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1 **Evaluating the impact of the menthol cigarette ban in England by**
2 **comparing menthol cigarette smoking among youth in England, Canada,**
3 **and the US from 2018-2020**

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34 **KEY POINTS**

35 **Question.** How has the menthol cigarette ban in England impacted menthol cigarette
36 smoking among youth smokers?

37 **Findings.** Using a quasi-experimental design and online surveys of 7067 youth smokers, this
38 study found that the menthol cigarette ban in England significantly reduced the prevalence of
39 menthol cigarette smoking from 12.1% to 3.0%. Menthol cigarette smoking remained stable
40 in the two comparison countries Canada (3.1-2.3%) and the US (33.6-36.9%). This effect was
41 consistent across all demographic groups.

42 **Meaning.** The proportion of youth smokers who smoke menthol (including capsule)
43 cigarettes decreased substantially following the menthol ban in England.

44

45 **ABSTRACT**

46 **Importance.** Menthol cigarettes were prohibited in England in May 2020 and nationally in
47 Canada in October 2017 but remain permitted in the United States (US). Evidence on the
48 impact of menthol cigarette bans among youth outside of Canada, and on the characteristics
49 of youth smokers, is lacking.

50 **Objectives.** To 1) evaluate the impact of menthol cigarette bans on youth menthol cigarette
51 smoking; 2) characterise youth menthol cigarette smokers in terms of demographics and
52 cigarette consumption/dependence.

53 **Design.** Quasi-experimental.

54 **Setting.** Online repeat cross-sectional ITC Youth Surveys conducted in 2018, 2019, February
55 2020, August 2020.

56 **Participants.** Past 30-day smokers aged 16-19.

57 **Outcome.** Usually smoke a brand of cigarettes that was menthol, including capsule.

58 **Exposure.** Menthol cigarette ban, contrasting three countries over time: Canada, where a ban
59 already existed, England, where a ban was implemented during the study, and the US, where
60 no national ban was present. Age, sex, race, and consumption/dependence were also
61 examined by menthol smoking in each country, and in England pre- vs. post-ban.

62 **Results.** The analytic sample comprised 7,067 participants aged 16-19, of which n=4,129
63 were female and n=5,019 were White. In England, the proportion of youth smokers who
64 reported smoking a menthol/capsule cigarette brand was stable in the three pre-menthol ban
65 waves (2018-Feb 2020: 9.4-12.1%; AOR=1.03, 95%CI=0.99-1.06) but decreased to 3.0%
66 after the ban (Feb vs. Aug 2020: AOR=1.07, 1.04-1.10). The decrease between Feb and Aug
67 2020 in England was similar across all demographic groups (all $p \geq .068$) but greater among

68 youth who perceived themselves as addicted to cigarettes ($p=.044$). In the two comparison
69 countries, menthol/capsule smoking was stable across all waves (2018-August 2020; US:
70 33.6-36.9%; Canada: 3.1-2.3%; all $p \geq .325$) and was most prevalent in the US (all country
71 comparisons: $p < .001$). Menthol/capsule smoking was also more prevalent among smokers
72 who: in England, were female vs. male (10.9% vs. 7.2%; $p=.002$); in the US, identified as
73 Black vs. White (60.6% vs. 31.9%; $p < .001$) or were frequent smokers, smoked more
74 cigarettes per day, or had urges to smoke every or most days (all $p \leq .026$); and, in Canada,
75 perceived themselves as addicted to cigarettes ($p=.013$).

76 **Conclusions.** In this survey study, the proportion of youth smokers who smoke menthol
77 (including capsule) cigarettes decreased substantially following the menthol ban in England.
78 This effect was consistent across all demographic groups. Perceived addiction among
79 menthol smokers was also lower where menthol cigarettes were banned.

80

81 INTRODUCTION

82 Menthol is added to tobacco products to improve taste and appeal, and reduce harshness and
83 perceived harms.¹⁻⁴ The demographic characteristics of smokers who use flavoured cigarettes,
84 including menthol, is variable, but use is typically more common among younger, newer
85 smokers,^{2,5-9} and adult females.^{6,8} Cigarettes can also contain a capsule that is crushed or
86 squeezed to release flavouring (usually menthol)¹⁰; capsule cigarettes are popular among
87 younger smokers.¹⁰⁻¹²

88 US data suggests that the availability of menthol cigarettes can increase smoking initiation
89 and slow declines in smoking prevalence, thereby increasing smoking-related mortality.¹³
90 Among adult smokers, menthol cigarette smoking has been associated with greater
91 dependence and reduced quit attempts and success.^{9,14,15} Among youth, initiation with
92 menthol cigarettes facilitates progression to established use,⁹ and menthol smoking is
93 associated with greater dependence.^{9,16} Banning menthol cigarettes could therefore accelerate
94 declines in smoking by reducing uptake and boosting cessation.

95 Bans on menthol cigarettes have been recommended by the World Health Organization and
96 implemented in many jurisdictions.¹⁷ In 2009, Canada and the US banned flavours *except*
97 menthol in cigarettes. In 2015, individual Canadian provinces became among the first
98 jurisdictions globally to also ban menthol in cigarettes; over the next two years, seven
99 provinces also did so.¹⁸ In October 2017, Canada implemented a national ban.¹⁹ In May 2020,
100 the European Union (EU) and England prohibited the sale of cigarettes with a characterising
101 flavour, including menthol.²⁰ In the US, some states have implemented menthol cigarette
102 bans and the Food and Drug Administration has committed to a federal ban on menthol in
103 cigarettes and cigars.²¹

104 Menthol cigarette markets vary across countries. The US has among the highest market share
105 (i.e., proportion of sales in that market) of menthol cigarettes (36% in 2018)²² compared to
106 21% and 5% in England and Canada, respectively, prior to national bans.^{19,22} The US also
107 has racial/ethnic differences in menthol smoking: 70% of youth, and 80% of adult, smokers
108 who identify as Black smoke menthol, and almost half of menthol smokers are from minority
109 racial/ethnic groups.⁶ This pattern is not seen among youth²³ or adults²⁴ in Canada. Little is
110 known about racial/ethnic characteristics of menthol smokers in England.

111 Menthol cigarette bans had a clear impact among adults in Canada.^{24-27,28} Following
112 Ontario's menthol ban, menthol cigarette sales neared zero and total cigarette sales declined
113 to a greater extent than in provinces without a ban.²⁶ Menthol cigarette bans in Ontario^{27,28}
114 and throughout Canada²⁴ have also been longitudinally associated with higher rates of quit
115 attempts and quit success among daily menthol smokers. In England, menthol cigarette
116 smoking among adult smokers remained high one year after the ban, at 15.7%.²⁹ In the US,
117 banning menthol cigarettes and cigars is predicted to reduce overall smoking prevalence and
118 smoking-related deaths.³⁰ Evidence on the impact of menthol bans among youth outside of
119 Canada is lacking.

120 The impact of menthol cigarette bans on smokers' characteristics warrants exploration.
121 Because menthol smoking is more common among younger, newer smokers,^{2,5-9} females,^{6,8}
122 and, in the US, those who identify as Black,⁶ menthol bans may reduce smoking to a greater
123 extent among these groups. However, menthol smokers who are more dependent may procure
124 menthol cigarettes via illicit sources when they are banned, potentially leading to greater
125 dependence among continuing menthol smokers.

126 This study aimed to: 1) evaluate the impact of menthol cigarette bans on menthol smoking
127 among youth in England (where menthol cigarettes were banned in May 2020) and Canada
128 (where menthol cigarettes were banned federally in October 2017), compared to the US

129 (where menthol cigarettes are not banned federally); 2) characterise menthol cigarette
130 smokers in terms of demographics and consumption/dependence, across countries, and in
131 England before and after the menthol ban. Hypotheses were:

- 132 1. In England, menthol/capsule smoking among past 30-day smokers would decline after
133 the ban, and this change would be greater than in the US and Canada.
- 134 2. Prevalence of menthol/capsule smoking among past 30-day smokers would be lower
135 in Canada than the US and England.
- 136 3. Past 30-day menthol/capsule smokers in Canada would report greater cigarette
137 consumption/dependence than the US and England.

138 **METHODS**

139 This quasi-experimental study compared youth menthol smoking where menthol bans were
140 implemented prior to the study (Canada), during the study (England), or not (US). Such
141 ‘natural experiments’³¹ provide stronger evidence than observational studies because there is
142 a natural ‘control’. Analyses were pre-registered (osf.io/q2bmj).³²

143 **Data Source**

144 Data were from the 2018 (August-September), 2019 (August-September), and 2020
145 (February-March, and August) waves of the online, repeat cross-sectional International
146 Tobacco Control (ITC) Youth Tobacco and Vaping Survey, conducted in Canada, England,
147 and the US. Detailed methods, with information on data collection, response (using AAPOR
148 reporting guidelines), samples, weighting procedures, and quality checks are available
149 online.³³⁻³⁵ Briefly, respondents aged 16-19 were recruited through Nielsen consumer panels,
150 and received remuneration according to their panel’s incentive structure. This study received
151 ethics clearance through the University of Waterloo Research Ethics Committee

152 (ORE#21847/31017) and the King's College London Psychiatry, Nursing & Midwifery
153 Research Ethics Subcommittee. Respondents were provided with study information and
154 indicated consent to participate.

155 A total of 56,595 respondents completed the surveys, of whom n=51,536 were in the full
156 sample, although we focussed on n=7,067 past 30-day smokers. Respondents were excluded
157 if they: failed data integrity checks (n=1,908), had missing/incomplete data on variables
158 required for calculating weights or determining smoking or vaping status (n=825), were
159 recruited in a previous wave (n=2,220), were an ineligible age (n=106), or, for the main
160 analyses, were not past 30-day smokers (n=44,414) or selected 'Refused' on outcomes
161 (n=55).

162 **Measures**

163 Full measure details are in the Supplementary File.

164 ***Outcomes***

165 *Usual brand/variety of cigarettes is menthol or capsule (primary outcome).* Past 30-day
166 smokers were asked to select the brand and variety of cigarettes that they smoked most often
167 from country-specific lists. Responses were classified as menthol/capsule vs. all other
168 responses.

169 *Smoked any menthol or flavour capsule cigarettes in the past 30 days (secondary outcome).*
170 Past 30-day smokers were asked whether they had smoked any cigarettes that a) were
171 flavoured to taste like menthol or mint, and b) have a filter that you squeeze or crush for
172 flavour, in the past 30 days. Respondents who selected 'Yes' to either were coded as
173 menthol/capsule smokers vs. all other responses. While this measure asked about flavour (not
174 menthol-specific) capsules, capsules in cigarettes are almost always menthol.^{10,12}

175 ***Exposure and independent variables***

176 *Exposure.* Menthol cigarette ban, contrasting countries where bans existed throughout the
177 study (Canada), were implemented during the study (England), and were not implemented
178 (US). *Country* (Canada, England, US) and *survey wave* (2018, 2019, February 2020, August
179 2020) were used as proxies for the policy.

180 *Demographics.* Age group (16-17, 18-19), sex (male, female), race/ethnicity (White only, any
181 Black, any other or mixed, don't know/refused).

182 *Consumption/dependence indicators.* Frequent smoking (≥ 20 of the past 30 days, otherwise),
183 cigarettes per day (≤ 1 , 2-5, > 5 , don't know/refused), perceived addiction to cigarettes (a
184 little/very, not at all, don't know/refused), urges to smoke (every day/most days, less often,
185 know/refused).

186 **Analyses**

187 ***Sample weighting***

188 Sample weighting details are available online.³³⁻³⁵ Briefly, cross-sectional post-stratification
189 sample weights were constructed for each country, based on population figures for sex-by-
190 age-by-region (sex-by-age-by-region-by-race in the US); calibrated to Wave 1 student status
191 and school grades, and past 30-day smoking trend in Canada and the US; and rescaled to each
192 country's sample size.

193 ***Aim 1. Impact of menthol cigarette bans on youth menthol smoking***

194 First, the proportion of past 30-day smokers who smoked menthol/capsule cigarettes was
195 reported (n=7,067). Second, logistic regression models adjusted for demographics were
196 estimated, predicting menthol/capsule smoking from country and survey wave. Third, a
197 country*survey wave interaction term was added to the regression models, and average

198 adjusted probabilities were predicted from this model and contrasted at each time point
199 within countries using Stata's post-estimation command *margins*.³⁶

200 Past 30-day smoking among the full sample (n=51,536) was also reported (not pre-
201 registered).

202 *Aim 2. Characterise menthol and capsule smokers*

203 Associations between demographics and menthol/capsule smoking were reported from
204 above-mentioned logistic regression models adjusting for country and survey wave. Separate
205 logistic regression models were then estimated to predict menthol/capsule smoking from each
206 consumption/dependence indicator, adjusting for country, survey wave, and demographics.
207 Interaction terms between country and each demographic and consumption/dependence
208 variable were added to the models in a subsequent step to examine whether associations
209 differed across countries, and interactions were explored as described above.

210 In an additional step that was not pre-registered, to examine changes in England after the ban,
211 adjusted logistic regression models were estimated using England data only, predicting
212 menthol/capsule smoking from 1) survey wave and demographics (entered simultaneously),
213 and 2) each consumption/dependence indicator (entered separately into the adjusted models).
214 As above, interaction terms between survey wave and each demographic and
215 consumption/dependence variable were added to the models in a subsequent step.

216 *Sensitivity analyses*

217 Analyses were stratified by past 30-day menthol (yes vs. other) and capsule (yes vs. other)
218 smoking.

219 **RESULTS**

220 Table S2 shows the sample characteristics. Of the n=7,067 past 30-day smokers aged 16-19, ,
221 n=4,129 were female and n=5,019 were White.

222 **Aim 1. Impact of menthol cigarette bans on youth menthol smoking**

223 Figure 1a shows the proportion of past 30-day smokers who reported a usual brand of
224 cigarettes that was menthol or capsule. In England, the proportion of youth past 30-day
225 smokers who reported usually smoking a menthol/capsule cigarette brand was stable prior to
226 the menthol ban (2018 to February 2020: 9.4% vs. 12.1%; AOR=1.03, 95% CI=0.99-1.06,
227 p=.146) but decreased to 3.0% after the ban (August 2020 vs. February 2020: 3.0% vs.
228 12.1%; AOR=1.07, 1.04-1.10, p<.001). There was also strong evidence that menthol/capsule
229 smoking was lower in England after the ban, in August 2020, compared with all survey
230 waves prior to the ban (Table S5). By contrast, menthol/capsule smoking was stable in the
231 US (33.6% to 36.9%) and Canada (3.1% to 2.3%) throughout the study period (Table S5).

232 Across all survey waves, the proportion of youth past 30-day smokers who reported usually
233 smoking a menthol/capsule cigarette brand was lower in Canada (2.4%) than England (8.9%;
234 AOR=4.07, 2.83-5.86, p<.001) and the US (34.6%; AOR=22.71, 15.92-32.39, p<.001).
235 Prevalence was also higher in the US than England (AOR=5.58, 4.63-6.72, p<.001).

236 Table S1 shows past 30-day smoking among the full sample.

237 **Aim 2. Characterise menthol and capsule smokers**

238 Tables S3-S4 show the characteristics of menthol smokers.

239 *Demographics*

240 Table 1 shows the proportion of youth past 30-day smokers in each country who reported a
241 usual cigarette brand that was menthol/capsule, by demographic characteristics. In Canada,
242 there was little evidence for any demographic differences (Table 1). In England,

243 menthol/capsule smoking was more common among females (10.9%) than males (7.2%;
244 Table 1). In the US, menthol/capsule smoking was twice as common among past 30-day
245 smokers who identified as Black (any) (60.6%) vs. White only (31.9%; Table 1).

246 Compared with Canada, the association between being female and smoking menthol/capsule
247 cigarettes was stronger in England (AOR=2.12, 1.06-4.21, p=.033) and the association
248 between identifying as Black (any) and smoking menthol/capsule cigarettes was stronger in
249 the US (AOR=8.12, 1.82-36.27, p=.006). There was little evidence for an interaction between
250 country and age group ($F_{(2,7065)}=1.02$, p=.359).

251 *Consumption/dependence indicators*

252 Table 2 shows the proportion of past 30-day smokers in each country who reported a usual
253 brand that was menthol/capsule, by consumption/dependence indicators. In Canada,
254 menthol/capsule smoking was more common among participants who reported being a
255 little/very addicted to cigarettes (3.1%) than those who reported not being addicted (1.3%;
256 Table 2). In England, there was little evidence for any associations between cigarette
257 consumption/dependence and menthol/capsule smoking (Table 2). In the US,
258 menthol/capsule smoking was more common among those who smoked on at least 20 of the
259 past 30 days (38.1%) vs. otherwise (32.7%), who smoked two to five (37.9%) or more than
260 five (38.5%) cigarettes per day than those who smoked one or fewer (29.8%), and who
261 reported urges to smoke every or most days (38.0%) vs. less often (30.3%) (Table 2).

262 Compared with Canada, there was some evidence that the association between smoking on at
263 least 20 of the past 30 days and menthol/capsule smoking was stronger in the US
264 (AOR=2.33, 1.02-5.34, p=.046) and that the association between perceived addiction to
265 smoking and menthol/capsule smoking was weaker in England (AOR=0.37, 0.17-0.83,
266 p=.015). There was little evidence for an interaction between country and cigarettes per day

267 ($F_{(5,7041)}=1.75$, $p=.120$), or country and urges to smoke ($F_{(3,7036)}=0.95$, $p=.415$), when
268 predicting menthol/capsule smoking .

269 *Changes in characteristics in England after the ban*

270 Figures 2 and 3 show the proportion of past 30-day smokers in England who reported a usual
271 brand that was menthol/capsule over time, by demographic characteristics and
272 consumption/dependence indicators. There was little evidence that demographic differences
273 in menthol/capsule smoking changed after the ban, in August 2020, compared with February
274 2020: age group (18-19 vs. 16-17 AOR=1.35, 0.44-4.16, $p=.598$), sex (female vs. male
275 AOR=3.22, 0.93-11.14, $p=.064$), race (any other/mixed vs. White AOR=0.94, 0.15-5.94,
276 $p=.947$; Black (any) vs. White unreportable due to low sample size)(Figure 2). There was
277 some evidence that the association between being a little/very addicted to cigarettes and
278 smoking menthol/capsule cigarettes weakened after the ban, in August 2020, compared with
279 February 2020 (AOR=0.37, 0.41-0.97, $p=.044$) and also 2018 (AOR=0.25, 0.09-0.71,
280 $p=.009$) (Figure 3). There was little evidence for any other differences in menthol/capsule
281 smoking by consumption/dependence indicators (Figure 3).

282 **Secondary outcome: Smoked any menthol or flavour capsule cigarettes in the past 30** 283 **days**

284 Trends and country differences (Figure 1b, Table S5) and changes in characteristics of
285 menthol/capsule smokers in England after the ban (Figures S1-S2) were similar when using
286 the secondary outcome of smoking any menthol/capsule cigarettes in the past 30 days,
287 although prevalence was higher than the usual brand measure.

288 However, there were several differences in the associations between demographics and
289 consumption/dependence indicators and menthol/capsule smoking when using the secondary
290 outcome (Tables 1-2). Briefly, any menthol/capsule smoking in the past 30 days was less

291 common among females in Canada, more common among respondents who identified as
292 Black in all three countries and any other/mixed race in Canada and England, and more
293 common in England but less common in the US among 18-19-year-olds (Table 1). Any
294 menthol/capsule smoking in the past 30 days was also associated with a greater number of
295 consumption/dependence indicators in all three countries than the usual brand measure (Table
296 2).

297 **Sensitivity analyses**

298 Trends were similar when stratified by menthol (Tables S7-S12, Figures S3-S6) and capsule
299 (Tables S13-S18, Figures S7-S10) smoking: in England the proportion of youth smokers who
300 reported usually smoking a *menthol* cigarette brand decreased from 4.0% in February 2020 to
301 0.3% in August 2020 (AOR=1.04, 1.02-1.06, $p<.001$) while the proportion who reported
302 usually smoking a *capsule* cigarette brand decreased from 8.1% in February 2020 to 2.7% in
303 August 2020 (AOR=1.02, 1.00-1.05, $p=.025$).

304 There were differences in between-country patterns for capsule smoking: unlike the overall
305 and menthol findings, there was little evidence that capsule smoking differed between
306 England and the US (Table S18). Further, in England, a larger proportion of youth reported
307 usually smoking capsule vs. menthol cigarette brands, while the inverse was seen in Canada
308 and the US.

309 **DISCUSSION**

310 This was the first study to evaluate the impact of menthol cigarette bans among youth outside
311 of Canada.^{24-27,28} Findings confirmed two of three hypotheses. First, consistent with findings
312 among adults in Canada,²⁴⁻²⁷ menthol (including capsule) cigarette smoking among past 30-
313 day smokers declined in England after the ban, and this decline was greater than in the US
314 and Canada, where menthol smoking remained stable. Second, consistent with market share

315 estimates,^{19,22} and that menthol cigarettes have been banned since 2017 in Canada, menthol
316 smoking among past 30-day smokers was lower in Canada than the US and England. Overall,
317 findings show a clear impact of menthol cigarette bans on reducing menthol smoking among
318 youth smokers.

319 There was little evidence to support the third hypothesis that menthol smokers in Canada
320 would report greater cigarette consumption/dependence than those in the US and England. By
321 contrast, dependence was greater among menthol smokers in the US and there was little
322 evidence for country differences in consumption. Further, in England, the association
323 between perceived addiction to cigarettes and menthol smoking weakened after the ban. The
324 hypothesis for Canada was based on the idea that more dependent/heavier smokers would
325 continue to seek out menthol cigarettes when they are banned; however, this did not appear to
326 be the case among youth.

327 This study also examined the demographics of menthol smokers, including changes in
328 England post-ban. Consistent with prior research,^{6,23} in the US menthol smoking was twice as
329 common among youth who identified as Black than White, but no racial/ethnic differences
330 were observed in England or Canada. Also consistent with prior research in Europe,⁸ menthol
331 smoking was more common among females in England, but not the US or Canada. Despite
332 this, in England, menthol smoking decreased to a similar extent post-ban among all youth,
333 regardless of sex or race/ethnicity.

334 Our primary outcome was self-report of a *usual brand/variety* of cigarettes, selected from a
335 country-specific list and coded as menthol or capsule. Brand loyalty is high among regular
336 smokers,³⁷ so this measure was used to reliably determine menthol cigarette smoking based
337 on the markets in each country. We also assessed a secondary self-reported outcome of
338 smoking *any* menthol cigarettes in the past 30 days, consistent with prior research.^{23,25,27,28}

339 Prevalence of reporting any menthol smoking was markedly higher than reporting a usual

340 brand/variety of cigarettes that is menthol; however key findings were similar across both
341 measures, demonstrating robustness.

342 The reasons for high prevalence of ‘any’ menthol smoking in the past 30 days, including after
343 menthol ban implementation in England (44%) and Canada (35-39%), are unclear.
344 Occasional menthol smoking via sharing/socially sourcing cigarettes may account for the
345 higher prevalence of ‘any’ use in contrast to the usual brand measure, but would do little to
346 explain why prevalence remains high post-ban. Other potential explanations include use of
347 menthol ‘accessories’ to add menthol flavour to regular cigarettes, illicit sourcing, low
348 compliance, and misreporting. Menthol ‘accessories’ (e.g., flavour cards, filter tips, sprays)
349 have been marketed in England and Canada post-bans and are popular among adult
350 smokers,^{29,38-40} but would not be captured by the usual brand measure. Illicit sourcing and
351 lack of compliance are also valid concerns. In Canada, provincial menthol bans have not
352 appeared to increase illicit purchasing^{28,41} and manufacturer compliance has been high;^{42,43}
353 however, there is little research outside of Canada or among youth. Finally, youth may be
354 misreporting other, non-cigarette, menthol nicotine products: cigarillo sales have grown
355 since the EU menthol ban was announced³⁹ and menthol is a popular e-cigarette flavour.^{44,45}
356 Future research should monitor menthol products/accessories used by youth, to further
357 understand the broader impact of menthol bans.

358 We did not formally examine whether menthol cigarette bans reduced youth smoking overall;
359 in line with conceptual models for evaluating tobacco control policies,⁴⁶ we focused on the
360 most specific outcome expected of the menthol cigarette ban—menthol cigarette smoking
361 among smokers—rather than overall smoking prevalence, which may be confounded by other
362 policy initiatives (e.g., Tobacco 21, tax increases) and COVID-19. Findings from Canada are
363 mixed regarding substitution after provincial menthol cigarette bans, with one study finding
364 that overall cigarette sales decreased,²⁶ another finding that adult menthol smokers commonly

365 switched to ban-exempt products (e.g., flavoured cigars),⁴⁷ and two finding that most smokers
366 substituted menthol with non-menthol cigarettes.^{24,48} In our study, past 30-day smoking
367 among youth in England increased shortly before the menthol cigarette ban, followed by a
368 decrease immediately following the ban; as such, smoking prevalence remained relatively
369 stable over the length of the study period. National surveys in England provide mixed
370 findings over this period, with some finding that smoking prevalence among young people
371 decreased between 2018 and 2020⁴⁹ and others finding an increase.⁵⁰ This variability may be
372 due to COVID-19 restrictions, which affected smoking behaviours,⁵¹⁻⁵³ and precludes
373 attribution of changes in smoking prevalence to the menthol ban. Moreover, the impact of
374 flavour restrictions on smoking initiation among young people is likely to occur gradually
375 over the long-term as youth age into the smoking initiation period without the inducement of
376 flavoured cigarettes. Examining substitution of menthol with non-menthol cigarettes
377 following national bans is therefore important for future research.

378 **Limitations and strengths**

379 First data for Canada and the US were weighted to reflect national smoking trends among
380 youth, while data for England were not, due to lack of national smoking estimates among
381 youth aged 16-19. However, prevalence estimates were similar to national benchmark
382 surveys.³³⁻³⁵ Second, as mentioned above, the August 2020 wave occurred during COVID-
383 19. Third, unmeasured confounding cannot be ruled out, although we selected variables that
384 were most specific to the policy being evaluated, adjusted for demographics, and weighted
385 the data to the populations from which the samples were derived.

386 Strengths include the quasi-experimental design, convergence of key findings across two
387 measures of menthol smoking, and large sample. Further, we used a population-based survey
388 among 16-19-year-olds in England, Canada, and the US, enhancing the generalisability of the
389 findings to these groups.

390 **Conclusion**

391 The proportion of youth smokers who smoke menthol (including capsule) cigarettes
392 decreased substantially following the menthol ban in England. This impact was similar
393 among youth aged 16-17 and 18-19 and by sex and racial/ethnic group. Perceived addiction
394 among menthol smokers was also lower where menthol cigarettes were banned.

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580 **Table 1. Percentages and contrasts of past 30-day smokers who reported a) a usual**
581 **brand/variety of cigarettes that was menthol or capsule, b) that they had smoked any menthol**
582 **or capsule cigarettes in the past 30 days, by demographics in each of Canada, England, and**
583 **the US. Data are aggregated across survey waves (2018 to August 2020). N=7,067.**

	Usual brand/variety of cigarettes is menthol or capsule (yes vs. other)			Smoked any menthol or capsule cigarettes in the past 30 days (yes vs. other)		
	%	AOR (95% CI)	p	%	AOR (95% CI)	p
CANADA						
<i>AGE</i>						
16-17	2.4	REF		35.5	REF	
18-19	2.4	1.00 (0.98-1.02)	.962	37.1	1.00 (0.96-1.05)	.875
<i>SEX</i>						
Male	2.7	REF		38.7	REF	
Female	1.9	0.99 (0.98-1.01)	.345	33.3	0.95 (0.91-0.99)	.015
<i>RACE/ETHNICITY</i>						
White only	2.7	REF		29.6	REF	
Any black	1.1	0.98 (0.97-1.00)	.098	49.3	1.22 (1.11-1.33)	<.001
Any other or mixed	1.9	0.99 (0.98-1.01)	.274	44.9	1.17 (1.11-1.23)	<.001
Don't know/refused	3.7	1.09 (0.91-1.31)	.326	48.6	1.22 (1.01-1.47)	.041
ENGLAND						
<i>AGE</i>						
16-17	7.6	REF		45.0	REF	
18-19	9.8	1.02 (1.00-1.04)	.113	55.3	1.10 (1.05-1.15)	<.001
<i>SEX</i>						
Male	7.2	REF		50.2	REF	
Female	10.9	1.04 (1.01-1.06)	.002	51.8	1.01 (0.97-1.06)	.519
<i>RACE/ETHNICITY</i>						
White only	9.2	REF		49.4	REF	
Any black	6.2	0.97 (0.93-1.01)	.173	59.8	1.11 (1.01-1.21)	.029
Any other or mixed	6.8	0.98 (0.94-1.01)	.188	57.3	1.08 (1.00-1.16)	.038
Don't know/refused	18.3	1.09 (0.91-1.31) ²	.326	69.2	1.22 (1.01-1.47)²	.041
US						
<i>AGE</i>						
16-17	34.9	REF		70.3	REF	
18-19	34.3	0.99 (0.94-1.05)	.763	63.1	0.93 (0.88-0.98)	.006
<i>SEX</i>						
Male	33.6	REF		65.8	REF	
Female	36.2	1.02 (0.97-1.07)	.375	67.9	1.02 (0.97-1.07)	.429
<i>RACE/ETHNICITY</i>						
White only	31.9	REF		65.3	REF	
Any black	60.6	1.33 (1.23-1.44)	<.001	77.0	1.12 (1.05-1.20)	.001
Any other or mixed	32.7	1.01 (0.94-1.07)	.854	67.7	1.02 (0.96-1.09)	.507
Don't know/refused	41.0	1.10 (0.72-1.68) ²	.665	48.2	0.85 (0.54-1.34) ²	.480

584 Data are weighted. Contrasts (AOR, 95% CI, p) are derived from interactions from logistic
585 regression models adjusting for country, survey wave, age, sex, and race/ethnicity (shown in Table
586 2). Data are aggregated across survey waves. ¹Estimate unreportable due to n=0. ²Treat estimate
587 with caution (denominator n<30).

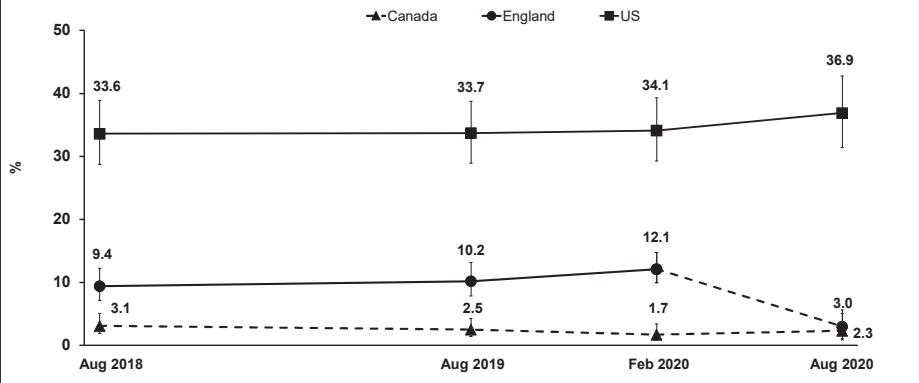
588

589 **Table 2. Percentages and contrasts of past 30-day smokers who reported a) a usual**
590**brand/variety of cigarettes that was menthol or capsule, b) that they had smoked any menthol or**
591**capsule cigarettes in the past 30 days, by consumption/dependence indicators in each of Canada,**
592**England, and the US. Data are aggregated across survey waves (2018 to August 2020). N=7,067.**

	Usual brand/variety of cigarettes is menthol or capsule (yes vs. other)			Smoked any menthol or capsule cigarettes in the past 30 days (yes vs. other)		
	%	AOR (95% CI)	p	%	AOR (95% CI)	p
CANADA						
FREQUENT SMOKING						
Other	2.8	REF		36.6	REF	
≥20 of past 30 days	1.7	0.99 (0.97-1.00)	.117	36.0	0.99 (0.95-1.04)	.823
CIGARETTES PER DAY						
≤1	2.5	REF		35.8	REF	
2-5	2.5	1.00 (0.98-1.02)	.909	39.6	1.04 (0.98-1.09)	.178
>5	2.2	1.00 (0.98-1.02)	.658	34.5	0.98 (0.93-1.04)	.573
Don't know/refused	0.0	- ^{1,2}	-	3.9	0.73 (0.69-0.78) ²	<.001
PERCEIVED ADDICTION						
Not at all	1.3	REF		30.1	REF	
A little/very	3.1	1.02 (1.00-1.03)	.013	40.4	1.10 (1.05-1.15)	<.001
Don't know/refused	0.0	- ^{1,2}	-	28.1	0.96 (0.80-1.14) ²	.602
URGES TO SMOKE						
Less often	2.0	REF		32.9	REF	
Every or most days	3.0	1.01 (0.99-1.02)	.241	41.2	1.08 (1.04-1.13)	<.001
Don't know/refused	0.0	- ^{1,2}	-	14.5	0.83 (0.73-0.94) ²	.003
ENGLAND						
FREQUENT SMOKING						
Other	9.5	REF		48.9	REF	
≥20 of past 30 days	7.6	0.98 (0.96-1.01)	.144	54.9	1.07 (1.03-1.12)	.002
CIGARETTES PER DAY						
≤1	8.6	REF		45.1	REF	
2-5	10.3	1.02 (0.99-1.04)	.252	55.4	1.11 (1.06-1.16)	<.001
>5	7.5	0.99 (0.96-1.02)	.512	56.0	1.13 (1.07-1.19)	<.001
Don't know/refused	2.0	0.94 (0.90-0.98)	.003	35.9	0.91 (0.77-1.07)	.247
PERCEIVED ADDICTION						
Not at all	9.5	REF		42.9	REF	
A little/very	8.4	0.99 (0.97-1.01)	.439	57.0	1.15 (1.11-1.20)	<.001
Don't know/refused	3.9	0.95 (0.88-1.02) ²	.158	33.7	0.92 (0.76-1.10) ²	.355
URGES TO SMOKE						
Less often	8.8	REF		47.2	REF	
Every or most days	8.9	1.00 (0.98-1.03)	.855	56.0	1.10 (1.05-1.14)	<.001
Don't know/refused	11.5	1.03 (0.91-1.17) ²	.659	34.8	0.90 (0.74-1.09)	.280
US						
FREQUENT SMOKING						
Other	32.7	REF		65.4	REF	
≥20 of past 30 days	38.1	1.07 (1.01-1.13)	.026	68.8	1.04 (0.99-1.10)	.128
CIGARETTES PER DAY						
≤1	29.8	REF		62.4	REF	
2-5	37.9	1.09 (1.02-1.15)	.006	70.7	1.09 (1.02-1.16)	.007
>5	38.5	1.10 (1.03-1.18)	.007	69.3	1.08 (1.01-1.15)	.030
Don't know/refused	45.6	1.14 (0.88-1.49) ²	.324	55.4	0.93 (0.69-1.25) ²	.638
PERCEIVED ADDICTION						
Not at all	32.5	REF		57.5	REF	
A little/very	35.1	1.03 (0.97-1.09)	.356	71.3	1.15 (1.09-1.22)	<.001
Don't know/refused	56.6	1.27 (1.03-1.58) ²	.027	52.1	0.95 (0.75-1.21) ²	.691
URGES TO SMOKE						
Less often	30.3	REF		58.6	REF	
Every or most days	38.0	1.08 (1.02-1.14)	.006	73.4	1.16 (1.10-1.22)	<.001
Don't know/refused	44.6	1.12 (0.85-1.48) ²	.412	63.4	1.04 (0.78-1.38) ²	.789

593 Data are weighted. Contrasts (AOR, 95% CI, p) are derived from interactions from logistic
594 regression models adjusting for country, survey wave, age, sex, and race/ethnicity. Data
595 are aggregated across survey waves. ¹ Estimate unreportable due to n=0. ² Treat estimate
596 with caution (denominator n<30).

(a) Usual brand/variety of cigarettes is menthol or capsule



(b) Smoked any menthol or capsule cigarettes in past 30 days

