence	<ul style="list-style-type: none"> <li>Some participants in all studies that offered it as a response option indicated intent to quit smoking</li> </ul>	<ul style="list-style-type: none"> <li>The percentage of participants who indicated intent to quit varied widely (16.0%-64.4%) across studies</li> </ul>	D'Silva et al., 2021; D'Silva et al., 2015; Guillory et al., 2020; O'Connor et al., 2012; Pearson et al., 2012; Rose et al., 2019; Wackowski et al., 2018;

Outcome	Conclusion	Level of Evidence	Factors that Increase the Quality of Evidence	Factors that Reduce the Quality of Evidence	Studies Contributing to Conclusion
			<ul style="list-style-type: none"> <li>Multiple surveys with different response options, different descriptions of hypothetical bans, conducted in different locations and different years found the same outcome</li> </ul>	<ul style="list-style-type: none"> <li>We cannot conclude whether participants who intend to quit would use another tobacco product or quit using tobacco products entirely</li> </ul>	Wackowski et al., 2015; Wackowski et al., 2014; Zatoński et al., 2018
Behavioral intention to switch to non-menthol cigarettes	Some menthol smokers intend to switch to non-menthol combusted cigarettes in response to a menthol ban.	Moderate Evidence	<ul style="list-style-type: none"> <li>Some participants in all studies that offered it as a response option indicated intent to switch to non-menthol cigarettes</li> <li>Multiple surveys with different response options, different descriptions of hypothetical bans, conducted in different locations and different years found the same outcome</li> </ul>	<ul style="list-style-type: none"> <li>The percentage of participants who indicated intent to switch to non-menthol cigarettes varied widely (14.7%-45.9%) across studies</li> </ul>	D’Silva et al., 2021; D’Silva et al., 2015; Guillory et al., 2020; O’Connor et al., 2012; Pearson et al., 2012; Rose et al., 2019; Wackowski et al., 2018; Wackowski et al., 2015; Wackowski et al., 2014; Zatoński et al., 2018

Outcome	Conclusion	Level of Evidence	Factors that Increase the Quality of Evidence	Factors that Reduce the Quality of Evidence	Studies Contributing to Conclusion
Behavioral intention to switch to menthol e-cigarettes	Few menthol smokers intend to switch to menthol ENDS when presented with a hypothetical ban on menthol cigarette sales.	Limited Evidence	<ul style="list-style-type: none"> <li>• Some participants in all studies that offered it as a response option indicated intent to switch to menthol e-cigarettes</li> <li>• Multiple surveys with different response options, different descriptions of hypothetical bans, conducted in different locations and different years found the same outcome</li> </ul>	<ul style="list-style-type: none"> <li>• Only three surveys included intent to switch to menthol e-cigarettes or e-cigarettes generally as a response option</li> <li>• D’Silva et al., 2015 surveyed only adult menthol smokers in Minnesota</li> <li>• Pacek et al., 2019 surveyed only young adult dual users of e-cigarettes and menthol cigarettes recruited from Amazon Mechanical Turk</li> <li>• While young adult dual users intended to increase e-cigarette use rather than cigarette use in response to a</li> </ul>	D’Silva et al., 2015; Pacek et al., 2019; Wackowski et al., 2015



Outcome	Conclusion	Level of Evidence	Factors that Increase the Quality of Evidence	Factors that Reduce the Quality of Evidence	Studies Contributing to Conclusion
				<p>menthol cigarette ban, the trend was not statistically significant (Pacek et al., 2019)</p> <ul style="list-style-type: none"> <li>• Pacek et al. (2019) did not indicate the flavor of e-cigarettes that participants intended to use</li> </ul>	
Behavioral intention to switch to some other menthol or non-menthol tobacco product	Few menthol smokers intend to switch to some other menthol or non-menthol tobacco product in response to a menthol cigarette ban.	Limited Evidence	<ul style="list-style-type: none"> <li>• Some participants in all studies that included response options indicating intent to use a non-cigarette or e-cigarette product in response to a menthol cigarette ban selected those options</li> <li>• Multiple surveys with different response options, different descriptions of hypothetical bans, conducted in</li> </ul>	<ul style="list-style-type: none"> <li>• Not all surveys that measured behavioral intentions in response to a menthol cigarette ban included response options indicating intent to switch to some other tobacco product</li> <li>• Response options differed widely across surveys</li> </ul>	D'Silva et al., 2015; Guillory et al., 2020; O'Connor et al., 2012; Rose et al., 2019; Wackowski et al., 2018; Wackowski et al., 2015; Wackowski et al., 2014

Outcome	Conclusion	Level of Evidence	Factors that Increase the Quality of Evidence	Factors that Reduce the Quality of Evidence	Studies Contributing to Conclusion
			<p>different locations and different years found the same outcome</p> <ul style="list-style-type: none"> <li>Rose et al., 2019 documented an increase in intent to switch to some other tobacco product from 2011-2016 among young adult menthol cigarette smokers</li> </ul>	<ul style="list-style-type: none"> <li>Wackowski et al., 2018 conducted focus groups with participants from New Jersey</li> <li>D’Silva et al., 2015 surveyed only adult menthol smokers in Minnesota</li> </ul>	
Uncertain or unspecified “other” behavioral intentions	Some menthol smokers are uncertain what they will do in the event of a menthol cigarette ban.	Insufficient Evidence	<ul style="list-style-type: none"> <li>Rose et al., 2019 documented uncertain behavioral intentions from 2011-2016 among young adult menthol cigarette smokers</li> </ul>	<ul style="list-style-type: none"> <li>Response options differed across surveys</li> <li>It is unclear whether “don’t know” indicates ambivalence, uncertainty, or intent to engage in some other unlisted behavior, particularly when “do something else” or “other” is not provided as a response option</li> </ul>	Guillory et al., 2020; O’Connor et al., 2012; Rose et al., 2019; Wackowski et al., 2015; Wackowski et al., 2014; Zatoński et al., 2018

Outcome	Conclusion	Level of Evidence	Factors that Increase the Quality of Evidence	Factors that Reduce the Quality of Evidence	Studies Contributing to Conclusion
Behavioral intention to access menthol cigarettes despite a ban	Few menthol smokers would circumvent menthol sales restrictions and access menthol cigarettes in some way.	Insufficient Evidence		<ul style="list-style-type: none"> <li>• Few surveys included intent to access menthol cigarettes despite a ban as a response option</li> <li>• The percentage of participants who intended to access menthol cigarettes despite a ban varied widely (2.7%-27.3%)</li> <li>• Response options differed across surveys</li> <li>• Zatoński et al., 2018 surveyed only European menthol cigarette smokers</li> <li>• O'Connor et al., 2012 surveyed participants in 2010</li> </ul>	D'Silva et al., 2015; O'Connor et al., 2012; Zatoński et al., 2018

Outcome	Conclusion	Level of Evidence	Factors that Increase the Quality of Evidence	Factors that Reduce the Quality of Evidence	Studies Contributing to Conclusion
				<ul style="list-style-type: none"> <li>• D'Silva et al., 2015 surveyed only adult menthol smokers in Minnesota</li> </ul>	
Behavioral intention to change the amount smoked	Some menthol smokers would change the amount they smoke in response to a menthol cigarette ban.	Inconclusive Evidence		<ul style="list-style-type: none"> <li>• Response options differed across surveys</li> <li>• Zatoński et al., 2018 surveyed only European menthol cigarette smokers</li> <li>• O'Connor et al., 2012 surveyed participants in 2010</li> <li>• There was no consistent direction in responses. Some participants in O'Connor et al. 2012 and Pacek et al. 2019 stated they would smoke the same amount, smoke more, or smoke less in response</li> </ul>	Zatoński et al., 2018; O'Connor et al., 2012; Pacek et al., 2019

Outcome	Conclusion	Level of Evidence	Factors that Increase the Quality of Evidence	Factors that Reduce the Quality of Evidence	Studies Contributing to Conclusion
				to a menthol cigarette ban	
<b>Product Choice in DCEs</b>					
Preference for Product Type	Tobacco product users prefer their usual product type (cigarettes vs. e-cigarettes).	Limited Evidence	<ul style="list-style-type: none"> <li>Consistent finding across all 4 studies</li> <li>Study designs had strong internal validity</li> </ul>	<ul style="list-style-type: none"> <li>Study sample compositions complicate interpretation</li> <li>Participants did not have experience with all product options for all studies. Lack of product familiarity may have affected results</li> </ul>	Buckell et al., 2019; Buckell & Sindelar, 2019; Shang et al., 2020; Yang et al., 2021
Preference for Flavor	Tobacco product users prefer their usual product flavor (menthol vs. tobacco)	Limited Evidence	<ul style="list-style-type: none"> <li>One study found flavor preference for the entire sample. Two studies found flavor preference for the entire sample and subgroups. One study found flavor preference only among subgroups.</li> </ul>	<ul style="list-style-type: none"> <li>Study sample compositions complicate interpretation</li> <li>Participants did not have experience with all product options for all studies. Lack of product familiarity may have affected results</li> </ul>	Buckell et al., 2019; Buckell & Sindelar, 2019; Shang et al., 2020; Yang et al., 2021

Outcome	Conclusion	Level of Evidence	Factors that Increase the Quality of Evidence	Factors that Reduce the Quality of Evidence	Studies Contributing to Conclusion
			<ul style="list-style-type: none"> <li>Study designs had strong internal validity</li> </ul>	<ul style="list-style-type: none"> <li>Buckell &amp; Sindelar, 2019 did not find a significant flavor preference when analyzing all participants' responses</li> </ul>	
Preference for use of any tobacco product	Smokers prefer the tobacco products available (vs. no product) when their preferred product is unavailable; non-smokers prefer no product	Insufficient evidence	<ul style="list-style-type: none"> <li>Difference in "prefer vaping" and "prefer smoking" groups in Buckell &amp; Sindelar, 2019 suggest an effect for smoking status exists</li> </ul>	<ul style="list-style-type: none"> <li>Study sample compositions complicate interpretation</li> <li>It is unclear how participants interpret the "no product" option in DCEs and if choosing no product was a salient choice, reducing internal validity</li> </ul>	Buckell et al., 2019; Buckell & Sindelar, 2019; Shang et al., 2020
<b>Experimental Marketplace Choices</b>					
Menthol smokers purchase e-cigarettes	Some menthol smokers purchased e-cigarettes.	Insufficient Evidence	<ul style="list-style-type: none"> <li>Even when menthol cigarettes were available for purchase (Guillory et al., 2020) or priced lower than market value</li> </ul>	<ul style="list-style-type: none"> <li>Guillory et al. 2020 found no significant difference in purchase of other tobacco products across</li> </ul>	Denlinger-Apte et al., 2021; Guillory et al., 2019

Outcome	Conclusion	Level of Evidence	Factors that Increase the Quality of Evidence	Factors that Reduce the Quality of Evidence	Studies Contributing to Conclusion
			<p>(Denlinger-Apte et al., 2021), a percentage of participants purchased menthol e-cigarettes</p> <ul style="list-style-type: none"> <li>Denlinger-Apte et al., 2021 found a dose-response relationship as the price of menthol cigarettes increased, menthol e-cigarette purchases increased</li> </ul>	<p>conditions, including a menthol sales restriction</p> <ul style="list-style-type: none"> <li>Participants in the Denlinger-Apte study who purchased e-liquid from the marketplace were loaned the e-cigarette device. In the real world, the additional cost of an e-cigarette device could be a barrier to use.</li> <li>Inclusion criteria for the Denlinger-Apte study included ever use of a non-cigarette tobacco or nicotine product in the past 12 months; therefore, findings may not generalize to</li> </ul>	

Outcome	Conclusion	Level of Evidence	Factors that Increase the Quality of Evidence	Factors that Reduce the Quality of Evidence	Studies Contributing to Conclusion
				people who only smoke menthol cigarettes	
Menthol smokers purchase non-menthol cigarettes	Some menthol smokers purchased non-menthol cigarettes if menthol cigarettes were unavailable.	Limited Evidence	<ul style="list-style-type: none"> <li>Guillory et al., 2020 found that nearly half of participants (49.3%) purchased cigarettes in a scenario where menthol cigarettes were unavailable.</li> <li>Denlinger-Apte et al., 2021 found a dose-response relationship for purchase of non-menthol cigarettes</li> </ul>	<ul style="list-style-type: none"> <li>Only two studies included in review</li> </ul>	Denlinger-Apte et al., 2021; Guillory et al., 2020
Menthol smokers purchase no product	Some menthol smokers purchase no product if menthol cigarettes are unavailable.	Insufficient Evidence	<ul style="list-style-type: none"> <li>Guillory et al. 2020 found that the percentage of participants who did not purchase any tobacco products increased as restrictions on menthol increased</li> </ul>	<ul style="list-style-type: none"> <li>No participants abstained from purchasing a tobacco product or nicotine replacement therapy in Denlinger-Apte, 2021</li> <li>Guillory et al. 2020 did not report if differences in the</li> </ul>	Denlinger-Apte et al., 2021; Guillory et al., 2020



Outcome	Conclusion	Level of Evidence	Factors that Increase the Quality of Evidence	Factors that Reduce the Quality of Evidence	Studies Contributing to Conclusion
				percentages of people who did not purchase any tobacco products across restriction scenarios were statistically significantly different	

## Section 3: Modeling the Public Health Effects of a Menthol Cigarette Ban in the United States

## Modeling the Public Health Effects of a Menthol Cigarette Ban in the United States

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## Abbreviations

CPS II .....	Cancer Prevention Study II
EE.....	Expert Elicitation
ENDS.....	Electronic Nicotine Delivery Systems
ERR .....	Excess Relative Risk
FDA.....	Food and Drug Administration
HTP .....	Heated Tobacco Products
LYL .....	Life Years Lost
NHIS.....	National Health Interview Survey
PATH.....	Population Assessment of Tobacco and Health
PRISMA.....	Preferred Reporting Items for Systematic Review and Meta-Analysis
SAVM.....	Smoking and Vaping Model
TCORS.....	Tobacco Centers of Regulatory Science
TUS-CPS.....	Tobacco Use Supplement to the Current Population Survey

## Executive Summary

This review was performed to inform the public health impact of prohibiting menthol as a characterizing flavor in cigarettes. We searched PubMed, Web of Science, EMBASE, and EBSCOhost to identify studies that quantitatively project the impact of a menthol cigarette ban on population health. Three articles were selected for review and all three are included in this final review. This review finds that results from simulation models are consistent with the findings that prohibiting menthol as a characterizing flavor in cigarettes would benefit the population's health. The "Smoking and Vaping Model" employed by Levy et. al. (2021) estimated 654,000 premature deaths and 11,300,000 life-years lost (LYL) averted between 2021-2060 by employing a menthol cigarette ban. Le and Mendez (2021) found that the Mendez-Warner model estimated that menthol cigarettes were responsible for approximately 378,000 smoking-related premature deaths, 3 million life years lost, and 10.1 million new smokers between 1980 and 2018. Levy et al. (2011) found that an estimated 324,000-634,000 premature deaths would be averted under a menthol ban between 2010-2050. We conclude that population health models simulating menthol ban policies support and are consistent with a strong public health benefit.

## Purpose

This document summarizes and evaluates modeling studies that quantify the effects of a menthol cigarette ban to inform an assessment of the potential behavioral responses to a menthol cigarette standard.

## Research Question

What are the quantitative effects (e.g., deaths averted and life-years gained) of a potential menthol cigarette ban in the US?

## Methods

### Eligibility Criteria

- Date Published: No limit
- Language: English
- Publication status:
  - Include - peer-reviewed published or in-press journal articles, full-text available
  - Exclude - literature review articles
- Location: US
- Population: All (e.g., youth, adults); focus on current menthol cigarette smokers
- Study Designs: Modeling studies
- Content:
  - Include – quantitatively project the impact of a menthol cigarette ban (e.g., deaths averted and/or life-years gained)
  - Exclude - cigarette ingredient, marketing, or harm perception studies, health outcome studies, literature reviews, non-combustible product studies, studies or models of other regulatory policies, and observational studies.

## Information Sources, Search Strategy, and Data Extraction

The databases used for this search included: PubMed, Web of Science, EMBASE, and EBSCOhost (Academic Search Complete, CINAHL, PsycInfo). The searches were performed on June 14, 2021 using the search strings listed in Appendix A.

The resulting citations from each search were aggregated in EndNote and deduplicated. The final list of 90 citations were screened by two separate reviewers first by reading each study's title and abstract, and then by reading the full-text articles. Studies that met the inclusion criteria were included in this review, and studies that met the exclusion criteria were excluded.

## Analysis

The following aspects of each study were evaluated: model design and assumptions, model inputs, model calibration, model results, any results reported by demographic groups, and any sensitivity analyses conducted.

## Results

### Study Selection

The literature search resulted in 127 citations from the four databases; after removing duplicates, 90 unique citations remained. The initial screening of titles and abstracts lead to exclusion of 88 articles for the following reasons: cigarette ingredient, marketing, or harm perception studies (n=30), health outcome studies (n=11), literature reviews (n=2), non-combustible product studies (n=7), studies or models of other regulatory policies (n=14), and observational studies (n=22). After screening, two citations were selected.

An additional peer-reviewed paper was identified and selected for inclusion by the reviewers and included in this review from one of the FDA's Tobacco Centers of Regulatory Science (TCORS), the University of Michigan TCORS. The peer-reviewed pre-print was supplied by the authors.<sup>1</sup>

A total of three papers are included in this review. A Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) diagram of this process is shown in Appendix B. Data were extracted for each study selected and summaries are provided in the section entitled "Modeling results from selected studies" and in Appendix C.

### Modeling Results from Selected Studies

The population health benefit of prohibiting menthol cigarettes has been examined in several simulation studies conducted in the past decade.<sup>1-3</sup>

A 2021 study by Levy et al. simulated the future benefit of a menthol cigarette ban on the whole U.S. population over the 2021-2060 period. This model compared a *Status Quo Scenario*, in which no menthol ban was implemented, to a simulated *Menthol Ban Scenario*, in which a complete ban on menthol cigarettes and cigars was implemented in 2021. Additionally, this study addressed the availability and use of ENDS products (nicotine vaping products in Levy et al.) by smokers and non-smokers over the study period.<sup>1,4,5</sup>

The simulation used the Smoking and Vaping Model (SAVM), a compartmental model capable of simulating the population effects of cigarette smoking and electronic nicotine delivery systems (ENDS)

use for specific birth cohorts. For this study, the model was extended to evaluate non-menthol and menthol cigarettes separately, with the following use states captured in the model compartments: 1) never users, 2) menthol smokers, 3) non-menthol smokers, 4) exclusive ENDS users, 5) former smokers using ENDS, 6) former smokers, and 7) former ENDS users.

The SAVM first utilized historical data from the National Health Interview Survey (NHIS) (1965-2013) for estimates of smoking prevalence (specific model inputs can be found in the manuscript).<sup>1,4,5</sup> The model projected prevalence estimates of never, current, and former smoking by age and gender beginning in 2013. The model was then recalibrated using 2013-2018 NHIS data to improve model estimates of smoking prevalence after ENDS products became more widely available around 2013. Next, age- and gender-specific rates of smoking initiation (i.e., any initiation of regular cigarette use by age 40) and cessation (i.e., cessation of regular cigarette use for two years, including those who temporarily use ENDS), cigarettes-to-ENDS switching (i.e., cessation of regular cigarette use with initiation of regular ENDS use), and initiation of ENDS use (i.e., initiation of regular ENDS use without regular cigarette use) were modeled using Population Assessment of Tobacco and Health (PATH) Study data, with separate rates of initiation, cessation and switching for menthol and non-menthol smokers. To simplify the model, dual users of cigarettes and ENDS were not modeled separately from current smokers. Smokers who switched to ENDS before age 35 were treated the same as exclusive ENDS users, while smokers who switched to ENDS age 35 or later were considered separately as former smokers using ENDS. Additionally, the transitions modeled were unidirectional; relapse (i.e., reinitiating regular cigarette or ENDS use after entering any group containing former users) was not considered in the model. Although age- and gender-specific effects were modeled, other sources of population heterogeneity, such as race, ethnicity, socioeconomic status, and geographical location, were not simulated.

Based on PATH Study data and other publications, the ratio of menthol to non-menthol cessation was modeled as 0.8 and the ratio of menthol to non-menthol switching was modeled as 0.9, in effect modeling menthol cigarette smokers as 20% less likely to quit smoking and 10% less likely to switch to ENDS than non-menthol smokers.<sup>6-11</sup> Based on PATH Study data, all cigarettes-to-ENDS switching was assumed to decline 10% annually from 2018. The excess relative risk (ERR) of mortality for ENDS products compared to cigarettes was set at 0.15.

To estimate the specific effects of a menthol ban on current and future tobacco use, an expert elicitation (EE) was conducted.<sup>4</sup> The EE used a systematic approach to identify 11 experts on topics related to the impacts of menthol flavor bans in tobacco products. Experts estimated a number of behaviors under a menthol ban, such as continued (illicit) menthol product use, menthol-to-regular product switching, switching to other nicotine products (e.g., ENDS, smokeless tobacco products), and tobacco cessation. These estimates were adapted to fit the simpler structure of the SAVM. For example, transitions from cigarettes to heated tobacco products (HTPs) were treated as a transition to ENDS, while transitions from menthol cigarettes to non-menthol cigars were treated as a transition to non-menthol cigarettes. Experts estimated the effects of a menthol ban for youth and young adults ages 12-24 who would otherwise have initiated smoking by age 24 (i.e., counterfactual menthol smokers), which were used as the ongoing initiation rates beginning with the simulated ban in 2021 in the *Menthol Ban Scenario*. Among menthol smokers in both the *Status Quo Scenario* and *Menthol Ban Scenario*, experts estimated transitions over a two-year period for ages 18-24 and 35-54, which were modeled as mean net differences applied to menthol smokers through age and menthol smokers over 30. The ban was assumed to have no effects on non-menthol smokers.

The model estimated smoking-attributable deaths averted and life-years lost (LYL) averted over the 2021-2060 period. Compared to the *Status Quo Scenario*, in which no menthol ban was implemented, under the *Menthol Ban Scenario* the estimated overall smoking prevalence declined 14.7% by 2026 and 15.1% by 2060. This overall decrease was due to a sharp reduction in menthol smoking (down 92.5% by 2026, and 96.5% by 2060), coupled with an increase in non-menthol smoking (up 47.4% by 2026, and 58.0% by 2060) over the same period. The ban was also estimated to increase ENDS use 22.6% by 2026, up to a 26.5% relative increase by 2060. Totaling the effects of the above behaviors, the model estimated 654,000 premature deaths and 11,300,000 LYL averted by 2060.

The study authors also conducted several sensitivity analyses to determine which model parameters had the greatest influence on outcome estimates. Increasing the ratio of menthol to non-menthol cessation rate from 0.8 to 1.0, in effect making menthol cigarettes no harder to quit than non-menthol cigarettes, had the greatest impact on the model estimates, resulting in decreasing deaths averted by 29.5% (to 461,000) and LYL averted by 24.2% (to 8.58 million). Eliminating the 10% annual declines in cigarette-to-ENDS switching from the model, in effect increasing the appeal of ENDS beyond 'early adopter' birth cohorts, reduced deaths averted by 20.5% (to 520,000) and LYL averted by 21.9% (to 8.83 million). Other sensitivity analyses included 10% absolute increases and decreases in the ERR of ENDS products to cigarettes, and 10% relative changes in smoking initiation, smoking cessation, time-independent cigarette-to-ENDS switching, ENDS initiation, and ENDS cessation. All of these sensitivity analyses resulted in modest (under 10%) changes to model-predicted deaths and LYL averted.

In addition to the SAVM study, another 2021 study by Le and Mendez evaluated the impact of menthol cigarettes in a historical simulation. Using a modified version of the Mendez-Warner model, a counterfactual scenario where menthol cigarettes were non-existent was simulated to describe the public health impact of menthol cigarettes on the U.S. population from 1980 to 2018. The model estimated that menthol cigarettes were responsible for approximately 378,000 smoking-related premature deaths, 3 million life years lost, and 10.1 million new smokers over the 38-year period. Under the simulated menthol ban, the U.S. smoking prevalence was estimated to decline from 33.2% in 1980 to 11.1% in 2018, below the observed 2018 smoking prevalence of 13.7%. The findings suggested that the negative population health impact of menthol cigarettes is due to increased smoking initiation and decreased smoking cessation compared to non-menthol cigarettes.<sup>3</sup> This model differed from Levy et al., 2021 in several ways, including that it did not model the impact of a ban, but rather attempted to simulate the scenario in which menthol cigarettes never existed and compared it to the status quo. In the Le and Mendez study, the added premature deaths attributable to menthol cigarettes stemmed from the differences in smoking initiation and cessation between menthol and regular cigarette smokers. The Levy et al., 2021 study examined the impact of a ban and modeled for the millions of current menthol smokers in the U.S., to respond by either quitting, switching to non-combusted tobacco products, or switching to non-menthol cigarette smoking as a result of the policy.

Finally, a 2011 study by Levy et al. that simulated the future benefit of a menthol cigarette ban was also consistent with the findings of other studies. This study estimated potential impacts of a U.S. menthol ban on future smoking prevalence and smoking attributable mortality for the total population, and for the Black population specifically.<sup>2</sup> The model used data from the 2003 Tobacco Use Supplement to the Current Population Survey (TUS-CPS) to characterize current smoking status, initiation and cessation rates by cigarette type, various other sources to characterize smoking relapse rates, and Cancer Prevention Study II (CPS II) to characterize mortality risks, which were treated as equivalent for menthol and non-menthol smokers. The analysis simulated the 2010-2050 period, with a menthol ban



going into effect in 2011. The study compared three menthol ban scenarios against a status quo scenario with no menthol ban:

- (1) 10 percent of menthol smokers quit permanently and 10 percent who would have initiated as menthol smokers do not take up smoking,
- (2) 20 percent quit and 20 percent never initiate, and
- (3) 30 percent quit and 30 percent never initiate.

The study estimated that by 2050 under these menthol ban scenarios, 324,000 (scenario 1) to 634,000 (scenario 3) smoking attributable deaths would have been averted in the U.S. overall, while relative declines in smoking prevalence were expected to range from 4.8 percent to 9.7 percent, under scenarios 1 and 3, respectively. Among Black persons, by 2050, an estimated 92,000 to 238,000 smoking attributable deaths would have been prevented, while relative declines in smoking prevalence ranged from 9.1 percent to 24.8 percent.<sup>2</sup>

## Discussion and Conclusion

As with all population health impact models, the estimates of public health benefits under similar menthol ban scenarios are subject to implicit and explicit model assumptions. In Levy et al.'s SAVM study, behaviors of current and future menthol smokers were determined via an Expert Elicitation (EE). Although common practice in public health modeling,<sup>12</sup> the use of EE may introduce biased estimates of the direct effects of a menthol ban policy. As described above, the SAVM study did not model race, ethnicity, socioeconomic status, or geography. The SAVM itself is also a simplified compartmental model that makes strong assumptions about the collapsibility of use behaviors of non-combusted tobacco products including ENDS, smokeless tobacco, and heated tobacco products (HTPs). In particular, the model and EE did not address the specific impacts of menthol or other non-tobacco flavored ENDS on ENDS use behaviors such as switching. The model also does not address the potential for 'feedback loops' resulting from additional government or industry reactions to the initial menthol ban policies. The authors of the SAVM study noted that these complexities would be best served through systems dynamics models and microsimulations of additional populations. However, the SAVM study only projected results through 2060 to limit the scope of the conclusions and reduce the impact of these assumptions on the final estimates.

We conclude that population health models simulating menthol ban policies support and are consistent with a strong public health benefit. The updated simulation by Levy et al., using the SAVM model, estimated approximately 650,000 premature deaths averted and 11.3 million LYL averted in the first 40 years of a menthol cigarette and cigar ban beginning in 2021.<sup>1,4,5</sup> The prevalence of smoking was also estimated to decline 15.1% in that period. Sensitivity analyses demonstrated that lower cessation among menthol smokers compared to non-menthol smokers was a notable driver of the public health impact of the simulated menthol ban. The overall findings were consistent with an earlier simulation by Levy et al. that estimated 324,000-634,000 premature deaths averted under a similar ban and time period.<sup>2</sup> The public health impact estimated in these forecasting models was also consistent with the historical simulation conducted by Le and Mendez, which estimated 378,000 premature deaths were attributable to menthol cigarettes between 1980 and 2018.<sup>3</sup>

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## Appendix A: Literature Search Strategy Details

### PubMed

Query:

Flavored

“Menthol”[Mesh] OR menthol[ti] OR “Flavoring Agents”[Mesh] OR flavor[ti] OR flavour[ti] OR additive[tiab] OR taste[tiab] or sweet\*[tiab] OR sugar[tiab] OR candy[tiab] OR cocoa[tiab] OR coffee[tiab] OR fruit[tiab] OR cinnamon[tiab]

Tobacco

(“Tobacco Products”[Mesh] OR tobacco[ti] OR smoking[ti] OR smoker[ti] OR smokers[ti] OR cigarette [TI] OR cigarettes[TI] OR cigar[TI] OR cigars[TI] OR cigarillo[TI] OR cigarillos[TI] OR cheroot[TW] OR cheroots[TW] OR stumpen[TW] OR stumpens[TW]) NOT (cigar-shape[TW] OR cigar-shaped[TW] OR “cigar body”[TW] OR “cigar-bodies”[TW] OR “cigar roll”[TW] OR “cigar rolls”[TW] OR “cigar-like”[TW] OR waterpipe”[TW] OR “e-cigarette”[TW] OR electronic[TW] OR e-vaping[TW])

Ban

“Government Regulation”[Mesh] OR “Health Policy”[Mesh] OR policy[ti] OR policies[ti] OR “Policy”[Mesh] OR ban[ti] OR restriction[ti] OR prohibit\*[ti] OR standard[ti] OR standards[ti] OR regulation[ti] OR regulations[ti] OR withdraw[ti] OR eliminat\*[ti] OR harm[ti]

Modeling

“Models, Statistical”[Mesh] OR model\*[ti] OR simulation[ti] OR impact [ti] OR forecast\*[ti] OR expect\*[ti] OR predict\*[ti]

- 45 hits

### Web of Science

Query:

TI=(“tobacco product\*” OR cigarette\* OR cigar OR cigars OR cigarillo OR cigarillos OR cheroot OR cheroots OR stumpen OR stumpens) NOT TI=(“cigar-shape” OR “cigar-shaped” OR “cigar body” OR “cigar-bodies” OR “cigar roll” OR “cigar rolls” OR “cigar-like” OR waterpipe OR e-cig\* OR electronic OR e-vap\*)

Menthol/flavor

TS=(vanillin OR flavor\* OR flavor\* OR vanilla OR mentha OR taste OR cinnamomum OR additive\* OR taste OR sweet\* OR benzaldehyde OR geraniol OR “isoamyl acetate” OR menthol OR cinnamon OR cinnamaldehyde OR cinnamyl OR licorice OR mint OR wintergreen OR citronellol OR sugar OR sucrose OR sucralose OR “high fructose corn syrup” OR candy OR cocoa OR chocolate OR coffee OR “propylene glycol”)

Ban

TI=("Government Regulation" OR policy OR policies OR ban OR restriction OR prohibit\* OR standard\* OR regulation\* OR harm\* OR withdraw\* or eliminat\*)

Modeling

TS=(model\* OR simulation OR impact OR forecast\* OR expect\* OR predict\* OR statistic\*)

- 40 hits

## EMBASE

Query:

(cigarette\*:ti OR cigar:ti OR cigars:ti OR cigarillo:ti OR cigarillos:ti OR cheroot:ti OR cheroots:ti OR stumpen:ti OR stumpens:ti) NOT ("cigar-shape":ti OR "cigar-shaped":ti OR "cigar body":ti OR "cigar-bodies":ti OR "cigar roll":ti OR "cigar rolls":ti OR "cigar-like":ti OR waterpipe:ti OR e-cig\* OR electronic OR e-vap\*)

OR

("tobacco products":ti AND (cigar:ti,ab OR cigars:ti,ab OR cigarillo:ti,ab OR cigarillos:ti,ab))

Menthol/Flavor

'flavoring agent'/exp OR vanillin:ti,ab OR "sweetening agent\*":ti OR vanilla:ti OR mentha:ti,ab OR taste:ti OR cinnamomum:ti,ab OR flavor\*:ti OR additive\*:ti OR taste:ti OR sweet:ti OR benzaldehyde:ti OR geraniol:ti OR "isoamyl acetate":ti OR menthol:ti,ab OR cinnamon:ti OR cinnamaldehyde:ti OR cinnamyl:ti OR licorice:ti OR mint:ti OR wintergreen:ti OR citronellol:ti OR sugar:ti OR sucrose:ti OR sucralose:ti OR candy:ti OR cocoa:ti OR chocolate:ti OR coffee:ti OR 'propylene glycol'/exp

Ban

"Government Regulation\*":ti,ab OR policy:ti,ab OR policies:ti,ab OR ban:ti,ab OR restriction:ti,ab OR prohibit\*:ti,ab OR standard\*:ti,ab OR regulation\*:ti,ab OR harm:ti,ab

modeling

model\*:ti,ab OR simulation:ti,ab OR impact:ti,ab OR forecast:ti,ab OR expect\*:ti,ab OR predict\*:ti,ab OR statistic\*:ti,ab

- 15 hits

## EBSCOhost

Query:

Tobacco/cigarette

TITLE: ("tobacco product\*" OR cigarette\* OR cigar OR cigars OR cigarillo OR cigarillos OR cheroot OR cheroots OR stumpen OR stumpens) NOT ("cigar-

shape" OR "cigar-shaped" OR "cigar body" OR "cigar-bodies" OR "cigar roll" OR "cigar rolls" OR "cigar-like" OR waterpipe OR e-cig\* OR electronic OR e-vap\* OR package\*)

Menthol/flavor

Abstract: vanillin OR flavor\* OR flavor\* OR vanilla OR mentha OR taste OR cinnamomum OR additive\* OR taste OR sweet\* OR benzaldehyde OR geraniol OR "isoamyl acetate" OR menthol OR cinnamon OR cinnamaldehyde OR cinnamyl OR licorice OR mint OR wintergreen OR citronellol OR sugar OR sucrose OR sucralose OR "high fructose corn syrup" OR candy OR cocoa OR chocolate OR coffee OR "propylene glycol"

Ban

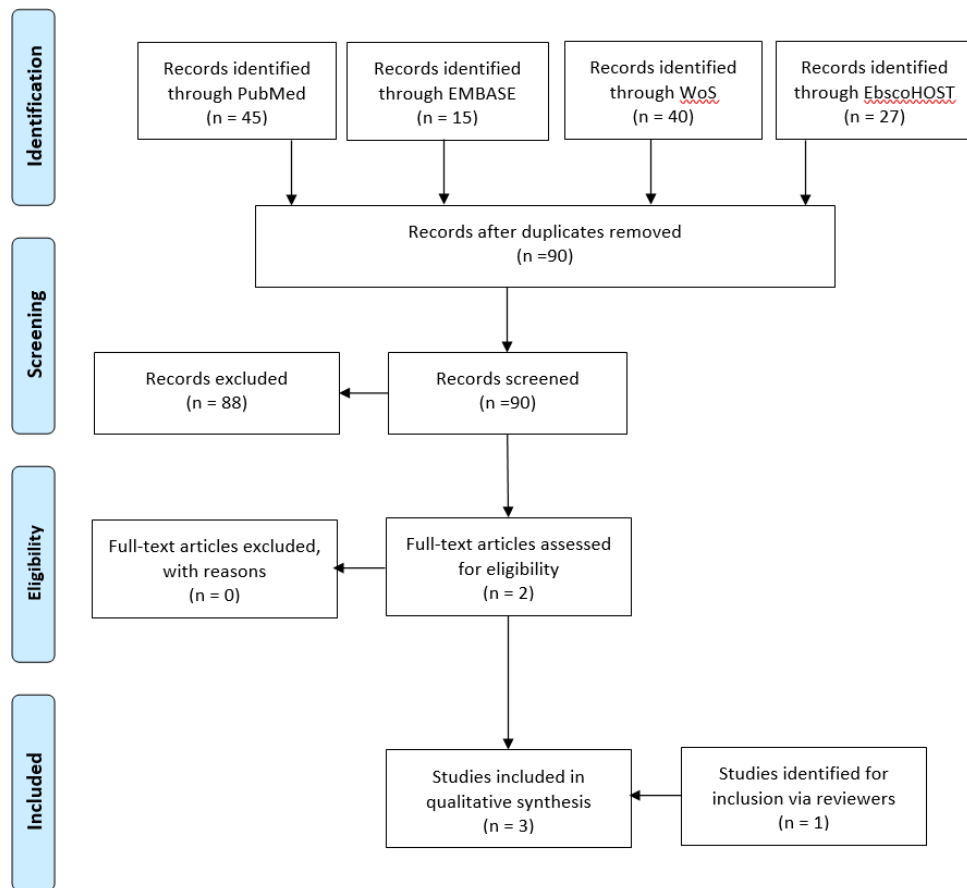
TITLE: "Government Regulation" OR policy OR policies OR ban OR restriction OR prohibit\* OR standard\* OR regulation\* OR harm\* OR withdraw\* or eliminat\*

Modeling

Abstract: model\* OR simulation OR impact OR forecast\* OR expect\* OR predict\* OR statistic\*

- 27 hits

## Appendix B: PRISMA Diagram



## Appendix C: Summary of Studies Modeling Health Effects of a Menthol Cigarette Ban in the United States

Study	Study Period	Model	Notable Assumptions	Deaths Averted	Life-years Gained
Le and Mendez (2021)	1980 - 2018	Inputs: A counterfactual scenario where menthol cigarettes were non-existent was simulated to describe the public health impact of menthol cigarettes on the U.S. population from 1980 to 2018  Outputs: Smoking-attributable deaths and life years lost	The only tobacco products modeled were menthol and non-menthol cigarettes  Only permanent quit rates were modeled; former smokers did not relapse  Menthol and non-menthol cigarettes were considered equally toxic	378,000 (deaths attributable)	3 million (life-years lost)
Levy et al. (2011)	2010 - 2050	Inputs: Three scenarios compared to a status quo: (1) 10 percent of menthol smokers quit permanently and 10 percent who would have initiated as menthol smokers do not take up smoking, (2) 20 percent quit and 20 percent never initiate, and (3) 30 percent quit and 30 percent never initiate.  Outputs: Future smoking prevalence and smoking attributable mortality for the total population, and for the Black population	The only tobacco products modeled were menthol and non-menthol cigarettes	324,000 - 634,000	(Not estimated in this study)
Levy et al. (2021)	2021 - 2060	Inputs: Behavioral transitions between menthol and non-menthol cigarettes and non-combusted products under <i>Menthol Ban</i> and	<u>The <i>Menthol Ban Scenario</i> applied to both cigarettes and cigars</u>	654,000	11.3 million

		<p><i>Status Quo Scenarios</i>, derived from an Expert Elicitation</p> <p>Outputs: All-cause smoking and vaping attributable deaths averted</p>	<p><u>The excess mortality risk of ENDS was 15% that of cigarettes</u></p> <p><u>Dual users were treated as current smokers</u></p> <p><u>Smokers who switched to ENDS products before age 35 were treated as exclusive ENDS users</u></p> <p><u>Menthol and non-menthol cigarettes were considered equally toxic</u></p> <p>Transitions modeled were unidirectional; relapse was not considered in the model.</p>		
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