



THE UNIVERSITY *of* EDINBURGH

Edinburgh Research Explorer

Smoking prevalence and purchasing of menthol cigarettes since the menthol flavour ban in Great Britain

Citation for published version:

Buss, VH, Tattan-Birch, H, Cox, SE, Bauld, L, Shahab, L & Brown, J 2024, 'Smoking prevalence and purchasing of menthol cigarettes since the menthol flavour ban in Great Britain: a population-based survey between 2020 and 2023', *BMJ Open*. <https://doi.org/10.1136/tc-2023-058390>

Digital Object Identifier (DOI):

[10.1136/tc-2023-058390](https://doi.org/10.1136/tc-2023-058390)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Publisher's PDF, also known as Version of record

Published In:

BMJ Open

General rights

Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact openaccess@ed.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.





OPEN ACCESS

Smoking prevalence and purchasing of menthol cigarettes since the menthol flavour ban in Great Britain: a population-based survey between 2020 and 2023

Vera Helen Buss ,^{1,2} Harry Tattan-Birch ,^{1,2} Sharon Cox,^{1,2} Linda Bauld,^{2,3} Lion Shahab ,^{1,2} Jamie Brown ^{1,2}

► Additional supplemental material is published online only. To view, please visit the journal online (<https://doi.org/10.1136/tc-2023-058390>).

¹Behavioural Science and Health, University College London, London, UK

²SPECTRUM Consortium, Edinburgh, UK

³Usher Institute and UK Centre for Tobacco and Alcohol Studies, College of Medicine and Veterinary Medicine, University of Edinburgh, Edinburgh, UK

Correspondence to

Dr Vera Helen Buss, Behavioural Science and Health, University College London, London, UK; v.buss@ucl.ac.uk

Received 8 September 2023
Accepted 5 February 2024



© Author(s) (or their employer(s)) 2024. Re-use permitted under CC BY. Published by BMJ.

To cite: Buss VH, Tattan-Birch H, Cox S, *et al.* *Tob Control* Epub ahead of print: [please include Day Month Year]. doi:10.1136/tc-2023-058390

ABSTRACT

Background Menthol cigarettes have been banned in Great Britain (GB) since May 2020. Still, menthol accessories and unlabelled cigarettes perceived as mentholated are available, and people can buy menthol cigarettes overseas or illicitly. This study assessed: trends in smoking menthol cigarettes among all adults and 18–24-year-olds in GB between October 2020 and March 2023; trends in and differences between England, Scotland and Wales during the same period and purchase sources among people smoking menthol versus non-flavoured cigarettes.

Methods Population-weighted data were from a monthly cross-sectional survey of adults in GB. Among people smoking cigarettes, we calculated the proportion smoking menthol cigarettes across all adults and 18–24-year-olds, and prevalence ratios (PR) between the first and last quarter. We also calculated the proportions of people smoking menthol/non-flavoured cigarettes by purchase source (including illicit sources).

Results In the first quarter, 16.2% of adults smoking cigarettes reported menthol cigarette smoking with little to no decline throughout the study (PR 0.85, 95% CI 0.71 to 1.01), while it declined among 18–24-year-olds (PR 0.75, 95% CI 0.63 to 0.89). The prevalence of menthol cigarette smoking fell by two-thirds in Wales (PR 0.36, 95% CI 0.19 to 0.62) but remained relatively stable in England (PR 0.88, 95% CI 0.72 to 1.06) and Scotland (PR 0.94, 95% CI 0.59 to 1.53). The main purchasing sources were licit (93.9%), 14.8% reported illicit sources and 11.5% cross-border purchases, without notable differences from people smoking non-flavoured cigarettes.

Conclusions Roughly one million adults in GB still smoke menthol cigarettes and, with the exception of Wales and young people, there were no noteworthy changes in the post-ban period. There was no indication that the overall persistence of menthol smoking was driven by illicit purchases.

INTRODUCTION

Factory-made and roll-your-own tobacco with characterising flavours (that alter the smell and taste of the product) has been banned in the UK and the European Union (EU) since May 2020.^{1,2} Menthol is the most common cigarette flavour and menthol cigarettes are particularly popular among youth (aged 12–17) and young adults (aged 18–24) because menthol reduces negative sensory characteristics

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Tobacco companies have used various loopholes in the legislation to circumvent the menthol cigarette ban in Great Britain and, in general, some people tend to migrate towards illicit purchases when their product is banned.

WHAT THIS STUDY ADDS

⇒ Despite the ban, menthol cigarettes have remained popular among adults who smoke in Great Britain, with roughly one in seven reporting smoking menthol cigarettes in 2023. Between October 2020 and March 2023, there was no noteworthy change in menthol cigarette smoking prevalence in the overall British adult population, but there was a sharp decline among the Welsh population.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Since the majority of people who reported menthol cigarette smoking purchased cigarettes through licit sources, it might indicate that most of them either use accessories to add menthol flavour to their cigarettes or they purchase cigarette brands that are perceived to contain menthol flavouring without being labelled as such. If the aim is to reduce menthol cigarette smoking prevalence to nearly zero, policy-makers in Great Britain should consider closing loopholes in the current legislation, such as prohibiting all menthol and its analogues and derivatives in all tobacco-related products, including accessories.

associated with smoking, and menthol cigarettes are misperceived as less harmful.^{3–5} Previous research showed that prevalence of menthol cigarette smoking has remained high in England in the year after the ban.^{6,7} It is important for policy-makers to know whether the relatively high prevalence has persisted, and if so, what the main drivers are.

As one of the main intentions of this legislation was to reduce smoking uptake among youth, other tobacco products containing menthol such as cigars were exempted from the ban due to low sales volumes or consumption among young people.² It is assumed that a menthol cigarette ban would lead to a decrease in smoking prevalence as fewer young

people would start smoking.^{5 8} Another rationale for the ban is that people who smoke menthol cigarettes will be more likely to quit when they can no longer purchase menthol cigarettes than to switch to non-flavoured cigarettes.^{5 8–10}

There are several reasons why people in the UK may continue to smoke menthol cigarettes despite the ban. First, it is possible to buy factory-made cigarettes or roll-your-own tobacco with menthol flavour in countries without a ban and bring them back to the UK either within the legal limits for personal use or through illicit means. Second, people can purchase menthol accessories, such as filters or capsules inserted in a hole in filters of factory-made cigarettes, infusion cards for cigarette packs to spread menthol aroma and flavour or menthol-flavoured filters for use with roll-your-own tobacco.¹¹ These accessories are not covered by the ban and some of them seem to have been placed on the UK market in direct response to the ban.^{11 12} Another tactic that the tobacco industry used to circumvent the ban is to produce cigarettes that may be perceived as mentholated, while the manufacturers claim that the flavours are not characterising and are therefore allowed.¹³ For example, some menthol cigarette products by Japan Tobacco International were rebranded under a 'dual' range, such as Benson & Hedges Dual, and have been accused of still containing menthol.^{13 14}

Early results from England after the ban showed a decline in menthol cigarette smoking among young people aged 16–19 years, from 12.1% of young people smoking in the past 30 days in February 2020 before the ban was implemented to 3.0% in August 2020 after the implementation.⁶ Figures referring to only those who smoked on at least 20 out of the last 30 days showed a decline from 11.1% to 2.0% in the same period.⁶ Another study from England found that among current smokers, 15.7% reported menthol cigarette smoking between July 2020 and June 2021 with a decline from April 2021 onwards.⁷ Among 16–24-year-olds currently smoking, the prevalence was 25.2% between July 2020 and June 2021 (post-ban). The study also found that among those reporting menthol cigarette smoking, the percentage of young people, women and people with professional or managerial occupations was higher than among those reporting smoking other cigarettes.⁷

This study aimed to provide an update on menthol cigarette smoking prevalence to assess whether it has continued to decline since June 2021. Further, it included data from all three nations in Great Britain (GB) to identify potential differences between England, Scotland and Wales. While the menthol ban applies to all three nations, Scotland differs from the other two nations in that the government prohibits the display of any tobacco and smoking-related products in shops,^{15 16} which could mean people living in Scotland are less aware of the availability of menthol-flavoured tobacco accessories. In England and Wales, tobacco accessories can be displayed at the point of sale.¹⁵ The study also evaluated where people who stated that they smoked menthol cigarettes purchased them, to understand purchase patterns (ie, licit, illicit or cross-border).

The research questions were as follows: (1) Has the prevalence of smoking menthol cigarettes among all adults who smoke cigarettes and specifically among young adults (18–24 years) smoking cigarettes in GB changed between October 2020 and March 2023? (2) Were there differences in the change in prevalence of smoking menthol cigarettes as a proportion of all adults who smoke cigarettes between England, Scotland and Wales? and (3) Where did people who smoke menthol cigarettes purchase tobacco products in GB between October 2020 and March 2023, were these illicit or cross-border purchases and

did the sources of purchase differ from those who smoked non-flavoured cigarettes?

METHODS

Study design

Data for this study were drawn from the Smoking Toolkit Study, an ongoing monthly population-based survey including demographic and smoking-related questions.¹⁷ This study includes data collected between October 2020 and March 2023 from England, Scotland and Wales. Prior to the analysis, the study protocol was published on the Open Science Framework (<https://osf.io/s8mjr/>). The manuscript followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.¹⁸ Data collection was conducted by a market research company using a combination of random location and quota sampling. Anonymised data were provided to the research team. The data collection method changed in March 2020 from face-to-face to telephone surveys. Studies showed similar results when comparing the two data collection methods.^{19–21}

Outcome variables and covariates

The primary outcome measures were the prevalence of menthol cigarette smoking as a proportion of all adults who smoke and specifically young adults smoking (18–24 years) and, for each purchasing source, the proportion of individuals smoking menthol cigarettes who stated that they purchased cigarettes through this source. First, participants were grouped according to whether they currently smoked cigarettes. Then, they were further classified based on whether they smoked menthol cigarettes (or for sensitivity analysis, any flavoured cigarettes). All variables are listed in [table 1](#) and are based on self-report.

Analysis

The analysis was conducted in RStudio (V.2022.07.2, R V.4.2.1). For each variable included in the analysis, the number and percentage of missing values are reported in online supplemental table S1. All values that the interviewer noted as 'don't know' or 'refused' were assumed to be missing. The study is based on a complete-case analysis. For the first research question, the weighted prevalence of smoking menthol cigarettes as a proportion of all adults in GB who smoke cigarettes was assessed for each quarter between October 2020 and March 2023. The prevalence was reported for quarters rather than months due to small samples in 18–24-year-olds, in Scotland and in Wales. Data were weighted using raking to match the population of GB.²² The weighted prevalence was plotted over time. Further, a logistic regression model with a restricted cubic spline function (three knots at the beginning, middle and end of the time series) was fitted to assess weighted prevalence as a proportion of people smoking menthol cigarettes over time. Prevalence ratios (PRs) and corresponding 95% compatibility intervals (CIs, using bootstrapping with n=2000 replicates^{23–26}) were calculated for the change in prevalence comparing the first quarter (Q4 2020) to the last quarter (Q1 2023). In addition, the weighted prevalence was assessed for young adults aged 18–24 years in GB. For the second research question, the weighted prevalence of smoking menthol cigarettes as a proportion of those who smoked cigarettes was assessed for each nation (England, Scotland and Wales) over time (in quarters). The weighted prevalence of smoking menthol cigarettes was plotted over time for each nation and PRs and corresponding 95% CIs (using bootstrapping with n=2000 replicates) calculated for the change in prevalence in each nation across the study period. In addition, logistic regression including

Table 1 Variables used in analyses, their definitions and categories if applicable

| Variable | Definition/categories |
|------------------------------|--|
| Cigarette smoking | Binary: yes, if stated: 'I smoke cigarettes (including hand rolled) every day', or 'I smoke cigarettes (including hand rolled), but not every day' to the question: 'Which of the following best applies to you?' |
| Smoking menthol cigarettes | Binary: yes, if cigarette smoking (see above) and stated 'Tobacco and menthol' to the question: 'Cigarettes can be sold in different flavours. They can also be flavoured by capsules, filter tips, cards inserted into a packet or flavoured rolling papers. How would you describe the flavour of the cigarettes you usually smoke/smoked?' |
| Smoking flavoured cigarettes | Binary: yes, if cigarette smoking (see above) and stated 'Tobacco and menthol' or 'Tobacco and some other flavour' to the question: 'Cigarettes can be sold in different flavours. They can also be flavoured by capsules, filter tips, cards inserted into a packet or flavoured rolling papers. How would you describe the flavour of the cigarettes you usually smoke/smoked?' |
| Purchasing sources* | Question: 'In the last 6 months, have you bought any cigarettes or hand rolled tobacco from any of the following?' Answer options: <ol style="list-style-type: none"> 1. Newsagent/off-licence/corner shop 2. Petrol garage shop 3. Supermarket 4. Cash and carry 5. Internet 6. Pub (behind the bar) 7. Pub (vending machine) 8. Pub (somebody who comes round selling cigarettes cheap) 9. People who sell cheap cigarettes on the street 10. People in the local area who are a trusted source of cheap cigarettes 11. Buy them cheap from friends 12. Buy them from abroad and bring them back with me 13. Newsagent/off-licence/corner shop—'under the counter' 14. Friends/family bring from abroad 15. Tobacconist Further, categorised into three groups: ▶ Licit: answer options 1–6, 15 ▶ Illicit: answer options 7–11, 13 ▶ Cross-border: answer options 12, 14 |
| Gender | Categorical: female, male or non-binary (due to the small proportion of participants who identified as non-binary, they were excluded from regression analyses) |
| Age | Numerical: modelled using restricted cubic splines with three knots placed at the minimum, median and maximum for age ^{48 49} |
| Nation | Categorical: England, Scotland, Wales |
| Social grade | Categorical: measure of socioeconomic position using the National Readership Survey's classification ⁵⁰ categories: ABC1 (high and intermediate managerial, administrative, or professional, supervisory, clerical, and junior managerial, administrative or professional) or C2DE (skilled manual workers, semi and unskilled manual workers, state pensioners, casual or lowest grade workers, unemployed with state benefits only) |

*In the study protocol, answer option 7 'Pub (vending machine)' was incorrectly classified as licit, and 14 'friends/family bring from abroad' and 15 'tobacconist' were not listed.

an interaction term between time and nation was used to calculate the PR ratio (unadjusted and adjusted for age, gender and social grade) of smoking menthol cigarettes among those who smoke cigarettes in Scotland and Wales compared with England (ie, dividing the PR of Scotland or Wales, respectively, by the PR of England). Corresponding 95% CIs were computed using bootstrapping (n=2000 replicates).

In England, the question about purchasing sources of cigarettes was only asked once per quarter since April 2022 (ie, in April 2022, July 2022, October 2022 and January 2023). Therefore, months in which data were only collected in Scotland and Wales were excluded from the analysis for the third research question. The weighted proportion of people who smoked menthol cigarettes stating that they purchased cigarettes from various sources (not mutually exclusive) was computed for the entire study period (excluding the above-mentioned months). Further, weighted proportions of licit, illicit and cross-border purchases were assessed. The weighted proportion for each purchase source was compared between those who smoked menthol cigarettes and those who did not smoke flavoured cigarettes using χ^2 statistics and Cramer's V as a measure of the effect size (following the interpretation by Cohen,²⁷ categorising Cramer's V into small, medium and large effect sizes). Further, purchase sources were compared between nations. In sensitivity analyses, the research questions were assessed including all people who

stated that they smoked flavoured cigarettes (menthol or some other flavour) instead of just those who stated that they smoked menthol cigarettes. Further, the prevalence of smoking menthol cigarettes among all adults and specifically young adults in all of GB and the prevalence of smoking menthol cigarettes among all adults separately in the three nations were assessed.

RESULTS

For 66 868 (98.7%) out of a total of 67 746 participants, complete data were available on all relevant variables, excluding purchasing sources (data on purchasing sources only available for 6757 out of 9195 participants who smoked cigarettes due to the months without data collection for this variable; 191 out of 6757 (2.9%) with missing values). Among these participants, 9773 (14.6%) smoked cigarettes (see table 2, unweighted data in online supplemental table S2). The median age was 49 years (IQR 33–63). There were 7660 participants aged between 18 and 24 years, of which 1536 (20.1%) smoked cigarettes.

Menthol cigarette smoking prevalence

The prevalence of menthol cigarette smoking in all adults and those aged 18–24 years who smoked cigarettes in GB, and adults in England, Scotland and Wales are listed by quarter in weighted data in online supplemental table S3, unweighted data in online

Table 2 Characteristics of survey respondents between October 2020 and March 2023 (N=66 868; data weighted)

| Characteristic | All | England (n=57 469) | Scotland (n=5832) | Wales (n=3264) |
|--------------------------|---------------|--------------------|-------------------|----------------|
| Age, median (IQR) | 49 (33–63) | 48 (32–63) | 52 (36–65) | 55 (40–69) |
| Gender, n (%) | | | | |
| Female | 32 427 (48.6) | 28 054 (48.7) | 2801 (47.9) | 1572 (48.0) |
| Male | 33 918 (50.8) | 29 258 (50.8) | 2996 (51.3) | 1664 (50.8) |
| Non-binary | 400 (0.6) | 316 (0.5) | 45 (0.8) | 39 (1.2) |
| Social grade, n (%) | | | | |
| ABC | 37 341 (55.9) | 32 416 (56.3) | 3188 (54.6) | 1738 (53.1) |
| C2DE | 29 404 (44.1) | 25 212 (43.7) | 2654 (45.4) | 1537 (46.9) |
| Cigarette smoking, n (%) | 9773 (14.6) | 8480 (14.7) | 817 (14.0) | 477 (14.6) |

supplemental table S4. **Figure 1** shows that the prevalence of menthol cigarette smoking was relatively stable over time among all adults, at 16.2% in the first quarter (Q4 2020) and 13.7% in the final quarter (Q1 2023; PR 0.85, 95% CI 0.71 to 1.01). Assuming an adult population of 52 million adults in GB,²⁸ this results in roughly one million adults smoking menthol cigarettes in the first quarter of 2023. Among 18–24-year-olds, the prevalence declined by a quarter from 25.7% to 19.4% (PR 0.75, 95% CI 0.63 to 0.89).

Figure 2 shows that the prevalence of menthol cigarette smoking was relatively stable over time in England, at 16.2% in the first quarter (Q4 2020) and 14.2% in the final quarter (Q1 2023; PR 0.88, 95% CI 0.72 to 1.06), and Scotland, at 12.0% in the first quarter and 11.3% in the final quarter (PR 0.94, 95% CI 0.59 to 1.53). In Wales, the prevalence decreased by almost two-thirds over time, from 22.5% in the first quarter to 8.1% in the last quarter (PR 0.36, 95% CI 0.19 to 0.62). There was initially a higher prevalence in Wales than England (modelled estimates for Q4 2020: 22.5% vs 16.2%) but a lower prevalence by 2023 (modelled estimates for Q1 2023: 8.1% vs 14.2%; unadjusted PR ratio 0.41, 95% CI 0.21 to 0.75; adjusted PR ratio 0.34, 95% CI 0.21 to 0.83). Conversely, Scotland had a lower prevalence than in England throughout the whole period (modelled estimates for Q4 2020: 12.0% vs 16.2, and for Q1

2023: 11.3% vs 14.2%; unadjusted PR ratio 1.07, 95% CI 0.64 to 1.80; adjusted PR ratio 1.21, 95% CI 0.69 to 2.07, **figure 3**).

Sources of purchasing

Table 3 shows the sources of purchase among those who smoked menthol cigarettes compared with those only smoking non-flavoured cigarettes (unweighted data in online supplemental table S5). The main sources were newsagents/off-licence/corner shops and supermarkets. There were no noteworthy differences between the two groups. Most participants reported purchasing through licit sources (for menthol cigarette smoking: 93.9%, 95% CI 92.2% to 95.5%; for non-flavoured cigarette smoking: 93.5%, 95% CI 92.7% to 94.2%). Illicit sources of purchase were reported by 14.8% (95% CI 12.2% to 17.3%) of those smoking menthol cigarettes and 12.5% (95% CI 11.5% to 13.5%) of those smoking only non-flavoured cigarettes. Cross-border purchases were reported by 11.5% (95% CI 9.2% to 13.8%) of participants smoking menthol cigarettes and 9.9% (95% CI 9.0% to 10.8%) of participants smoking only non-flavoured cigarettes.

Table 4 shows the sources of purchasing cigarettes among those who smoked menthol cigarettes in England, Scotland and Wales (unweighted data in online supplemental table S6). All differences between nations were non-significant. The main sources

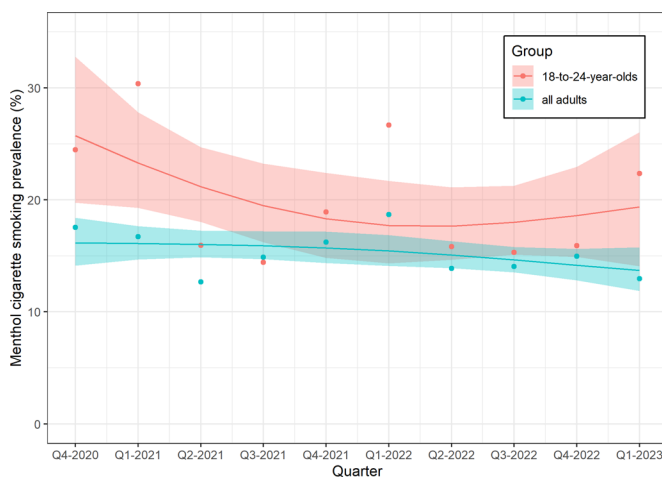


Figure 1 Weighted prevalence of smoking menthol cigarettes among all adults who smoke cigarettes and those aged 18–24 years in Great Britain over time. Lines and shaded bands represent point estimates and 95% compatibility intervals, respectively, from logistic regression with time modelled with restricted cubic splines (three knots). The points represent unmodelled data.

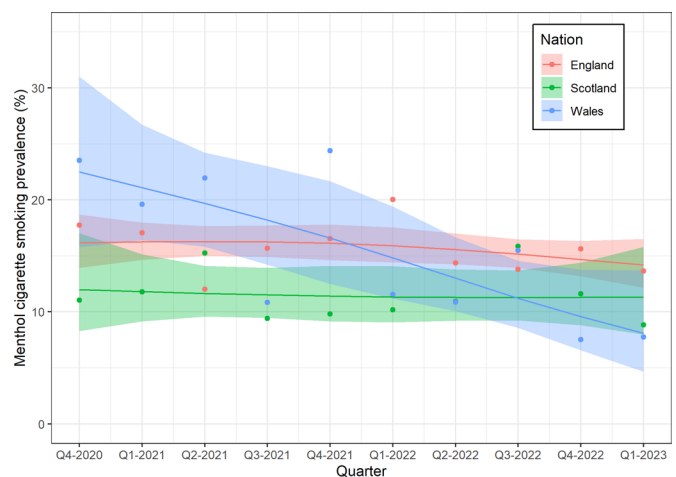


Figure 2 Weighted prevalence of smoking menthol cigarettes among adults who smoke in England, Scotland and Wales over time. Lines and shaded bands represent point estimates and 95% compatibility intervals, respectively, from logistic regression with time modelled with restricted cubic splines (three knots). The points represent unmodelled data.

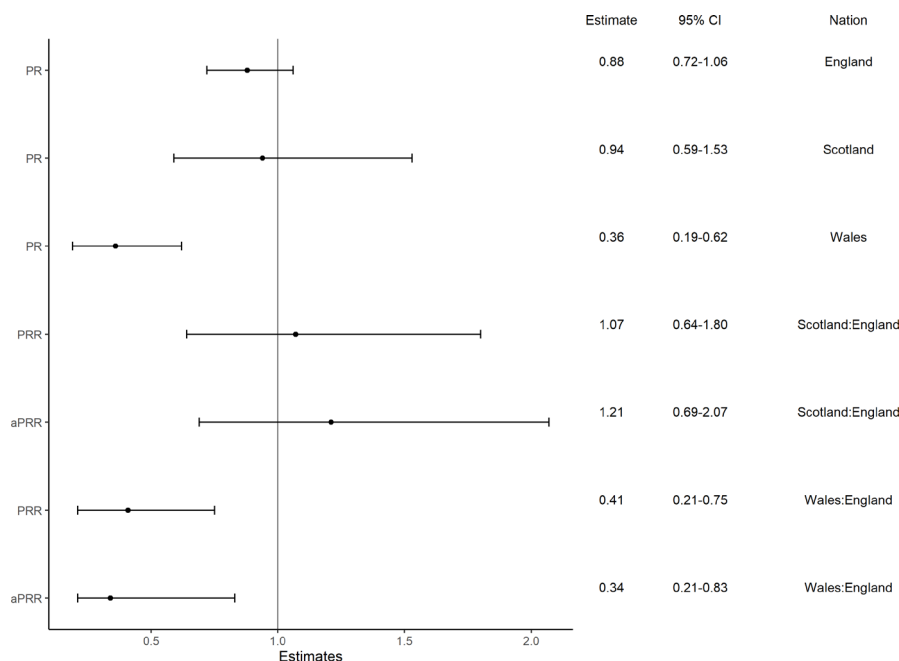


Figure 3 Prevalence ratios (PR) comparing menthol smoking among people who smoked in Q4 2020 (reference) to Q1 2023 by nation, and PR ratios (PRR) comparing PRs between nations. aPRR, adjusted PRR (adjusted for age, gender and social grade using the median (49 years) and the most common category (men, ABC1) as reference).

of purchase for all nations were small shops (ie, newsagent, off-licence or corner shop) and supermarkets.

Sensitivity analyses

Additional sensitivity analyses including all participants who reported that they smoked flavoured cigarettes (instead of only those who reported smoking menthol cigarettes) and the prevalence among all adults (ie, the proportion of individuals smoking menthol cigarettes among all participants) are presented in online supplemental tables S7–S13 and figures S1–S4. The first sensitivity analysis including all people who smoked any flavoured

cigarettes did not show meaningful differences compared with the main analysis. In the second sensitivity analysis investigating the prevalence of smoking menthol cigarettes as a proportion of all adults (or all aged 18–24 years, respectively), the difference in the prevalence between all adults and 18–24 years became more pronounced (see online supplemental tables S12 and figure S3). Online supplemental figure S3 shows additionally the prevalence of smoking any type of cigarette among all adults and those aged 18–24 years in GB over the same time. The trend lines run in parallel to each other. Also, the decrease in prevalence was greater among 18–24-year-olds when calculating the

Table 3 Sources of cigarette purchases in the last 6 months (not mutually exclusive) among those who smoke menthol cigarettes or non-flavoured cigarettes between October 2020 and March 2023 (n=6621, data weighted)

| Source of purchase | Among people smoking menthol cigarettes, % (95% CI) | Among people smoking non-flavoured cigarettes, % (95% CI) | P value* |
|---|---|---|----------|
| Newsagent/off-licence/corner shop | 72.8 (69.7 to 75.8) | 69.7 (68.3 to 71.1) | 0.047 |
| Petrol garage shop | 43.0 (39.6 to 46.5) | 40.9 (39.4 to 42.4) | 0.193 |
| Supermarket | 72.4 (69.3 to 75.5) | 72.2 (70.8 to 73.5) | 0.885 |
| Cash and carry | 6.2 (4.4 to 8.0) | 5.3 (4.6 to 6.0) | 0.237 |
| Internet | 2.3 (1.3 to 3.4) | 2.7 (2.2 to 3.2) | 0.481 |
| Bar in pub | 2.1 (1.0 to 3.2) | 1.3 (0.9 to 1.6) | 0.036 |
| Other sources | 0.5 (0.0 to 1.1) | 1.0 (0.7 to 1.3) | 0.186 |
| Illicit | | | |
| Newsagent/off-licence/corner shop—'under the counter' | 8.2 (6.2 to 10.2) | 6.0 (5.3 to 6.8) | 0.009 |
| Friends | 5.9 (4.2 to 7.6) | 5.6 (4.8 to 6.3) | 0.683 |
| Trusted local | 3.8 (2.4 to 5.2) | 3.5 (2.9 to 4.1) | 0.638 |
| Person in pub | 2.9 (1.6 to 4.1) | 1.8 (1.4 to 2.3) | 0.027 |
| Person on the street | 2.3 (1.2 to 3.3) | 2.3 (1.8 to 2.8) | 0.952 |
| Vending machine pub | 1.2 (0.4 to 2.1) | 0.9 (0.6 to 1.2) | 0.292 |
| Cross-border | | | |
| Buy them from abroad and bring them back | 11.3 (9.0 to 13.5) | 9.7 (8.9 to 10.6) | 0.136 |
| Friends/family bring from abroad | 0.3 (0.1 to 0.7) | 0.1 (0.0 to 0.2) | 0.244 |

*All values for Cramer's V were ≤ 0.10 .

Table 4 Sources of cigarette purchases in the last 6 months (not mutually exclusive) among those who smoke menthol cigarettes by nation between October 2020 and March 2023 (n=6621, data weighted)

| Source of purchase | Among people smoking menthol cigarettes in England, % (95% CI) | Among people smoking menthol cigarettes in Scotland, % (95% CI) | Among people smoking menthol cigarettes in Wales, % (95% CI) | P value* |
|---|--|---|--|----------|
| Newsagent/off-licence/corner shop | 73.1 (69.7 to 76.5) | 69.6 (61.5 to 77.7) | 70.9 (61.1 to 80.7) | 0.802 |
| Petrol garage shop | 42.8 (39.0 to 46.6) | 40.2 (31.5 to 48.8) | 50.1 (39.4 to 60.9) | 0.521 |
| Supermarket | 72.3 (68.9 to 75.8) | 70.0 (61.7 to 78.3) | 75.8 (66.6 to 85.0) | 0.783 |
| Cash and carry | 6.5 (4.5 to 8.5) | 5.4 (1.8 to 9.0) | 2.9 (0.0 to 5.7) | 0.554 |
| Internet | 2.3 (1.1 to 3.5) | 3.5 (0.7 to 6.4) | 1.6 (0.0 to 3.8) | 0.776 |
| Bar in pub | 2.3 (1.1 to 3.5) | 1.5 (0.0 to 4.0) | 0.7 (0.0 to 2.1) | 0.699 |
| Other sources | 0.5 (0.0 to 1.1) | 0.4 (0.0 to 1.3) | 0.0 (0.0 to 0.0) | 0.846 |
| Illicit | | | | |
| Newsagent/off-licence/corner shop— ‘under the counter’ | 8.4 (6.2 to 10.6) | 3.0 (0.4 to 5.6) | 10.9 (3.9 to 17.8) | 0.256 |
| Friends | 6.1 (4.2 to 8.0) | 3.4 (0.0 to 7.3) | 5.3 (1.2 to 9.4) | 0.687 |
| Trusted local | 4.0 (2.5 to 5.5) | 0.0 (0.0 to 0.0) | 5.0 (0.2 to 9.9) | 0.260 |
| Person in pub | 2.9 (1.5 to 4.3) | 2.9 (0.0 to 6.4) | 1.9 (0.0 to 5.6) | 0.915 |
| Person on the street | 2.2 (1.1 to 3.3) | 3.6 (0.0 to 7.7) | 2.5 (0.0 to 6.4) | 0.772 |
| Vending machine pub | 1.3 (0.4 to 2.2) | 1.3 (0.0 to 3.8) | 0.0 (0.0 to 0.0) | 0.708 |
| Cross-border | | | | |
| Buy them from abroad and bring them back | 11.4 (8.9 to 13.9) | 12.5 (6.3 to 18.6) | 7.7 (2.6 to 12.9) | 0.686 |
| Friends/family bring from abroad | 0.2 (0.0 to 0.7) | 0.0 (0.0 to 0.0) | 1.3 (0.0 to 3.8) | 0.324 |

*All values for Cramer's V were ≤ 0.10 .

prevalence among all participants (PR 0.64, 95% CI 0.53 to 0.77, modelled prevalence for Q4 2020: 5.7% and for Q1 2023: 3.7%) compared with the prevalence among only those who smoked (PR 0.75, 95% CI 0.63 to 0.89, modelled prevalence for Q4 2020: 25.7% and for Q1 2023: 19.4%). For the between-nation comparison, the results for prevalence among all adults and prevalence among those who smoked were comparable.

DISCUSSION

Summary of findings

Despite being banned in 2020, one million adults continue to smoke menthol cigarettes in GB. The prevalence of menthol cigarette smoking only decreased slightly and non-significantly among adults who smoke, from 16% at the end of 2020 to 14% at the beginning of 2023. During the same period, the prevalence among 18–24-year-olds dropped by a quarter from 26% to 19%. These figures show that despite the ban, menthol cigarette smoking remains common among people who smoke in GB, used by roughly one in seven adults who smoke and one in five among young adults who smoke. Nevertheless, the ban may have had some positive effect particularly on young people. The only nation with a substantial decline in the prevalence was Wales, where it fell by two-thirds from 23% to 8%. Compared with England and Scotland, Wales started off with a higher prevalence, but by the beginning of 2023 it had the lowest prevalence. In contrast, the prevalence in England and Scotland remained relatively stable throughout the period, but in Scotland it was consistently lower than in England.

It is unclear why the trend in Wales differed from the other two nations. Potential contributors could include differences in government approaches and differences in purchasing sources. Since our data on purchasing sources did not differentiate whether people bought menthol cigarettes or accessories to mentholate their cigarettes, we may have missed differences in purchasing sources by nation which are specific to menthol cigarettes. Another explanation could be that the tobacco industry

focused its marketing tactics for legal menthol accessories on larger urban areas, mainly in England, rather than less populous localities found in Wales. A further, more unlikely explanation is that people who smoked menthol cigarettes in Wales at the start of the study period were more likely to have quit smoking altogether. When comparing England and Scotland, a potential explanation for the lower overall prevalence in Scotland could be the display ban for tobacco-related accessories in Scotland. Whereas tobacco products (cigarettes, loose tobacco, cigars, etc) are subject to a display ban in all three nations, only Scotland bans tobacco product accessories from being visible at the point of sale.^{15 16} This difference in legislation could mean that people living in Scotland may be less aware of menthol-flavoured accessories.

There were no noteworthy differences in purchasing sources between menthol and non-flavoured cigarettes; small shops and supermarkets were the most popular places to buy both kinds of cigarettes. There was no evidence that people smoking menthol cigarettes were particularly likely to obtain these from abroad or through illicit sources. Rather, people continued to buy menthol cigarettes in regular shops. This indicates that they either purchased menthol-flavoured accessories or cigarettes they perceived to be mentholated, but which are not labelled as such by the manufacturer.

Comparison to existing literature

Canada was one of the first countries to introduce a menthol ban and, in contrast to the UK and the EU, it completely prohibited menthol and its analogues and derivatives in cigarettes nationwide from 2017.²⁹ In a pre-post ban comparison, only 20% of people who reported smoking menthol cigarettes before the ban continued doing so afterwards, while 59% switched to non-menthol cigarettes and 22% stopped smoking entirely.³⁰ In a follow-up study using brand validation analysis, Chung-Hall *et al*³¹ found that verified rates of menthol cigarette smoking post-ban in Canada were considerably lower than what survey

respondents had reported (11% vs 20%). In a Dutch longitudinal study, people who smoked menthol cigarettes before the ban there (in March 2020) were asked again about their cigarette smoking behaviour in June–July 2021.³² The results showed that 33% of them reported still smoking menthol cigarettes as their usual brand, 40% switching to non-menthol cigarettes, 1% smoking cigarettes with unknown flavour and 26% having quit smoking. These studies demonstrate that in other countries people also continued smoking menthol cigarettes despite the ban. Potentially, the fact that fewer people who previously smoked menthol cigarettes continued to do so in Canada post-ban compared with the Netherlands shows that a ban on menthol as an additive may be more effective than just as a characterising flavour.

Data from Canada and the Netherlands also refute the hypothesis that menthol cigarette bans lead to a surge in illicit purchases.^{33 34} Similarly, Laverty *et al*³⁵ found that the implementation of standardised packaging in the EU did not lead to an increase in the availability of illicit cigarettes. These findings strengthen the alternative hypothesis that people who continue menthol cigarette smoking after the ban either buy menthol-flavoured accessories or cigarettes that are perceived as being mentholated by consumers but not labelled as such by the manufacturers.^{13 30 32 34 36 37} A recent study assessing use of menthol cigarettes and accessories in England among youth (aged 16–19) after the ban was introduced showed that around two-thirds of those who reported usually smoking menthol cigarettes used menthol accessories.³⁸ Data from California, which also has a sale ban on most flavoured tobacco products, including those with characterising menthol flavours, showed that tobacco manufacturers in some cases replaced menthol with synthetic cooling agents that have similar cooling sensory effects without the characterising flavour.³⁹ These cigarettes were then marketed by industry as menthol replacement products.⁴⁰ Similar products might have entered the UK market after the ban was introduced, and survey participants consuming these products may have reported smoking menthol cigarettes.

Policy implications

The current study shows no increase in illicit purchasing 3 years after the ban in GB and is an important contribution to the literature assessing the longer-term impact of menthol cigarette bans; it is another example of how the industry's oft-predicted surge in illicit cigarette purchases as a result of tobacco control measures did not materialise.

The menthol ban, implemented as part of the EU Tobacco Products Directive, had a 2-year implementation period from 2014 to 2016 and allowed an additional 4-year grace period for 'tobacco products with a characterising flavour whose Union-wide sales volumes represent 3% or more in a particular product category' (ie, menthol cigarettes).⁴¹ This extended 6-year period between the adoption of the law and its entry into force illustrates how the tobacco industry may have been lobbying policymakers to gain additional time to prepare for legislative changes and exploit loopholes.^{42 43} This example also highlights how tobacco control legislation in the EU and the UK can be delayed or impeded due to industry interference, and how moratoria undermine the impact of strong regulations.^{42 43}

One of the loopholes in the legislation is that menthol and its analogues are not prohibited as additives per se but only as characterising flavours.² There are two problems associated with this loophole. First, it is difficult to determine whether a cigarette possesses characterising flavour.⁴⁴ Second, menthol

exhibits sensory effects even when added in low concentrations to tobacco that is not considered characterising.⁴⁵ These effects appear to be mediated through the activation of the transient receptor potential melastatin 8, also known as the cold and menthol receptor 1,⁴⁶ and include the suppression of irritating properties of cigarette smoke.⁴⁵ The second point is important to consider because allowing menthol or analogues to be added to cigarettes in low concentrations undermines the intended impact of menthol cigarette bans. For an effective ban, menthol and all its analogues and derivatives should be completely prohibited in all tobacco-related products.

Further, the difference in menthol cigarette smoking prevalence between England and Scotland found in this study may illustrate the strength of a point-of-sale display ban covering not only tobacco products but also tobacco accessories. On a more general note, not all EU countries have introduced a point-of-sale display ban on tobacco products, as this policy was removed from an early draft of the 2014 EU Tobacco Products Directive due to industry interference.⁴³

Limitations

This study has several limitations. It is cross-sectional and it is based on self-reported data. No data were available on menthol cigarette smoking prevalence and the purchasing sources for those smoking menthol cigarettes prior to the ban because the question about menthol smoking was only included in the survey after the legislation came into force. The purchasing sources are not specific to where menthol cigarettes were purchased (ie, they refer to any cigarettes) and it is difficult to clearly classify some of the sources as licit or illicit (eg, pub behind the bar). One should also note that all the sources of purchase for menthol cigarettes, including supermarkets, could in theory be illicit given the menthol ban in the UK. However, there is no concrete evidence that labelled menthol cigarette packs are still regularly sold in the UK. Given that the UK has relatively strict regulations on standardised packaging,⁴⁷ labelled menthol cigarette packs could only be sold in the UK if either tobacco companies continued to manufacture them specifically for the UK market despite the ban, or if retailers sold packs made for other markets. In the second case, these packs would probably be sold 'under the counter' (which was another answer option in the study questionnaire) rather than regularly 'over the counter'. A further limitation of the study is that the question about menthol cigarette smoking in the survey does not provide information about which type of menthol cigarette participants were using.

CONCLUSIONS

Despite the ban, menthol cigarette smoking prevalence remains relatively high among adults in GB as a whole. The cigarette purchasing sources reported by people who smoked menthol cigarettes indicate that most people bought these in regular shops and there was no noteworthy difference to those who only smoked non-flavoured cigarettes. Taking these results together with findings from previous studies, it appears that for an effective ban on menthol cigarettes, legislators should close loopholes, such as strictly prohibiting menthol and all its analogues and derivatives in any tobacco-related products. Additionally, better controls might be required to ensure that manufacturers follow these rules.

Twitter Vera Helen Buss @VeraBuss and Harry Tattan-Birch @TattanBirch, UCL Tobacco Alcohol @UCL_TARG and SPECTRUM Research Consortium @SPECTRUMRes.

Acknowledgements We would like to acknowledge the anonymous reviewers for their valuable feedback on the manuscript.

Contributors VHB: conceptualisation, data curation, formal analysis, writing—original draft, writing—review and editing. HT-B and SC: conceptualisation, validation, writing—review and editing. LB and LS: conceptualisation, funding acquisition, validation, writing—review and editing. JB: conceptualisation, data curation, funding acquisition, validation, writing—review and editing. VHB is the guarantor.

Funding This work was supported by Cancer Research UK (PRCRPG-Nov21/100002) and the UK Prevention Research Partnership (MR/S037519/1), which is funded by the British Heart Foundation, Cancer Research UK, Chief Scientist Office of the Scottish Government Health and Social Care Directorates, Engineering and Physical Sciences Research Council, Economic and Social Research Council, Health and Social Care Research and Development Division (Welsh Government), Medical Research Council, National Institute for Health Research, Natural Environment Research Council, Public Health Agency (Northern Ireland), The Health Foundation and Wellcome.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and the University College London Ethics Committee granted ethical approval for the Smoking and Alcohol Toolkit Study (ID 0498/001). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request. The command syntax for the statistical analyses is available on the Open Science Framework (<https://osf.io/s8mjtr/>).

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution 4.0 Unported (CC BY 4.0) license, which permits others to copy, redistribute, remix, transform and build upon this work for any purpose, provided the original work is properly cited, a link to the licence is given, and indication of whether changes were made. See: <https://creativecommons.org/licenses/by/4.0/>.

ORCID iDs

Vera Helen Buss <http://orcid.org/0000-0001-9963-8693>
Harry Tattan-Birch <http://orcid.org/0000-0001-9410-8343>
Lion Shahab <http://orcid.org/0000-0003-4033-442X>
Jamie Brown <http://orcid.org/0000-0002-2797-5428>

REFERENCES

- Department for Health and Social Care. *The Tobacco Products and Nicotine Inhaling Products (Amendment) (EU Exit) Regulations 2020*. London, United Kingdom: UK Government, 2020.
- European Commission. *Revision of the Tobacco Products Directive*. Brussels, Belgium: European Commission, 2016. Available: https://health.ec.europa.eu/tobacco/product-regulation/implementing-tobacco-products-directive-directive-201440eu/revision-tobacco-products-directive_en
- Hersey JC, Ng SW, Nonnemaker JM, et al. Are menthol cigarettes a starter product for youth?. *Nicotine Tob Res* 2006;8:403–13.
- Kreslake JM, Wayne GF, Connolly GN. The menthol smoker: tobacco industry research on consumer sensory perception of menthol cigarettes and its role in smoking behavior. *Nicotine & Tobacco Res* 2008;10:705–15.
- Villanti AC, Collins LK, Niaura RS, et al. Menthol cigarettes and the public health standard: a systematic review. *BMC Public Health* 2017;17:983.
- East KA, Reid JL, Burkhalter R, et al. Evaluating the outcomes of the menthol cigarette ban in England by comparing menthol cigarette smoking among youth in England, Canada, and the US, 2018–2020. *JAMA Netw Open* 2022;5:e2210029.
- Kock L, Shahab L, Bogdanovica I, et al. Profile of menthol cigarette smokers in the months following the removal of these products from the market: a cross-sectional population survey in England. *Tob Control* 2023;32:e121–4.
- Zatoński M, Herbec A, Zatoński W, et al. Characterising smokers of menthol and flavoured cigarettes, their attitudes towards tobacco regulation, and the anticipated impact of the tobacco products directive on their smoking and quitting behaviours: the EUREST-PLUS ITC Europe Surveys. *Tob Induc Dis* 2018;16:A4.
- Kotlyar M, Shanley R, Dufresne SR, et al. Effect of restricting menthol flavored cigarettes or e-cigarettes on smoking behavior in menthol smokers. *Preventive Medicine* 2022;165:107243.
- Bold KW, Jatlow P, Fucito LM, et al. Evaluating the effect of switching to non-menthol cigarettes among current menthol smokers: an empirical study of a potential ban of characterising menthol flavour in cigarettes. *Tob Control* 2020;29:624–30.
- Dance S, Evans-Reeves K. 2021. *Menthol: tobacco companies are exploiting loopholes in the UK's characterising flavours ban London, United Kingdom: Blog - Tobacco Control*, Available: <https://blogs.bmj.com/tc/2021/05/05/menthol-tobacco-companies-are-exploiting-loopholes-in-the-uks-characterising-flavours-ban>
- Branston JR, Hiscoc R, Silver K, et al. Cigarette-like cigarillo introduced to bypass taxation, standardised packaging, minimum pack sizes, and menthol ban in the UK. *Tob Control* 2021;30:708–11.
- Stockton B, Margottini L, Cerantola A, et al. 'Impossible to enforce': big tobacco exploiting loopholes in European menthol ban. London, United Kingdom: the Bureau of Investigative Journalism. 2021. Available: <https://www.thebureauinvestigates.com/stories/2021-11-02/big-tobacco-exploiting-loopholes-in-european-menthol-ban>
- Ciurcanu A, Cerantola A. Japan Tobacco International making a mint by circumventing menthol cigarette ban Washington DC, United States of America: Organized Crime and Corruption Reporting Project. 2021. Available: <https://www.occrp.org/en/investigations/japan-tobacco-international-making-a-mint-by-circumventing-menthol-cigarette-ban>
- Conway L. Prohibition of tobacco displays. Briefing paper. London, United Kingdom. 2020:1–12.
- Haw S, Currie D, Eadie D, et al. The impact of the point-of-sale tobacco display ban on young people in Scotland: before-and-after study. *Public Health Res* 2020;8:1–118.
- Kock L, Shahab L, Moore G, et al. Protocol for expansion of an existing national monthly survey of smoking behaviour and alcohol use in England to Scotland and Wales: the Smoking and Alcohol Toolkit Study. *Wellcome Open Res* 2021;6:67.
- Elm E von, Altman DG, Egger M, et al. The strengthening of reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *BMJ* 2007;335:806–8.
- Jackson SE, Beard E, Angus C, et al. Moderators of changes in smoking, drinking and quitting behaviour associated with the first COVID-19 lockdown in England. *Addiction* 2022;117:772–83.
- Jackson SE, Garnett C, Shahab L, et al. Association of the COVID-19 Lockdown with smoking, drinking and attempts to quit in England: an analysis of 2019–20 data. *Addiction* 2021;116:1233–44.
- Kock L, Tattan-Birch H, Jackson S, et al. Socio-demographic, smoking and drinking characteristics in GB: A comparison of independent telephone and face-to-face Smoking and Alcohol Toolkit surveys conducted in March 2022. *Qeios* 2022.
- Lumley T. *Complex surveys: a guide to analysis using R*. 2010.
- Cole SR, Edwards JK, Greenland S. Surprise! *Am J Epidemiol* 2021;190:191–3.
- Efron B, Tibshirani RJ. *An introduction to the bootstrap*. Boca Raton, United States of America; London, United Kingdom: Chapman & Hall/CRC, 1994.
- Hawkins AT, Samuels LR. Use of confidence intervals in interpreting nonstatistically significant results. *JAMA* 2021;326:2068–9.
- Rafi Z, Greenland S. Semantic and cognitive tools to aid statistical science: replace confidence and significance by compatibility and surprise. *BMC Med Res Methodol* 2020;20:244.
- Cohen J. *Statistical power analysis for the behavioral sciences*. Elsevier Science, 2013.
- Office of National Statistics. *Principal projection - Great Britain population in age groups*. In: *Office for National Statistics, ed. Population projections*. London, United Kingdom. 2022.
- Government of Canada. *Tobacco act - order amending the schedule to the tobacco act (menthol)*. Ottawa, Canada: Health Canada, 2017.
- Chung-Hall J, Fong GT, Meng G, et al. Evaluating the impact of menthol cigarette bans on cessation and smoking behaviours in Canada: longitudinal findings from the Canadian arm of the 2016–2018 ITC Four Country Smoking and Vaping Surveys. *Tob Control* 2022;31:556–63.
- Chung-Hall J, Fong GT, Meng G, et al. Illicit cigarette purchasing after implementation of menthol cigarette bans in Canada: findings from the 2016–2018 ITC Four Country Smoking and Vaping Surveys. *Tob Control* 2023;tc-2022-057697.
- Kyriakos CN, Driezen P, Fong G. 2022 Impact of the European Union's menthol cigarette ban on smoking cessation outcomes: longitudinal findings from the 2020–2021 ITC Netherlands Surveys. *Tob Control*
- Stoklosa M. No surge in illicit cigarettes after implementation of menthol ban in Nova Scotia. *Tob Control* 2019;28:702–4.
- Kyriakos CN, Driezen P, Fong GT, et al. Illicit purchasing and use of flavour accessories after the European Union menthol cigarette ban: findings from the 2020–21 ITC Netherlands Surveys. *Eur J Public Health* 2023;33:619–26.
- Laverty AA, Millett C, Hopkinson NS, et al. Introduction of standardised packaging and availability of illicit cigarettes: a difference-in-difference analysis of European Union survey data 2015–2018. *Thorax* 2021;76:89–91.
- Brink A-L, Glahn AS, Kjaer NT. Tobacco companies' exploitation of loopholes in the EU ban on menthol cigarettes: a case study from Denmark. *Tob Control* 2023;32:809–12.
- Tobacco Control Research Group University of Bath. Menthol cigarettes: industry interference in the EU and UK [Internet]. Bath, United Kingdom:Tobacco Control Research Group, University of Bath; 2021. Available: [https://tobaccotactics.org/article/menthol-interference-euuk/#:~:text=To%20companies%20used%20several%20tactics,products%20\(pipe%20or%20shisha%20tobacco](https://tobaccotactics.org/article/menthol-interference-euuk/#:~:text=To%20companies%20used%20several%20tactics,products%20(pipe%20or%20shisha%20tobacco) [Accessed 15 Dec 2023].

- 38 Kyriakos CN, Filippidis FT, East KA, *et al.* Use of menthol cigarettes and accessories among youth who smoked after the menthol cigarette ban in England and Canada, 2021: implications for health equity. *Nicotine Tobacco Res* 2023.
- 39 Page MK, Paul EE, Leigh NJ, *et al.* Still 'cool': tobacco industry responds to state-wide menthol ban with synthetic coolants. *Tob Control* 2023;tc-2023-058149.
- 40 Meza LR, Galimov A, Sussman S, *et al.* Proliferation of 'non-menthol' cigarettes amid a state-wide flavour ban. *Tob Control* 2023;tc-2023-058074.
- 41 European Commission. Directive 2014/40/EU of the European Parliament and of the Council, Official Journal of the European Union; 2014.
- 42 Costa H, Gilmore AB, Peeters S, *et al.* Quantifying the influence of the tobacco industry on EU governance: automated content analysis of the EU Tobacco Products Directive. *Tob Control* 2014;23:473–8.
- 43 Peeters S, Costa H, Stuckler D, *et al.* The revision of the 2014 European Tobacco Products Directive: an analysis of the tobacco industry's attempts to 'break the health silo' *Tob Control* 2016;25:108–17.
- 44 Talhout R, van de Nobelen S, Kienhuis AS. An inventory of methods suitable to assess additive-induced characterising flavours of tobacco products. *Drug Alcohol Depend* 2016;161:9–14.
- 45 Paschke M, Tkachenko A, Ackermann K, *et al.* Activation of the cold-receptor TRPM8 by low levels of menthol in tobacco products. *Toxicol Lett* 2017;271:50–7.
- 46 Bautista DM, Siemens J, Glazer JM, *et al.* The menthol receptor TRPM8 is the principal detector of environmental cold. *Nature* 2007;448:204–8.
- 47 Tobacco Policy Team, Healthy Behaviours, Population Health Directorate. Tobacco packaging guidance: guidance for retailers, manufacturers and distributors of tobacco packaging in Great Britain. London, United Kingdom Department of Health and Social Care; 2021.
- 48 Bates D, Mächler M, Bolker B. 2015 Fitting linear mixed-effects models using **Lme4**. *J Stat Soft*;67.
- 49 Harrell FE. 2015 Regression modeling strategies.
- 50 Collis D. Social grade: a classification tool—bite sized through piece, Ipsos Mediact. London, United Kingdom. 2009:1–6.