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Review

The Impact of Menthol Cigarette Bans: A Systematic Review and Meta-Analysis

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Abstract

Introduction: This review investigates the impacts of banning the sale of menthol cigarettes at stores.

Methods: A systematic search of studies published in English up to November 2022 was conducted. The following databases were searched: PubMed/Medline, CINAHL, PsycINFO, Web of Science, and Embase, as well as a non-indexed journal. Studies evaluating either the impact of real-world or hypothesized menthol cigarette bans were included. Primary outcomes include tobacco use behaviors. Secondary outcomes include cigarette sales, retailer compliance, and the tobacco industry's response to a menthol ban. Data on tobacco use behavior after a menthol ban were pooled using random-effects models. Two pairs of reviewers independently extracted data and assessed study quality.

Results: Of the 964 articles that were identified during the initial search, 78 were included in the review and 16 were included in the meta-analysis. Cessation rates among menthol cigarette smokers were high after a menthol ban. Pooled results show that 24% (95% confidence interval [95% CI]: 20%, 28%) of menthol cigarette smokers quit smoking after a menthol ban, 50% (95% CI: 31%, 68%) switched to non-menthol cigarettes, 12% (95% CI: 3%, 20%) switched to other flavored tobacco products, and 24% (95% CI: 17%, 31%) continued smoking menthol cigarettes. Hypothesized quitting and switching rates were fairly close to real-world rates. Studies found the tobacco industry attempts to undermine menthol bans. National menthol bans appear more effective than local or state menthol bans.

Conclusions: Menthol cigarette bans promote smoking cessation suggesting their potential to improve public health.

Implications: Findings from this review suggest that menthol cigarette bans promote smoking cessation among menthol cigarette smokers and have the potential to improve public health.

Menthol cigarettes are of particular public health concern because studies show that the anesthetic and cooling effects of menthol mask the harshness of cigarettes, making it easier for youth to initiate smoking.[1] Menthol in cigarettes has been found to increase the bioavailability of nicotine, which is hypothesized to result in greater dependence, and smokers have greater difficulty in quitting menthol cigarettes compared to non-menthol cigarettes.[1]

Prevalence rates of menthol cigarette use among cigarette smokers vary globally.[2] In a 2016 study of eight European countries, 7.4% of smokers, on average, used menthol cigarettes.[2] Prevalence rates ranged from 0.4% in Spain to 12.4% in England. In Kenya and Zambia, rates of menthol cigarette use among smokers were 21% (2012) and 43% (2014), respectively.[3] In the United States (US) 43.4% of adult past-month smokers used menthol cigarettes in 2020.[4] Menthol cigarettes are disproportionately used by youth, racial/ethnic minority, and lower-income smokers in the US.[4] Approximately 81% of non-Hispanic Black smokers in the US use menthol cigarettes, as compared to 34% of non-Hispanic White smokers.[4]

More than 170 US localities and two states, several countries (eg, Canada, Ethiopia), and the European Union ban the sale of menthol cigarettes.[5,6] Research on the impacts of policies that ban the sale of menthol cigarettes is emerging. To the best of our knowledge, this study is the first systematic review to incorporate a meta-analysis of research examining the impact of menthol cigarette bans (also referred to as menthol bans) on tobacco use behaviors. Secondary outcomes for the review include impacts on cigarette sales, retailer compliance, and the tobacco industry's response to menthol bans. A prior scoping review of studies published until November 2019 suggested that banning flavored tobacco product sales would promote smoking cessation.[7] A systematic review of studies published through May 2020 concluded there was insufficient evidence to make definitive conclusions about the effects of flavor bans on tobacco use behavior.[8] The number of localities with menthol bans has grown rapidly in the US

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and internationally.[5,6] An updated comprehensive review of studies is needed to summarize the latest research. In addition, a meta-analysis may provide more precise quantitative estimates of changes in tobacco use behaviors after a menthol ban. Meta-analyses increase statistical power and provide more robust summary estimates with greater generalizability than the results of individual studies.[9]

Methods

Data Sources and Search

A literature search of PubMed/Medline, CINAHL, PsycINFO, Web of Science, and Embase was conducted on May 20, 2020, and updated on November 3, 2022. A manual search of *Tobacco Regulatory Science* was conducted in 2020, as the journal was not indexed in electronic databases at that time. The search strategy was developed for PubMed/Medline and translated for use in the other databases (Appendix Table 1). This study was registered (CRD42020156087) with the International Prospective Register of Systematic Reviews (PROSPERO), an online database of review protocols, and was guided by the standards of the Preferred Reporting Items for Systematic reviews and Meta-Analyses Statement (PRISMA).[10] Prospectively registering a review aims to increase transparency and reduce bias in the conduct of research.

Study Selection

Studies investigating either the real-world or hypothesized impacts of menthol cigarette bans on tobacco use behavior (ie, quitting, switching to other products, continued use of menthol cigarettes) were included. Studies of hypothesized tobacco use behavior refer to studies where smokers in settings without menthol bans were asked to consider how their tobacco use behavior would change in the presence of a menthol ban (eg, "If menthol cigarettes were no longer sold in US stores, would you quit smoking?"). Grey literature was included, and studies were not restricted by methodology (eg, experimental, cross-sectional). Studies were also included if they examined any of the following secondary outcomes: impact of a menthol ban on cigarette sales, retailer compliance, or the tobacco industry's response to a menthol ban. Opinion pieces, commentaries, and articles published in languages other than English were excluded.

Two pairs of investigators independently evaluated studies for potential inclusion in Covidence, a web-based tool that supports the screening and data extraction process in systematic reviews.[11] Titles/abstracts were screened to identify relevant articles. Next, full-text articles were reviewed to determine eligibility for inclusion. Disagreements between investigators were resolved by a third investigator. Inter-rater agreement between the two investigators was good for the title/abstract screen (2020 screen: 96% agreement; Cohen's $\kappa = 0.77$; 2022 screen: 90% agreement; Cohen's $\kappa = 0.79$) and moderate to good for the full text review (2020 screen: 83% agreement; Cohen's $\kappa = 0.46$; 2022 screen: 88% agreement; Cohen's $\kappa = 0.67$).

Data Extraction and Study Assessment

The following information was extracted from studies that met inclusion criteria: (1) sample characteristics, (2) location, (3) study design, (4) ban information, (5) study period, and (6) results. We used the PREFS checklist, a tool for assessing the quality of stated preference studies, to evaluate stated preference experimental studies and studies of hypothesized tobacco use behavior.[12] The PREFS checklist evaluates study quality based on the study purpose, respondent sampling, description of methods, bias in reporting of results, and use of significance testing. Scores range from zero to five, and higher scores indicate higher study quality.[12] The quality of the other studies in the review was assessed using the Study Quality Assessment Tools, an online set of tools specific to individual study designs focused on appraising internal validity.[13] The tools include items that assess for potential flaws in methodology, sources of bias (eg, patient selection), strength of causality in the association between the intervention and outcome, and other factors.[13] Items include, "Was the study population clearly specified and defined?" and "Were the outcome measures clearly defined, valid, reliable, and implemented consistently across all study participants?"[13] Some items in the tool were not applicable to the studies evaluated (eg, "For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome"). Two pairs of reviewers independently assessed the quality of studies. For the Study Quality Assessment Tools, reviewers provided a rating of "good," "fair," or "poor" based on an overall assessment of quality informed by their evaluation of relevant items in the assessment tool. Discrepancies in quality ratings were resolved by a third reviewer.

Statistical Analysis

Meta-analytic techniques were used to pool estimates of menthol cigarette smokers' real-world or hypothesized tobacco use behaviors in the setting of a menthol ban. Studies examining real-world menthol bans in the meta-analysis were restricted to longitudinal studies among pre-ban menthol cigarette smokers. Studies on sales and cross-sectional studies examining the prevalence of menthol cigarette use or other tobacco products in the setting of menthol bans, without accounting for individuals' pre-ban tobacco use behavior, were excluded. These studies did not provide information on tobacco use behavior specific to pre-ban menthol cigarette smokers in the setting of a menthol ban.

When at least two studies provided prevalence estimates for a tobacco use behavior outcome (eg, percentage of menthol smokers that quit), pooled prevalence estimates were obtained across studies using random effects models. Studies were pooled if they examined tobacco use behavior in similar policy environments (eg, national vs. local menthol bans) and time periods after the ban. In each study included in the meta-analysis, the prevalence estimate of the tobacco use behavior outcome was extracted. The standard error of each estimate was calculated using standard formulas based on the 95% confidence intervals (95% CI) of the estimate or the sample sizes reported in the study. The meta-analysis was conducted using *metan* in STATA version 18. The logits of the prevalence estimates and their standard errors were used to obtain the pooled prevalence estimates. For the forest plots, random effect regression logits and 95% confidence intervals were back transformed so absolute prevalence estimates, instead of logits, are presented. Statistical heterogeneity in the estimates were assessed using the I^2 statistic.

Results

Systematic Review

The search yielded 964 unique articles. Seventy-eight articles met inclusion criteria (Figure 1). The majority examined

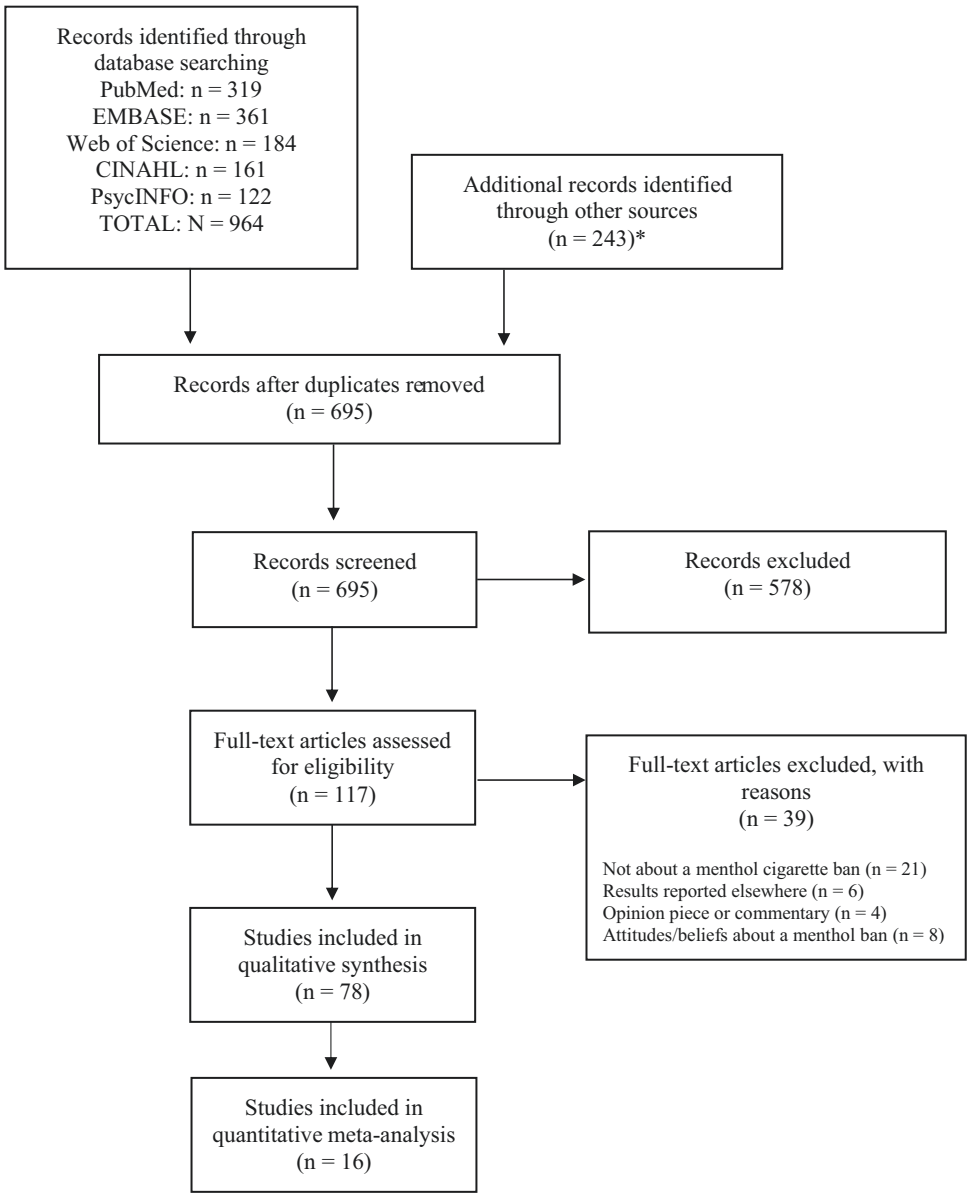

Figure 1. Literature flow diagram. *Additional records were identified from *Tobacco Regulatory Science*, a journal that was not indexed in an electronic database at the time of the initial search.

real-world or hypothesized tobacco use behaviors after a ban (real-world: k (number of studies) = 20; hypothesized: k = 32). Fewer studies assessed the industry's response (k = 9), retailer compliance (k = 6), and cigarette sales after a ban (k = 11). The quality of most studies was high (Appendix Table 2). Informed by the studies identified in the review and health behavior theories that propose behavior is determined in part by attitudes and beliefs, intentions, and environmental factors, we developed a theoretical model describing the relationship between a menthol ban and tobacco use behavior (Figure 2).[14]

Tobacco Use Behaviors

Quitting and Reducing Consumption.

Compared to non-menthol cigarette smokers, menthol cigarette smokers quit smoking at higher rates after a menthol ban.

Canada. Seven studies assessed quitting among menthol cigarette smokers after menthol bans in Canada.[15–21] In a longitudinal study, Chaiton et al.[15] assessed smoking behavior *1 month* after the 2017 ban in Ontario among a sample (N = 325) of smokers who had used at least one menthol cigarette in the past year.[15] In October 2017 menthol cigarettes and most flavored cigars were banned nationally.[22] Flavored e-cigarettes were excluded from the bans. Chaiton et al.[15] found that 29.1% of pre-ban menthol smokers reported they attempted to quit, whereas only 14.5% of respondents believed they would attempt to quit prior to the ban. Twelve percent of pre-ban menthol smokers were not smoking at 1-month follow-up.[15] In a cross-sectional study of lower quality, *3 months* after policy implementation in Ontario, Soule et al.[16] surveyed past-year menthol smokers (N = 67) and found the majority (76.1%) reported using cigarettes most days or every day; 7.5% reported using cigarettes (menthol or non-menthol) "not at all." Among pre-ban menthol

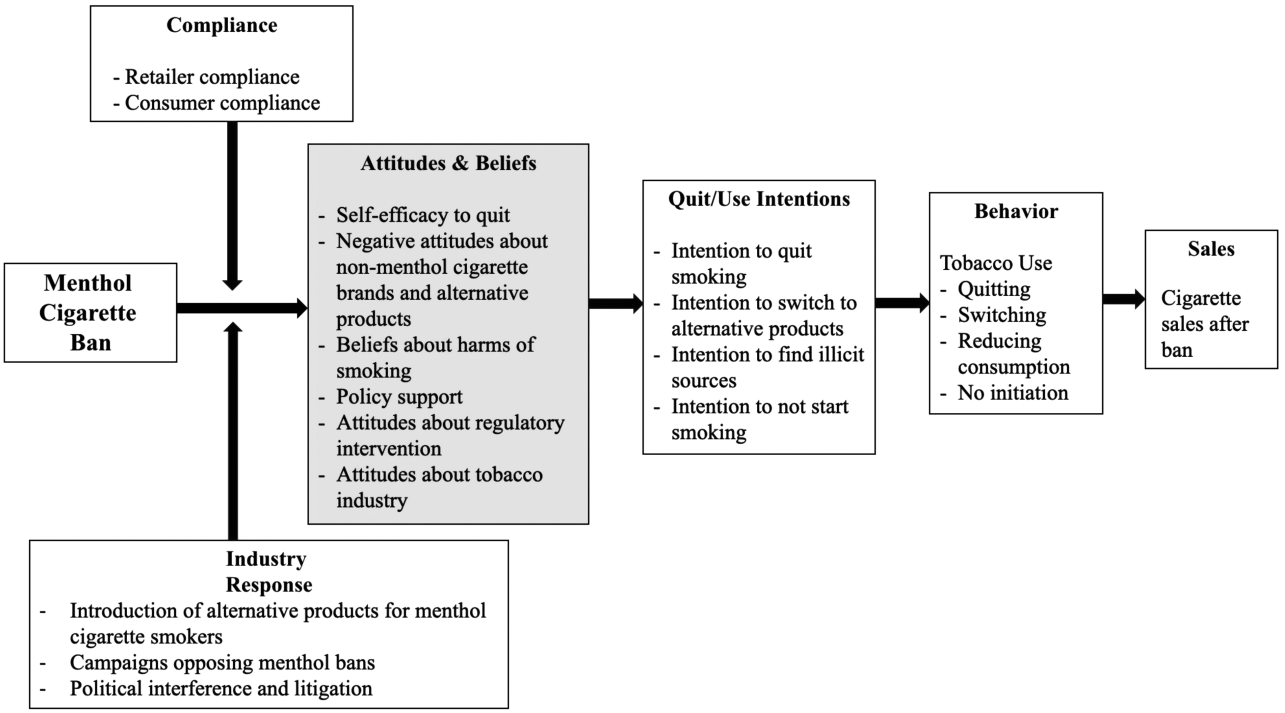

Figure 2. Theoretical model describing the relationship between a menthol cigarette ban and tobacco use behavior. The model was informed by studies identified in the review and health behavior theories that propose health behavior is determined, in part, by attitudes and beliefs, intentions, and environmental factors. The model indicates that a menthol ban impacts tobacco use behavior and sales by affecting individuals' attitudes and beliefs and quit/use intentions. In addition, retailer and consumer compliance and the tobacco industry's response to a menthol ban moderate the relationship between a menthol ban and individuals' attitudes and beliefs. For example, studies identified in the review suggest the tobacco industry interferes with menthol bans by introducing new replacement products for menthol smokers to the market. Studies about attitudes and beliefs about menthol bans were not reviewed or summarized in this review.

smokers who had quit post-ban, 30.7% of smokers reported the menthol ban helped with smoking cessation.[18] Pooling data from a cohort study[17] of smokers in Ontario and another cohort study of smokers in provinces across Canada,[19] Fong et al.[20] found that 22.3% of pre-ban menthol smokers successfully quit when surveyed approximately *1 to 2 years* post-ban.[20] Only 15.0% of non-menthol smokers successfully quit, indicating that a menthol ban was associated with a net cessation effect size of 7.3 percentage points.[20] Another study following the Ontario cohort *2 years* post-ban found similar effect sizes.[21] Twelve percent of daily and 10% of occasional menthol smokers reported having quit smoking, as compared to 3% of non-menthol smokers.[21]

European Union. Two studies examined tobacco use behavior among smokers in the Netherlands and England after the menthol ban in the European Union (EU).[23,24] In May 2020 the EU banned menthol cigarettes.[6,25] Flavored cigarillos, cigars, smokeless tobacco products, and e-cigarettes were exempted from the ban.[6,25] In a cohort study of adult smokers living in the Netherlands, 26.1% of menthol cigarette smokers quit approximately *1 year* after the EU menthol ban was implemented, as compared to 14.1% of non-menthol cigarette smokers (% difference = 12.0, $p = .002$).[23] In a repeated cross-sectional survey of youth in England, 12.1% of youth reported smoking a menthol (including capsule) cigarette brand prior to the menthol ban in February 2020.[24] Approximately *3 months* after the ban, 3% of youth reported smoking a menthol cigarette brand.[24]

United States. In a small longitudinal study of pre-ban menthol cigarette smokers in Massachusetts ($N = 14$), 50% (7 out of 14) reported making a quit attempt because of the 2020 flavored tobacco products ban in the state, and two reported successfully quitting *6 months* post-ban.[26] The Massachusetts policy bans the sale of menthol cigarettes, other flavored tobacco products (eg, flavored cigars), and flavored e-cigarettes in most retailers.[27] The use of flavored tobacco products is restricted to smoking bars for onsite consumption only.[27] A San Francisco, California, study found only one of 20 (5%) pre-ban menthol smokers quit approximately *1 year* after the comprehensive flavored tobacco products ban on menthol cigarettes, e-cigarettes, and other flavored tobacco products in the city.[28]

A cross-sectional study compared trends in tobacco use among youth in Minneapolis and St. Paul, Minnesota, where menthol bans were implemented in 2018, to trends in the rest of the state that did not have a menthol ban.[29] Cigarette use declined at a faster rate from 2016 (pre-policy) to 2019 (post-policy) in Minneapolis and St. Paul as compared to the rest of the state.[29] In a qualitative study conducted in Minneapolis and Duluth, Minnesota, youth reported that the impact of the menthol bans may have been limited because many youth regularly travel to adjacent cities without bans.[30] The local policies in Minnesota ban sales of fruit-, candy-, and menthol-flavored tobacco products but have exemptions for adult-only tobacco stores and liquor stores in Minneapolis and St. Paul and exemptions for adult-only tobacco shops in Duluth.[29,30]

Hypothesized behavior. Ten studies assessed hypothesized smoking behaviors in the event of a menthol ban in the US. Across studies, between 7% and 64.6% of menthol smokers reported they would quit or try to quit smoking.[31–40] Smokers

who identified as Black, female, had less than a high school education, smoked less than a pack per day, were not a daily smoker, did not smoke soon after waking, and had current intentions to quit were more likely to express intentions to quit after a menthol ban.[33–36,41] One study[36] found that being older was associated with greater intentions to quit after a potential ban, while another study[41] found the opposite. In a qualitative study conducted among young adult (18–24 years) menthol smokers in New Jersey, Wackowski et al.[42] found that, despite not supporting a menthol ban, participants reported that a ban would help them quit smoking.

Quasi-experimental studies and other studies that assessed hypothesized behavior suggest that banning menthol cigarettes may also encourage smokers to reduce the number of cigarettes smoked per day[2,43–49] and support smoking cessation by reducing immediate relapse after a cessation attempt.[50] For example, to simulate the effect of a menthol ban, Bold et al.[43] examined changes in tobacco use behavior when study participants who used menthol cigarettes were switched to non-menthol cigarettes for 2 weeks. After switching to non-menthol cigarettes, participants on average smoked 2.2 fewer cigarettes per day and reported lower nicotine dependence and cravings. One of the studies that found a menthol ban would encourage smokers to reduce the number of cigarettes smoked was of lower quality because only an abstract with limited study information was published.[46]

Three studies from the same research group used simulation modeling to estimate the potential effects of a menthol ban in the US.[51–53] If a menthol ban were implemented in 2021, overall smoking prevalence was estimated to decline by 16% within *5 years* post-ban.[52] Among non-Hispanic Black adults, smoking prevalence would decline by 25.3%.[53] An earlier study conducted by Levy et al.[51] simulated the impact of a menthol ban if implemented in 2011. These earlier predictions were more conservative. The model predicted a 4.8%–9.7% relative reduction in smoking prevalence in the US population *40 years* post-ban.[51] The relative reduction among Black individuals was also higher than the general population in this study, at 9.1%–24.8%.[51]

Levy et al.[54] also conducted an expert elicitation to estimate the impact of a menthol ban on tobacco use in the US. Expert elicitation is a process to integrate knowledge among experts to estimate unknown parameters.[54] Experts hypothesized that *2 years* after a menthol ban, compared to pre-ban rates, combustible tobacco product use would decline by 20% among menthol cigarette users 35–54 years old. Among those no longer using combustible tobacco products post ban, half were expected to quit smoking and half would switch to non-combustible products such as e-cigarettes.[54] Young adult (18–24) menthol cigarette smokers were expected to reduce combustible tobacco product use by 30% in the setting of a ban.[54]

Zeng et al.[55] simulated the impact of a menthol ban in Singapore. They estimated that *50 years* after a menthol ban smoking prevalence would decrease by 2.1 percentage points. In the status quo scenario with no menthol ban, smoking prevalence was expected to increase from 12.7% in 2018 to 15.2% in 2068.[55]

Switching to Non-menthol Cigarettes.

Among pre-ban menthol cigarette smokers, rates of switching to non-menthol cigarettes were higher in settings of national menthol bans in Canada and the Netherlands as compared to switching rates found in the setting of a statewide menthol ban in the US.[15,19,23,26]

Canada. In a longitudinal study in Ontario, *1 month* after ban implementation in the province, 28.2% of menthol smokers had switched to non-menthol cigarettes compared to 59.7% who hypothesized they would switch prior to the ban.[15] In a separate study following a Canadian cohort, 59.1% of pre-ban menthol cigarette smokers switched to non-menthol cigarettes *1 to 2 years* post-ban.[19]

European Union. In a longitudinal study in the Netherlands, *1 year* after the EU menthol ban 40.0% of menthol cigarette smokers switched to non-menthol cigarettes.[23]

United States. In a small longitudinal study examining the 2020 Massachusetts ban, two of 14 (14%) pre-ban menthol smokers reported starting to use non-menthol cigarettes *6 months* post-ban.[26] Another study examined the impact of the 2018 comprehensive flavored tobacco products ban in San Francisco, California.[56] A difference-in-difference analysis was conducted using data from the cross-sectional Youth Risk Behavior Surveillance System survey. Contrary to expectations, the ban was associated with 2.24 [95% CI, 1.42, 3.53] higher odds of past 30-day cigarette smoking among high school students.[56] The authors reported that their results suggest youth substituted e-cigarettes with non-menthol cigarettes after the flavor ban.[56] Some researchers have noted that the results of this study are misleading.[57,58] Among other critiques, the flavor ban in San Francisco was not enforced at the time of data collection for the study.[58]

Hypothesized behavior. In studies conducted in the US, 10.7%–53.6% of menthol cigarette smokers reported they would switch to non-menthol cigarettes in the event of a ban.[31,33–37,39–41] In a study of eight European countries, 20% of menthol cigarette smokers reported they would switch to a non-menthol brand.[2] In a study conducted in Brazil, 21.1% of menthol cigarette smokers reported they would switch to non-menthol cigarettes.[47]

Switching to E-cigarettes and Other Flavored Tobacco Products.

In the setting of a menthol ban, menthol cigarette smokers switch to e-cigarettes and other flavored tobacco products (OTPs; eg, flavored cigars) on the market. Studies suggest that a ban on menthol cigarettes without an accompanying ban on flavored e-cigarettes may increase e-cigarette use.[48,59–63]

Canada. Three longitudinal studies by the same lead author assessed rates of e-cigarette and OTP use among pre-ban menthol cigarette smokers at different time periods after the ban. *One month* after implementation of the menthol cigarette ban in Ontario, Canada, 29.1% of menthol cigarette smokers had switched to flavored e-cigarettes and OTPs, whereas only 5.8% reported they would switch to flavored e-cigarettes or OTPs prior to the ban.[15] The menthol ban exempts flavored e-cigarettes and OTPs such as alcohol-flavored cigars without filters.[64] In the *year* after implementation of the ban in Ontario, 18% of daily menthol smokers reported using flavored tobacco products and 34% reported using e-cigarettes.[64] Approximately *2 years* after the Ontario ban, 14.6% of pre-ban daily menthol smokers reported using additive cards, drops, or oil to add menthol flavoring.[65] Prior to the ban 4.4% of daily menthol smokers tried flavor additives.[65]

United States. In a longitudinal study examining the 2020 flavored tobacco products ban in Massachusetts, one of

14 (7%) pre-ban menthol smokers reported starting to use e-cigarettes *6 months* post-ban.[26]

Hypothesized behavior. In two studies conducted in the US assessing hypothesized behavior, 8% and 22% of menthol cigarette smokers reported they would switch to OTPs and flavored e-cigarettes.[31,41] In another study, 12% of menthol cigarette smokers reported they would switch to flavored cigars.[32] An estimated 12.3%–25.6% of menthol cigarette smokers reported they would switch to e-cigarettes (flavored and/or non-flavored).[36,37,40,41] In a qualitative study of 35 menthol cigarette smokers in Rhode Island, the majority (23/35) reported they would begin using e-cigarettes at least some of the time.[39] Predictors of hypothesized product switching included greater nicotine dependence,[33] current use of OTPs,[35] and being White and male.[34]

Continued Menthol Cigarette Use.

Rates of continued menthol cigarette use were typically higher in settings of local or state menthol bans as compared to national menthol bans.

Canada. Three longitudinal studies from the same lead author examined the percentage of menthol cigarette smokers who continued using menthol cigarettes after the menthol ban in Ontario, Canada. In a sample of past-year menthol smokers, 14.1% reported using contraband menthol cigarettes (eg, purchasing cigarettes online or from another country) *1 month* after the ban.[15] In another sample of menthol cigarette smokers in Ontario, 46.3% of participants reported using menthol cigarettes at least rarely *3 months* after implementation of the ban.[16] In a separate sample surveyed *at least a year* after ban implementation, 22% of daily menthol smokers reported purchasing menthol cigarettes since the beginning of the ban.[17] Participants primarily reported purchasing on First Nations Reservations.[17] Stoklosa et al.[66] compared the number of illicit cigarettes seized by the Provincial Tax Commission in Nova Scotia, Canada, before and after the menthol ban and found no surge in illicit cigarettes.[66]

European Union. In a cohort study of smokers in the Netherlands, 2.9% of menthol cigarette smokers reported using menthol cigarettes *1 year* after the EU menthol ban.[23] In a cross-sectional study of smokers in England, 15.7% smoked menthol cigarettes between July 2020 and June 2021 after the EU ban (implemented in May 2020).[67]

United States. In a longitudinal study examining the 2020 Massachusetts flavor ban, eight of 14 (57%) pre-ban menthol smokers reported continuing to smoke menthol cigarettes exclusively *6 months* post-ban.[26] Most reported purchasing menthol cigarettes out of state.[26]A cross-sectional study of individuals in residential substance use disorder treatment in San Francisco, California, found 50% of menthol smokers reported recently purchasing menthol cigarettes in San Francisco approximately *1 year* after the comprehensive flavor ban.[68] Another cross-sectional study found 70% of pre-ban menthol smokers continued using menthol cigarettes in San Francisco approximately *1 year* post-ban.[28]

Hypothesized behavior. In studies examining hypothesized behavior in the US, 24.1%–54.5% of menthol smokers reported they would find a way to buy a menthol brand or purchase from illicit sources.[32,39,40] In a qualitative study of 27 African American menthol cigarette smokers in Minneapolis and St. Paul, Minnesota, individuals reported they would find a way to obtain menthol cigarettes by asking friends to purchase them, traveling to other cities, or finding illegal sources.[69]

In samples of European, Brazilian, and Canadian menthol smokers, 27%, 16.8%, and 11.1% reported they would find a way to get the banned product or use contraband menthol cigarettes, respectively.[2,15,47] Kulick et al.[70] modeled the unintended consequences of cigarette prohibition and suggested that a menthol ban would shift demand to illicit products. The study was contracted by Altria Client Services.[70]

Sales

Canada. Three studies examined cigarette sales pre- and post-implementation of menthol cigarette bans in Canada.[22,71,72] Brown et al.[72] compared cigarette sales pre- (January–June 2016) and post-menthol ban (January–June 2017) in Ontario, Canada. Per capita sales of menthol cigarettes decreased by 93% in Ontario, compared with only a 2% decline in British Columbia, a comparison Canadian province without a ban.[72] The authors reported that substitution of menthol cigarettes with non-menthol cigarettes or other tobacco products appeared minimal.[72] Using wholesale cigarettes sales data from all 10 provinces in Canada between 2010 and 2018, Chaiton et al.[71] found that menthol cigarette sales increased from 2013 to 2017, prior to the nationwide ban implemented in October 2017. After the national ban, sales of menthol cigarettes fell to zero in all Canadian provinces.[22,71] Total cigarette sales declined by 4.6% as compared to the same month in the previous year.[22,71]

United States. Six studies examined change in tobacco product sales associated with menthol bans in the US.[73–76] Four of these studies assessed sales in Massachusetts,[73–76] which implemented the first statewide menthol ban in the US in June 2020. One study assessed sales in San Francisco, California,[77] and another study assessed sales in St. Paul and Minneapolis, Minnesota.[78] The Massachusetts studies found that after ban implementation menthol cigarette sales decreased by more than 90% in the state compared to sales prior to the ban.[73–76] There was some evidence, including from one study of lower quality, that individuals were going to other states to purchase tobacco products.[73,75] However, overall, there was a net decline in total cigarette sales in Massachusetts and neighboring states.[79] In San Francisco, average weekly sales of menthol cigarettes declined by 96% from pre-policy to post-enforcement periods and at a higher rate than in comparison cities without menthol bans (11% decline in San Jose and 20% decline in San Diego).[77] In St. Paul and Minneapolis, weekly unit sales of menthol cigarettes decreased by 67.1% and 72.4% post-policy implementation, respectively, compared to approximately 2 years prior. These rates were higher than menthol cigarette sales reductions in the rest of the state and in the US.[78] The St. Paul and Minneapolis policies exempted some liquor stores and tobacco product shops, which may explain the lesser effect on sales as compared to the comprehensive menthol bans in Massachusetts and San Francisco.[77,78]

European Union. Liber et al.[80] examined cigarette sales in Poland pre- and post-implementation of the 2020 EU menthol ban. Overall, there was no significant change in the sale of cigarettes (menthol and non-menthol) that could be attributed to the menthol ban.[80] Sales of menthol cigarettes declined by 97% from May 2018 to April 2021 in Poland but sales of non-flavored cigarettes increased by 38%.[80] In particular regions in Poland with relatively high menthol share of cigarettes before the ban (eg, 36.8% in Warsaw), there was a significant reduction in total cigarette sales.[80]

On the other hand, in regions with below the nationwide average menthol share of cigarette sales pre-ban, there was no significant reduction in total cigarette sales.[80] Liber et al.[80] noted that the ban may have not had its intended impact in part because the tobacco industry released new alternative products for menthol smokers like cigarette pack inserts with a menthol flavor.

Retailer Compliance

Retailer compliance with menthol bans was evaluated in two Canadian provinces, Chicago, Illinois, and cities in Minnesota and California. See Table 1 for a summary of studies examining retailer compliance.

Canada. In province-wide menthol bans in Alberta and Nova Scotia, Canada, Brown et al.[83] purchased a sample of cigarette packs post-ban and found no packs labeled as "menthol."

United States. Czaplicki et al.[90] evaluated retailer compliance in Chicago, Illinois, *1 year* after implementation of their policy that restricted retailers within 500 feet of high schools from selling flavored tobacco products including menthol cigarettes. Only 57% of affected stores were compliant. Compared to larger/chain stores, gas stations had an 81% lower odds of compliance.[90] D'Silva et al.[91] found higher (97.5%–100%) compliance rates in a sample of retailers in Minneapolis, St. Paul, Duluth, and Falcon Heights, Minnesota, where sales of menthol cigarettes were restricted to adult-only tobacco shops and liquor stores. Two convenience stores in Minneapolis sampled added interior adult-only tobacco shops to circumvent the policy.[91]

In three studies of California communities with menthol bans, 12.9%–35.4% of retailers sold menthol cigarettes or Newport menthol cigarettes, the most popular menthol cigarette brand. Pre-policy 87.9%–89.6% of stores sold menthol or Newport menthol cigarettes.[92–94] Vyas et al.[95] evaluated retailer compliance in San Francisco, California, before and after the San Francisco Department of Public Health began enforcing the policy with compliance inspections and penalties. Prior to enforcement 17% of retailers inspected were compliant with the ban. After enforcement began, 80% of retailers were compliant.[95]

In Oakland, California, Kurti et al.[96] found that approximately half (46.0%) of discarded cigarette packs on streets and sidewalks were menthol *7 months* after a menthol ban exempting adult-only tobacco shops went into effect. The authors concluded that a comprehensive ban is needed to reduce product availability.[96]

Industry Response

See Table 1 for a summary of studies examining the industry's response to menthol bans.

Canada. Borland et al.[81] conducted a content analysis of cigarette packs before and after a menthol ban in Ontario, Canada. Menthol descriptors were typically removed from "non-menthol alternative" packs post-ban. These packs did

Table 1. Summary of Studies Examining the Tobacco Industry's Response to Menthol Cigarette Bans and Retailer Compliance

Industry response	Summary	Studies
Canada		
	In Ontario, "non-menthol alternative" replacement packs were promoted by tobacco companies. Some replacement packs used blue as the prominent color instead of green, which is typically associated with menthol cigarettes. In Alberta, Canada, replacement packs still used green as the prominent color and packs stated "smooth taste without menthol."	Borland et al.[81] Schwartz et al.[82] Brown et al.[83]
European Union		
	After the EU menthol ban was announced the industry introduced new products including cigarillos with menthol capsules and tobacco flavor accessories that could be inserted into cigarette packs, filters, and roll-your-own tobacco. To encourage retailers to stock a new cigarillo product with a menthol capsule, the industry offered a wholesale price that provided retailers with a higher profit margin.	Hiscock et al.[84] Branston et al.[85] Brink et al.[86]
United States		
	In Minnesota, the tobacco industry stated a menthol ban would have negative financial impacts on tobacco retailers and result in more policing of black men. The tobacco industry disseminated messages opposing menthol bans by hosting forums, sending mailers to households, and posting messages at tobacco retailers.	Ackert et al.[87] Bosma et al.[88]
Brazil		
	In Brazil, the tobacco industry used several strategies to delay ban implementation including political interference and litigation.	Oliveira da Silva et al.[89]
Retailer compliance		
Canada		
	In province-wide menthol bans in Alberta and Nova Scotia, Canada, a sample of cigarette packs purchased post-ban found no packs labeled as "menthol," suggesting high retailer compliance.	Brown et al.[83]
United States		
	There was a range of retailer compliance rates in cities across the US. In Chicago, Illinois, only 57% of stores sampled were compliant with the menthol ban. Higher (97.5%–100%) compliance rates were found in a sample of retailers in cities in Minnesota. Compliance rates increased from 17% to 80% after policy enforcement began in San Francisco.	Czaplicki et al.[90] D'Silva et al.[91] Holmes et al.[92] Welwean et al.[93] Andersen-Rogers at al.[94] Vyas et al.[95]

not have menthol but were promoted by tobacco companies as being the best replacement. Instead of using green as the prominent pack color, some replacement packs used blue as the prominent color and variant name (eg, LD Super Kings Blue) post-ban.[81] In addition, prior to the ban, new menthol products with prominent blue coloring emerged on the market and were cheaper than traditional menthol packs.[81] In a small study with lower-quality evidence, Schwartz et al.[82] also reported similar changes in products and packaging in Ontario. In Alberta, Canada, Brown et al.[83] found "menthol replacement" packs post-ban that used green as the prominent color, like menthol cigarette packs pre-ban. The majority (87.3%) of menthol replacement packs had a cellophane wrapper that stated "smooth taste without menthol."[83]

United States. Schroth et al.[97] discussed potential industry responses to a national menthol ban in the US. For example, Altria and Reynolds will likely challenge a menthol ban in court and claim that a ban on menthol cigarettes would increase illicit trade.[97] The authors report that scientific evidence supporting the ban will be sufficient for a court to uphold the policy.[97] In cities in Minnesota, the tobacco industry stated a menthol ban would have large negative financial impacts on tobacco retailers, including job loss, and a menthol ban would result in more policing of black men.[87,88] The industry disseminated messages opposing menthol bans by sending mailers to households, putting postcards about the ban at the point-of-sale and hosting forums.[87,88]

European Union. In the United Kingdom, Hiscock et al.[84] and Branston et al.[85] observed that after the EU ban on menthol cigarettes was announced, the tobacco industry introduced new products including cigarillos with menthol capsules and menthol accessories that provide menthol flavor if inserted into cigarettes. Branston et al.[85] reported that to encourage retailers to stock a new cigarillo product with a menthol capsule, the industry offered a wholesale price that provided retailers a higher profit margin on the product. Similarly, Brink et al.[86] reported that tobacco companies introduced tobacco flavor accessories that could be inserted into cigarette packs, filters, and roll-your-own tobacco in Denmark. Tobacco companies included descriptors on packs that suggested the cigarette would have a menthol-like flavor, which the authors reported may violate the EU Tobacco Products Directive.[86] Prior to the EU ban in 2020, two new variants of cigarillos with menthol flavor were put on the market in Denmark, and cigarillo and cigar sales rose by 7% in 2019 and 2020.[86]

Brazil. In Brazil, Oliveira da Silva et al.[89] reported that the industry used several strategies to delay ban implementation including political interference, litigation, and sponsoring research.

Meta-Analysis

Findings from 16 studies were used for the meta-analysis (Figures 3 and 4). Among studies of real-world behavior, we

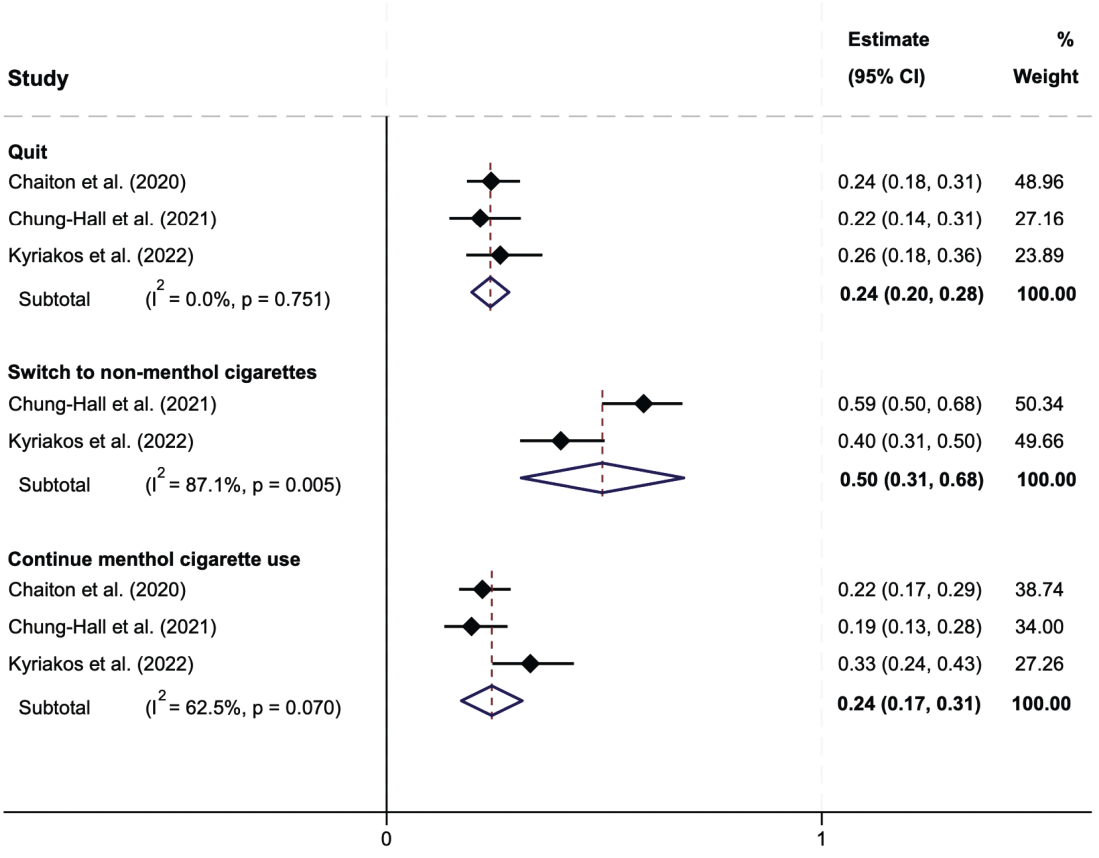

Figure 3. Results from the meta-analysis of real-world studies examining the impact of menthol cigarette bans on tobacco use behavior among menthol cigarette smokers. 95% CI = 95% confidence interval. Studies examined tobacco use behavior among pre-ban menthol cigarette smokers 1 to 2 years after ban implementation. In the graphical display in the figure, each line represents a single study. The black diamond on the line symbolizes the point estimate of the effect. The width of the line extending through the black diamond shows the confidence interval for the point estimate. The unshaded diamond represents the pooled estimate.

pooled estimates across three studies that assessed tobacco use behavior *1 to 2 years* after national menthol bans.[17,19,23] We did not pool estimates from studies of local or state bans; there were not enough local or state-level studies identified in the review conducted around the same time period after a menthol ban to pool estimates. Studies assessing hypothesized behavior after a menthol ban asked about behavior broadly without specifying a particular time period and thus were pooled together without subdivision. One study of hypothesized behavior was excluded because it did not provide the information needed to calculate the standard error of the prevalence estimate.[36]

Tobacco Use Behavior

Quitting.

Findings from the meta-analysis indicate that 24% (95% CI: 20%, 28%) of menthol cigarette smokers quit smoking approximately 1 to 2 years after a real-world menthol ban. Among studies examining hypothesized behavior, 33% (95% CI: 24%, 41%) of menthol smokers hypothesize they would quit or try to quit smoking.

Switching to Non-menthol Cigarettes.

Pooling across real-world studies, 50% (95% CI: 31%, 68%) of menthol smokers switched to non-menthol cigarettes

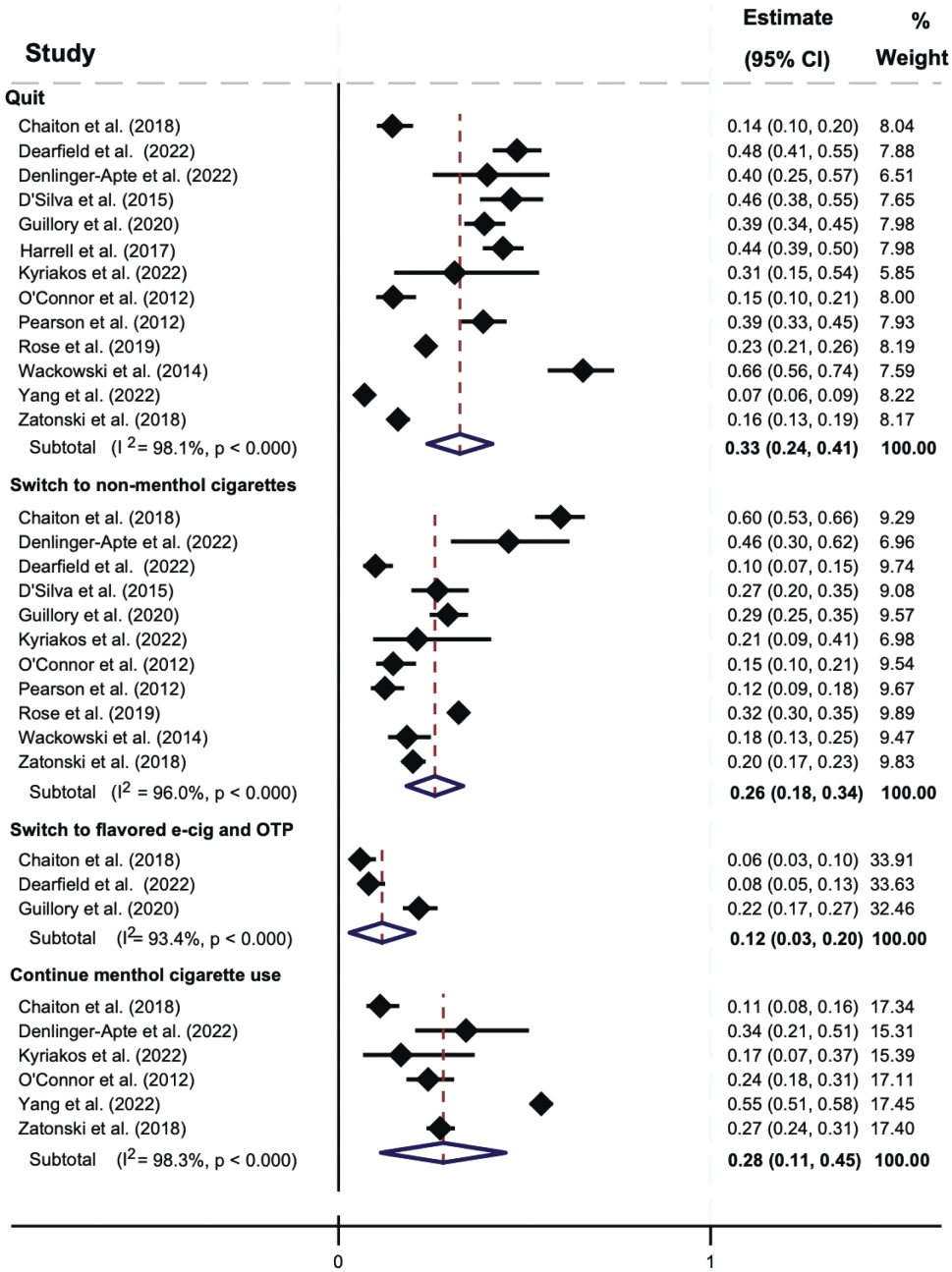

Figure 4. Results from meta-analysis of studies examining the hypothesized impact of menthol cigarette bans on tobacco use behavior among menthol cigarette smokers. 95% CI = 95% confidence interval; E-cig = e-cigarettes; OTP = other flavored tobacco products (eg, flavored cigars). Studies examining hypothesized tobacco use behavior asked about behavior after a menthol ban without specifying a time period (eg, "If menthol cigarettes were no longer sold in US stores, would you quit smoking?"). In the graphical display in the figure, each line represents a single study. The black diamond on the line symbolizes the point estimate of the effect. The width of the line extending through the black diamond shows the confidence interval for the point estimate. The unshaded diamond represents the pooled estimate.

approximately 1 to 2 years after a ban. Pooling across studies examining hypothesized behavior, 26% (95% CI: 18%, 34%) of menthol smokers hypothesize they would switch to non-menthol cigarettes after a ban.

Switching to Flavored E-cigarettes and Other Flavored Tobacco Products.

There were not enough real-world studies to obtain a pooled estimate of the percentage of menthol smokers who switched to flavored e-cigarettes or OTPs post-ban. Among studies examining hypothesized behavior, 12% (95% CI: 3%, 20%) of menthol smokers hypothesize they would switch to flavored e-cigarettes or OTPs.

Continued Menthol Cigarette Use.

Pooling across real-world studies, 24% (95% CI: 17%, 31%) of menthol smokers reported continued use of menthol cigarettes after a menthol ban. Among studies examining hypothesized behavior, 28% (95% CI: 11%, 45%) of menthol smokers hypothesized continued use of menthol cigarettes.

Discussion

There has been policy debate over menthol cigarette bans.[98] The Tobacco Products Scientific Advisory Committee, a Congressionally-mandated committee formed to advise the Food and Drug Administration, concluded that removing menthol cigarettes from the marketplace would benefit public health.[1] Critics of menthol bans, however, report that such policies will have little benefit because menthol smokers will not quit after a ban and instead switch to non-menthol cigarettes and OTPs.[98] Concern about an increase in illicit trade of cigarettes is another argument against a ban.[98] In contrast, findings from this review suggest that menthol cigarette smokers quit smoking at relatively high rates after a menthol ban. Research from Canada found no increase in the number of illicit cigarettes seized after the ban.[66]

A prior review concluded that there was moderate evidence flavored tobacco sales bans decrease tobacco use prevalence and low-quality evidence that a flavored tobacco sales ban has intended effects on quit attempts and cessation.[8] At the time of the prior review, the authors identified only one study conducted on quitting behavior after a menthol ban. The study found only 1 of 20 pre-ban menthol smokers quit after the comprehensive flavor ban in San Francisco.[28] Unlike the prior review, which was limited to US studies, the present review also included studies examining menthol bans implemented internationally. In this review, compared to non-menthol cigarette smokers, quit rates among menthol smokers were 7 to 12 percentage-points higher 1 to 2 years after menthol bans in Canada and the Netherlands.[20,21,23] More studies conducted in US cities have been published since the prior review. Research finds cigarette use declined at a faster rate in US cities with menthol bans as compared to those without.[29] Studies examining sales found significant declines in menthol cigarette sales and total cigarette sales after a menthol ban.[22,71,73–76] As expected, rates of continued menthol cigarette use were lower in settings of national bans and highest in settings of local or statewide menthol bans.[26,28,68] Individuals can more easily access menthol cigarettes in settings of local menthol bans by traveling to nearby jurisdictions without a ban. The effects of a ban on tobacco use behavior were also less pronounced in settings with policies that exempted particular store types like liquor stores.[77,78] In Poland, there was no significant change in cigarette sales after the menthol ban.[80] This may have been due to the relatively low share of menthol cigarette sales in the country.[80]

In the US, racial/ethnic minority and lower-income smokers use menthol cigarettes at higher rates than non-Hispanic White and higher-income smokers, respectively.[4] Therefore, a menthol ban may promote cessation disproportionately among racial/ethnic minority and lower-income groups. Using simulation modeling, Levy et al.[52] and Issabakhsh et al.[53] estimated a 16% reduction in smoking prevalence in the total US population within 5 years after a menthol ban and 25.3% reduction among non-Hispanic black adults.[52,53] A menthol ban appears to be a strong policy option to support equity-focused goals.

Studies in this review highlight the importance of promoting retailer compliance, implementing comprehensive flavored products bans and preparing for the tobacco industry's response to undermine flavor bans. Policy enforcement coupled with retailer education may help increase compliance.[95] In addition, studies suggest a menthol ban that is not comprehensive may slightly increase e-cigarette and OTP use.[15,17,59,60] Presently, bans on the sale of menthol cigarettes vary across US localities, and some policies do not apply to e-cigarettes.[5] Also, policies should anticipate the industry's response by prohibiting new products like menthol accessories for cigarettes, synthetic coolants, and regulating changes to packaging.[84,99]

There are limitations to this review. Not all studies examining the impact of menthol bans may have been identified because our search strategy may not have identified all relevant articles. We included abstracts and grey literature that emerged from our search but did not conduct a separate review of industry or sales data. In addition, there was significant heterogeneity in many of the pooled estimates from the meta-analysis. This is, in part, a result of the limited number of studies available. To date, studies examining real-world menthol bans that could be pooled were limited to those conducted in Canada and the Netherlands. In addition, it is common for I^2 values to be high in meta-analyses of proportions.[100] Another study found a median I^2 of 96.9% in 134 meta-analyses of proportions.[100] Researchers note that high I^2 values do not necessarily mean that study estimates are inconsistent.[100] Considering the *expected* range of estimates is recommended.[100] Also, the majority of studies evaluated in the meta-analysis were derived from studies of hypothesized behavior. Although rates of switching to non-menthol cigarettes in real-world studies were higher than studies of hypothesized behavior, estimates from real-world and hypothesized studies for the other tobacco use behavior outcomes examined were similar. Findings from hypothesized studies were also typically consistent with studies examining cigarette sales. In addition, studies in this review focused on pre-ban menthol cigarette smokers. Future studies should assess tobacco use behavior in the setting of menthol bans among other tobacco product users.

Menthol bans promote smoking cessation. This review provides a snapshot of what is known about the impacts of menthol bans. This literature is an evolving area as more localities and countries implement menthol bans, the tobacco industry responds to the changing regulatory environment with new products, and the longer-term impacts of menthol bans emerge.

Supplementary material

Supplementary material is available at *Nicotine and Tobacco Research* online.

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