nature human behaviour

Article

https://doi.org/10.1038/s41562-024-02002-7

# A systematic review and network meta-analysis of population-level interventions to tackle smoking behaviour

Received: 27 April 2023

Accepted: 4 September 2024

Published online: 7 October 2024

Check for updates

Shamima Akter[1], Md. Mizanur Rahman[1], Thomas Rouyard[1,2], Sarmin Aktar[3], Raïssa Shiyghan Nsashiyi[4] & Ryota Nakamura[1,5]

This preregistered systematic review and meta-analysis (PROSPERO: CRD 42022311392) aimed to synthesize the effectiveness of all available population-level tobacco policies on smoking behaviour. Our search across 5 databases and leading organizational websites resulted in 9,925 records, with 476 studies meeting our inclusion criteria. In our narrative summary and both pairwise and network meta-analyses, we identified anti-smoking campaigns, health warnings and tax increases as the most effective tobacco policies for promoting smoking cessation. Flavour bans and free/discounted nicotine replacement therapy also showed statistically significant positive effects on quit rates. The network meta-analysis results further indicated that smoking bans, anti-tobacco campaigns and tax increases effectively reduced smoking prevalence. In addition, flavour bans significantly reduced e-cigarette consumption. Both the narrative summary and the meta-analyses revealed that smoking bans, tax increases and anti-tobacco campaigns were associated with reductions in tobacco consumption and sales. On the basis of the available evidence, anti-tobacco campaigns, smoking bans, health warnings and tax increases are probably the most effective policies for curbing smoking behaviour.

Tobacco use remains a persistent global health challenge. Despite numerous control policies implemented at both global and national levels over the years[1], tobacco use continues to be a major cause of premature death. In 2019 alone, there were a staggering 8.7 million deaths worldwide directly attributable to tobacco consumption[2]. Tobacco exposure, through active or passive smoking, presents serious risks for non-communicable diseases, particularly cardiovascular diseases, cancers, chronic respiratory diseases and diabetes[3], which account for nearly three-quarters of annual deaths globally[1]. Various control approaches have been proposed and implemented to deter the demand for smoking and improve health, including taxation, mass media campaigns, health warnings on packaging, marketing restrictions and smoke-free laws[4–6].

To date, evidence on behavioural outcomes such as smoking prevalence, initiation and cessation in response to tobacco control policies has been mixed[4,7,8]. In 2008, the World Health Organization, in line with the Framework Convention on Tobacco Control, introduced the MPOWER policy package—a set of six measures designed to guide countries in rolling out cost-effective interventions aimed at reducing tobacco demand across populations[9]. As shown in previous studies[10,11], countries that have implemented high levels of MPOWER measures, particularly those pertaining to "monitoring the use of tobacco products" and "raising taxes on tobacco products"[10], have effectively reduced smoking prevalence among adults. However, in many countries implementing lower levels of MPOWER, it remains

[1]Hitotsubashi Institute for Advanced Study, Hitotsubashi University, Tokyo, Japan. [2]Graduate School of Public Health & Health Policy, City University of New York, New York, NY, USA. [3]Global Public Health Research Foundation, Dhaka, Bangladesh. [4]Institute for Nature, Health, and Agricultural Research, Yaounde, Cameroon. [5]Graduate School of Economics, Hitotsubashi University, Tokyo, Japan. e-mail: ryota.nakamura@r.hit-u.ac.jp

unclear whether and how different types of interventions, standalone or combined, can reduce smoking at scale.

Existing systematic reviews and meta-analyses focusing on population-level smoking behaviour have reported mixed results (Supplementary Table 1)[3,4,8,12–26]. A recent study by Bafunno et al. noted a reduction in smoking initiation after tax or price increases, an increase in quit attempts associated with mass media campaigns and a modest increase in cessation rates resulting from smoking bans[8]. An earlier systematic review revealed that in high-income countries (HICs), taxes, smoking bans, multicomponent programmes and cessation treatments are associated with reduced smoking prevalence[25]. Wilson et al.[4]. found that tobacco prices had a substantial impact on smoking prevalence, while smoking bans and mass media campaigns had a moderate impact on both smoking prevalence and initiation. There was limited evidence regarding the impact of other interventions, such as health warnings and advertising bans[4]. Other reviews have found varying effects of standalone tobacco control policies on behavioural outcomes. Five systematic reviews focusing on mass media campaigns[3,12,17–19] and three centred on smoking bans[13–15] reported inconsistent results. Chaloupka et al. found that tax or price increases had a positive impact on smoking cessation and reduced smoking initiation and intensity[27].

Nevertheless, all the systematic reviews and meta-analyses mentioned above share certain characteristics: (1) a focus on recent primary studies at the time of their publication[8]; (2) a focus on specific population groups[23,24]; (3) a tendency to analyse single or selected interventions/policies, limiting the ability to directly compare different policy types[3,12–15,24]; and (4) a publication date before 2020, with several empirical studies having been published afterwards[3,4,12–19,21,22,24]. Finally, there is a lack of comprehensive systematic reviews assessing the impacts of alternative policies (for example, youth access laws or plain packaging mandates) on smoking behaviour. In this context, there is a clear need for a comprehensive evaluation of all available population-level primary prevention strategies for tobacco control to ascertain and compare their effects on smoking behaviour.

Our recently published systematic review and meta-analysis examined the associations between population-level tobacco control policies and health outcomes[6]. We found that only smoke-free legislation significantly reduces mortality and morbidity related to cardiovascular disease, chronic respiratory diseases and perinatal outcomes[6]. However, we did not explore the association between tobacco control interventions and behavioural outcomes, which are closely related to morbidity and mortality. This study delves deeper into smoking-related behaviours, which are more frequently represented in the existing literature and provide a richer dataset for analysis. It systematically reviews population-level policy interventions aimed at reducing smoking behaviour, covering all types of primary preventive interventions, including tax/price increases, campaigns, smoking bans, health warnings on cigarette packs and the free distribution of nicotine patches. This comprehensive analysis of real-world, population-level interventions allows us to synthesize the effects of individual policy types on behavioural outcomes and conduct a network meta-analysis to compare effectiveness and hierarchically establish policy priorities among the broad spectrum of population-level interventions. Such an approach is critical given the expected growth in the disease burden attributable to tobacco, especially in light of new public health threats such as COVID-19, which poses higher risks for infections and hospitalizations among smokers[1,28,29].

## Results

### Study characteristics

Figure 1 presents the PRISMA flow chart detailing the study selection. The initial search identified 9,925 records. An additional 139 records were found in the reference lists of previous systematic reviews. After removing duplicates, we screened 8,587 articles for potential eligibility by title and abstract. Overall, 683 full-text articles were reviewed, of which 476 (refs. 10,11,30–503) studies were included in this systematic review. Of these 476 studies, 237 were included in the meta-analysis only, 211 were included in the narrative review only and 28 were included in both (Table 1).

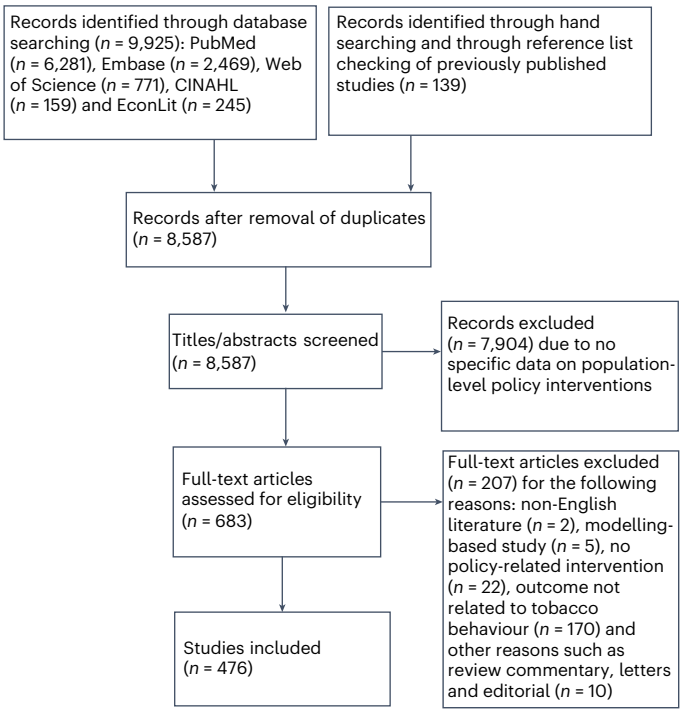


**Fig. 1 | Study selection.** PRISMA flow chart detailing the identification and screening of identified records for the systematic review and meta-analysis.

The characteristics of the 476 included studies are summarized in the supplementary material (Supplementary Table 2). Most studies were conducted in HICs, particularly the USA (225), Australia (28), the UK (28), Canada (24), the Netherlands (8), Finland (6), New Zealand (5), South Korea (8) and Japan (8), while only a few were conducted in low- and middle-income countries (LMICs), particularly in India (13) and China (12) (Supplementary Fig. 1). All included articles were published between 1981 and 2023. The most frequently reported outcomes were smoking prevalence (165 studies), quit rate (126), quit attempt (107), quit intention (54) and tobacco sales (27). The most commonly analysed policies were campaigns and advertisements ($n$ = 138), tax/price increases ($n$ = 139), smoking bans ($n$ = 100), multicomponent policies ($n$ = 27), health warnings ($n$ = 55), flavour bans ($n$ = 25) and youth access laws ($n$ = 30). Other identified policies included free/discounted nicotine replacement therapy (NRT) ($n$ = 7), education ($n$ = 12), Quitline services ($n$ = 7), media expenditure ($n$ = 11), e-cigarette bans ($n$ = 7), point-of-sale display bans ($n$ = 12) and tobacco retail licensing ($n$ = 3). Most studies were observational ($n$ = 352), using cross-sectional (207), longitudinal (97), cohort (47) or case–control (1) designs. Fewer studies were quasi-experimental ($n$ = 124), with designs such as controlled before and after (14), before and after (2), interrupted time series (66) or other quasi-experimental approaches (42). Finally, most studies were judged to be of high quality (305), with only a minority judged to be of moderate (101) or low (70) quality (Supplementary Table 2).

We found 14 (refs. 102–104,119,120,183,245,288,305,311,315,344,420,498) studies covering different interventions/policies and outcomes that provided effect estimates in terms of relative risks (RRs) or hazard ratios (HRs) and offered sufficient information to convert these RRs/HRs into odds ratios (ORs). Among these studies, three[103,288,498] had an outcome prevalence of less than 10% (Supplementary Table 2).

**Table 1 | References of the 476 total included studies in each analysis**

| Analysis | No. of studies | References |
|---|---|---|
| Meta-analysis | 237 | 10,32–37,46,48,54,55,59–62,71,73,74,77,78,83,84,86–90,93,95,96,100–106,111–120,122,123,125–128,132,134,142,144,146,147,150–159,161,165,168,169,171–176,182–185,187,189,193–195,198,206,208,213,216–218,220,222,224,226,228,231,235,236,240–242,245,247,250,252,253,255,257–259,261,263,264,268,271,272,277,280,281,287–290,293,295,296,299,300,304–307,311–315,317–320,324,325,329–335,337,339–341,345,346,348–350,358–360,362,368,373,376,382,385–387,395,396,398–403,406,408,409,412,416,417,419,420,424,428,433–435,438–440,442,444–450,452,454,461,462,466,468,470,472,474,476,478,479,481,483,484,490,492,495,497,498,502 |
| Narrative review | 211 | 10,30,31,38–40,42–45,47,49–51,53,56,57,63,65,67,70,72,75,76,79,80,85,91,92,97–99,107–110,124,129–131,133,135–139,141,143,145,148,149,162–164,166,167,170,178–181,186,188,190–192,197,199,200,202,203,205,207,209,211,213,215,219,221,225,227,229,230,232–234,238,239,243,245,246,249,251,254,260,262,266,269,270,273,275,278,282,283,285,286,291,292,294,298,301–303,308–310,316,321–323,326–328,336,338,342,343,351–357,361,363–367,369–372,374,375,377–381,383,384,388–394,397,404,405,410–412,414,415,418,421–423,425,429–432,436,437,441,451,456–460,463,465,469,471,473,475,477,479,482,485–489,491,493,499,500,503 |
| Both | 28 | 11,41,52,58,81,82,94,121,211,223,248,256,265,267,279,284,297,344,407,427,443,453,455,464,467,494,496,501 |

## Main findings

**Smoking behaviour.** Table 2 presents the results of the pairwise meta-analysis for outcomes related to smoking cessation. Supplementary Table 3 provides the effect size and 95% confidence interval (CI) for each policy and outcome for which the pooled OR was calculated. To clarify the results, we included a study with only one outcome and policy. The odds of intending to quit smoking were greater after the implementation of health warnings (OR, 1.69; 95% CI, 1.17–2.44; $P < 0.01$; 12 studies; $\tau^2 = 0.14$) and campaigns (OR, 1.39; 95% CI, 1.11–1.74; $P < 0.01$; 14 studies; $\tau^2 = 0.09$) than for the control group. The odds of attempting to quit smoking increased significantly after the implementation of campaigns (OR, 1.16; 95% CI, 1.08–1.24; $P < 0.001$; 33 studies; $\tau^2 = 0.02$), health warnings (OR, 1.54; 95% CI, 1.28–1.87; $P < 0.001$; 19 studies; $\tau^2 = 0.10$), tax increases (OR, 1.70; 95% CI, 1.14–2.55; $P = 0.01$; 11 studies; $\tau^2 = 0.37$), and a combination of health warnings and campaigns (OR, 1.57; 95% CI, 1.35–1.83; $P < 0.01$; 2 studies; $\tau^2 = 0.0$).

Importantly, the implementation of campaigns (OR, 1.17; 95% CI, 1.04–1.33; $P = 0.01$; 20 studies; $\tau^2 = 0.04$), tax increases (OR, 1.18; 95% CI, 1.03–1.35; $P = 0.02$; 18 studies; $\tau^2 = 0.05$), health warnings (OR, 1.86; 95% CI, 1.28–2.69; $P < 0.01$; 6 studies; $\tau^2 = 0.02$), NRT (OR, 1.52; 95% CI, 1.29–1.79; $P < 0.01$; 3 studies; $\tau^2 = 0.0\%$) and multicomponent laws (OR, 1.06; 95% CI, 1.00–1.12; $P = 0.049$; 2 studies; $\tau^2 = 0.53$) were all significantly associated with increased odds of quitting smoking. However, no clear association was detected between the implementation of a smoking ban and changes in quit rates, quit attempts or quit intentions. When all three outcomes were pooled together, health warnings and campaigns (either in combination or alone), tax increases, flavour bans, multicomponent laws and NRT were all significantly associated with beneficial changes.

Figure 2 illustrates the results of the network meta-analysis for smoking-cessation-related outcomes, organized by outcome type and policy category. Health warnings (OR, 1.41; 95% CI, 1.23–1.60; *p*-score, 0.85 (the *p*-score value derived from network meta-analysis was used to rank interventions based on their effectiveness)) were identified as the most effective policy for increasing quitting intention, followed by tax increases (OR, 1.39; 95% CI, 1.17–1.67; *p*-score, 0.82) and campaigns (OR, 1.27; 95% CI, 1.12–1.43; *p*-score, 0.57). For quit attempts, the network meta-analysis results indicate that the most effective policies included health warnings, health warnings combined with campaigns, flavour bans, tax increases, multicomponent laws and campaigns alone. For quit rates, the results varied slightly across meta-analysis types. The network meta-analysis findings show that health warnings (OR, 1.79; 95% CI, 1.54–2.09; *p*-score, 0.92), flavour bans (OR, 1.80; 95% CI, 1.12 –2.89; *p*-score, 0.87), NRT (OR, 1.53; 95% CI, 1.27–1.83; *p*-score, 0.76), multicomponent laws (OR, 1.22; 95% CI, 1.06–1.41; *p*-score, 0.52), tax increases (OR, 1.20; 95% CI, 1.13–1.28; *p*-score, 0.49) and campaigns (OR, 1.08; 95% CI, 1.03–1.12; *p*-score, 0.26) were all significantly associated with higher quit rates. Overall, the network meta-analysis results indicate beneficial changes in all types of quit-related outcomes when implementing flavour bans, NRT, health warnings combined with campaigns, health warnings alone, tax increases, multicomponent laws and campaigns alone.

**Cigarette consumption.** Table 3 presents the results of pairwise meta-analyses for smoking prevalence, e-cigarette consumption and secondhand smoke. Supplementary Table 4 provides the effect size and 95% CI for each policy and outcome for which the pooled OR was calculated. A significant reduction in smoking prevalence was observed for smoking bans (OR, 0.81; 95% CI, 0.71–0.91; $P < 0.01$; 24 studies; $\tau^2 = 0.06$), campaigns alone (OR, 0.86; 95% CI, 0.80–0.92; $P < 0.001$; 16 studies; $\tau^2 = 0.01$), tax increases (OR, 0.89; 95% CI, 0.80–0.99; $P = 0.04$; 11 studies; $\tau^2 = 0.02$) and a combination of bans, tax increases and health warnings (OR, 0.84; 95% CI, 0.74–0.95; $P = <0.01$; 2 studies; $\tau^2 = 0.0$). A significant reduction in e-cigarette consumption was found for smoking bans (OR, 0.89; 95% CI, 0.82–0.96; $P < 0.01$; 2 studies; $\tau^2 = 0.01$), e-cigarette bans (OR, 0.68; 95% CI, 0.48–0.97; $P = 0.03$; 1 study) and tobacco retail licensing (OR, 0.90; 95% CI, 0.85–0.96; $P < 0.001$; 2 studies; $\tau^2 = 0.18$). For secondhand smoke, only one study on campaigns showed a significant reduction.

The network meta-analysis results (Fig. 3a,c) indicate that only smoking bans (OR, 0.81; 95% CI, 0.74–0.88; *p*-score, 0.86), campaigns (OR, 0.85; 95% CI, 0.76–0.95; *p*-score, 0.72) and tax increases (OR, 0.88; 95% CI, 0.78–0.99; *p*-score, 0.62) were effective in reducing smoking prevalence. In terms of reducing e-cigarette consumption, the network meta-analysis results (Fig. 3b,d) indicate that only flavour bans were effective (OR, 0.69; 95% CI, 0.49–0.98; *p*-score, 0.85).

Table 4 presents the results of pairwise meta-analyses for cigarette consumption, e-cigarette consumption, tobacco sales, e-cigarette sales, smoking prevalence and quit attempts/rates when effect estimates were presented as regression coefficients. Supplementary Table 5 provides the effect size and 95% CI for each policy and outcome for which the pooled coefficient was calculated. A significant negative association was found between tax increases and cigarette consumption (coefficient, −0.24; 95% CI, −0.38 to −0.09; $P < 0.01$; 27 studies; $\tau^2 = 0.18$). For e-cigarette consumption, a significant negative association was found for flavour bans (coefficient, −1.21; 95% CI, −1.99 to −0.43; $P < 0.001$; 2 studies; $\tau^2 = 0.53$). Finally, we observed an inverse association between smoking bans and tobacco sales (coefficient, −0.11; 95% CI, −0.15 to −0.08; $P < 0.001$; 3 studies; $\tau^2 = 0.0$). No significant associations were found for the other types of policies and outcomes.

**Narrative summary.** A narrative summary of the effects of tobacco policies on smoking behaviour was derived from 239 papers that lacked sufficient quantitative data for inclusion in the meta-analysis.

https://doi.org/10.1038/s41562-024-02002-7

**Table 2 | Pairwise meta-analysis of the effects of tobacco policies on outcomes related to smoking cessation, by outcome type and policy category**

| Policy | No. of studies[a] | Pooled OR (95% CI) | *P* | Heterogeneity (95% CI) | |
|---|---|---|---|---|---|
| | | | | $I^2$ (%) | $\tau^2$ |
| **Quit intention** | | | | | |
| Campaign | 14 | 1.39 (1.11–1.74) | 0.0069 | 77.9 (64.1–86.5) | 0.09 (0.03–0.43) |
| HW | 12 | 1.69 (1.17–2.44) | 0.0094 | 77.9 (58.3–86.4) | 0.14 (0.08–1.75) |
| Tax | 4 | 1.45 (0.97–2.15) | 0.0596 | 85.2 (63.4–94) | 0.05 (0.01–0.88) |
| Smoking ban | 3 | 1.01 (0.97–1.05) | 0.4396 | 0 (0–89.6) | 0 (0–5.96) |
| MMC-EXP | 1 | 1.11 (0.99–1.26) | 0.0094 | NA | NA |
| **Quit attempt** | | | | | |
| Campaign | 33 | 1.16 (1.08–1.24) | 0.0001 | 77.3 (68.7–83.5) | 0.02 (0.01–0.07) |
| HW | 19 | 1.54 (1.28–1.87) | 0.0001 | 89.3 (85–92.3) | 0.10 (0.04–0.36) |
| Tax | 11 | 1.70 (1.14–2.55) | 0.0139 | 96.5 (95.1–97.4) | 0.37 (0.18–1.14) |
| Smoking ban | 9 | 1.03 (0.96–1.11) | 0.3167 | 52.6 (6–76.1) | 0.00 (0–1.17) |
| HW+CAMP | 2 | 1.57 (1.35–1.83) | 0.0062 | 0 (0–89.6) | 0 (0–0.01) |
| Flavour ban | 2 | 1.48 (0.86–2.55) | 0.0687 | 0.0 (NA) | 0 (NA) |
| Law | 2 | 1.18 (0.60–2.31) | 0.1971 | 23 (NA) | 0.00 (NA) |
| Menthol flavour ban | 1 | 1.44 (1.05–1.98) | 0.0246 | NA | NA |
| MMC-EXP | 1 | 0.91 (0.85–0.98) | 0.0094 | NA | NA |
| **Quit rate** | | | | | |
| Campaign | 20 | 1.17 (1.04–1.33) | 0.0147 | 84.7 (78.2–89.2) | 0.04 (0.03–0.30) |
| Tax | 18 | 1.18 (1.03–1.35) | 0.0235 | 86.3 (79.8–90.7) | 0.05 (0.02–0.15) |
| Smoking ban | 8 | 1.05 (0.84–1.31) | 0.6183 | 69.7 (39.6–84.8) | 0.03 (0.01–0.85) |
| HW | 6 | 1.86 (1.28–2.69) | 0.0096 | 48.6 (0–81.2) | 0.02 (0–1.29) |
| Flavour ban | 2 | 1.81 (0.12–27.89) | 0.2224 | 0.0 (NA) | 0 (NA) |
| NRT | 3 | 1.52 (1.29–1.79) | 0.0000 | 0.0 (0–74.6) | 0 (0–0.05) |
| Law | 2 | 1.06 (1.00–1.12) | 0.0495 | 97.7 (NA) | 0.53 (NA) |
| MMC-EXP | 1 | 0.44 (0.40–0.49) | 0.0000 | NA | NA |
| PODB | 1 | 1.01 (0.97–1.06) | 0.6602 | NA | NA |
| E-cigarette ban | 1 | 1.3 (0.94–1.82) | 0.1181 | NA | NA |
| Menthol flavour ban | 1 | 1.62 (1.08–2.43) | 0.0191 | NA | NA |
| Youth access policy | 1 | 0.57 (0.35–0.93) | 0.0257 | NA | NA |
| **Quit any** | | | | | |
| Campaign | 54 | 1.83 (1.18–1.26) | 0.0000 | 79.9 (75.1–83.7) | 0.03 (0.03–0.11) |
| HW | 30 | 1.56 (1.18–2.08) | 0.0029 | 91.7 (89.6–93.4) | 0.6 (0.41–1.13) |
| Tax | 28 | 1.47 (1.20–1.79) | 0.0004 | 94.6 (93.3–95.6) | 0.29 (0.18–0.55) |
| Smoking ban | 18 | 1.00 (0.99–1.01) | 0.2235 | 55.7 (29.3–72.3) | 0 (0.00–0.15) |
| Flavour ban | 3 | 1.53 (1.27–1.85) | 0.0000 | 0.0 (0–84.7) | 0 (0–0.46) |
| Law | 3 | 1.09 (1.04–1.15) | 0.0002 | 93.9 (87.5–97) | 0.20 (0.06–3.12) |
| MMC-EXP | 3 | 0.76 (0.23–2.256) | 0.4370 | 98.8 (98–99.3) | 0.23 (0.06–9.37) |
| NRT | 3 | 1.52 (1.29–1.79) | 0.0000 | 0.0 (0–74.6) | 0 (0–0.05) |
| HW+CAMP | 3 | 1.57 (1.02–2.41) | 0.0416 | 0.0 (0–89.6) | 0 (0–0.003) |
| Menthol flavour ban | 2 | 1.51 (1.17–1.93) | 0.0013 | 0.0 (NA) | 0 (NA) |
| E-cigarette ban | 1 | 1.30 (0.94–1.82) | 0.1181 | NA | NA |
| PODB | 1 | 1.01 (0.97–1.06) | 0.6602 | NA | NA |
| Youth access policy | 1 | 0.57 (0.35–0.93) | 0.0257 | NA | NA |

[a]Where two or more papers are included in the meta-analysis, the effect size (coefficient) is pooled; for single studies, the original effect size is presented. CAMP, campaigns; HW, health warnings; MMC-EXP, mass-media campaign expenditure; NA, not available; PODB, point-of-sale display ban.

https://doi.org/10.1038/s41562-024-02002-7

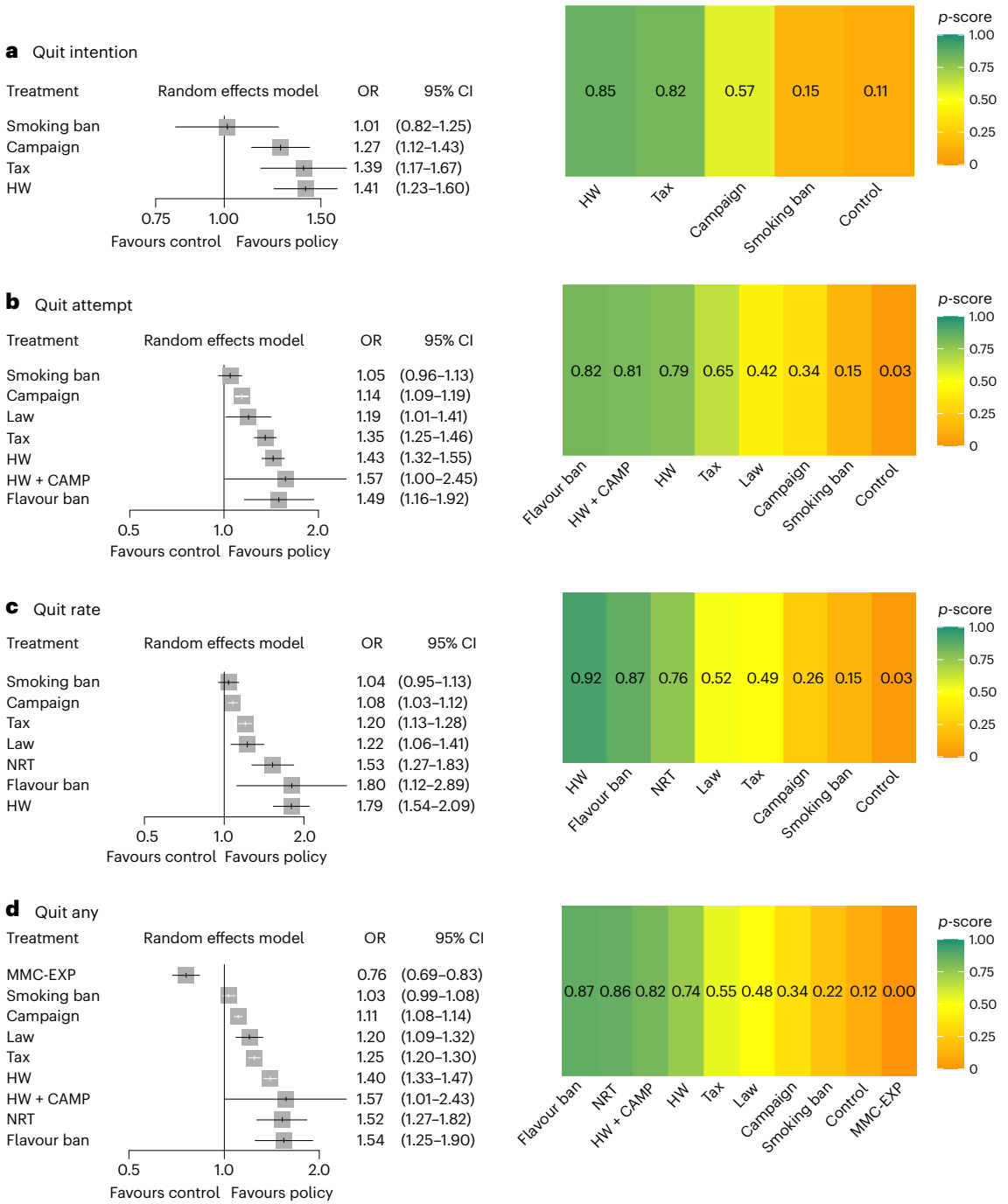


**Fig. 2 | Network meta-analysis of the effects of tobacco policies on smoking cessation, by outcome type and policy category, ranked by effect magnitude.** **a**–**d**, Network forest plots are shown on the left, and rank plots are shown on the right. The axis ranges differ across panels. Two or more studies available for each policy and outcome are included in the network meta-analysis as mentioned in Table 1. In the left panels, the squares indicate pooled estimates of effect size, and the whiskers indicate the 95% CIs. The white lines within the grey squares indicate pooled ORs with narrow CIs, while the black lines indicate the other values. The *p*-score was used to rank interventions on the basis of their effectiveness, and the right panels visually represent this ranking score by showing higher probabilities of effectiveness in dark green and lower probabilities in orange.

A concise version of this summary is provided in Fig. 4, and more detailed information for each policy is compiled in the supplementary material (Supplementary Tables 6–12). We found that nearly all studies reported an increase in quit attempts following the implementation of multicomponent tobacco control programmes (6/6 studies), smoking bans (5/7), campaigns (9/9) and tax policies (4/5). Regarding quit rates, increases were observed after implementing smoking bans (8/9), flavour bans (4/4), multicomponent tobacco control policies (9/12), tax increases (8/12) and campaigns (9/13). In addition, reductions in smoking prevalence were observed following the implementation of multicomponent tobacco control programmes (19/21), smoking bans (15/18), tax increases (24/30) and campaigns (13/19). Similarly, reductions in tobacco consumption were noted following the enactment of multifaceted tobacco control programmes (13/15), smoking bans (16/21), flavour bans (3/3), tax increases (35/40) and campaigns (13/20). These findings suggest that multicomponent tobacco control programmes, tax increases and smoking bans are the most effective policies for reducing smoking prevalence and cigarette consumption.

**Table 3 | Pairwise meta-analysis of the effects of tobacco policies on smoking prevalence and e-cigarette use, by policy category**

| Policy | No. of studies[a] | Pooled OR (95% CI) | *P* | Heterogeneity (95% CI) | |
|---|---|---|---|---|---|
| | | | | $I^2$ (%) | $\tau^2$ |
| **Smoking prevalence** | | | | | |
| Smoking ban | 24 | 0.81 (0.71–0.91) | 0.0015 | 99.8 (NA) | 0.06 (0.05–0.30) |
| Campaign | 16 | 0.86 (0.80–0.92) | 0.0003 | 84.2 (76–89.6) | 0.01 (0–0.03) |
| Tax | 11 | 0.89 (0.80–0.99) | 0.0369 | 87.5 (80.3–92) | 0.02 (0.0–0.11) |
| Youth access policy | 7 | 1.09 (0.76–1.58) | 0.5819 | 92.6 (87.7–95.5) | 0.15 (0.05–0.87) |
| Flavour ban | 4 | 1.19 (0.51–2.77) | 0.5532 | 89.9 (77.2–95.6) | 0.27 (0.04–3.51) |
| Ban+tax+HW | 2 | 0.84 (0.74–0.95) | 0.0056 | 0 (NA) | 0 (NA) |
| Ban+HW | 1 | 1.00 (0.99–1.01) | 0.2648 | | |
| MPOWER | 1 | 1.00 (0.99–1.00) | 0.0459 | | |
| HW | 1 | 0.72 (0.67–0.78) | 0.0000 | | |
| Ban+tax | 1 | 0.85 (0.80–0.91) | 0.0000 | | |
| Menthol flavour ban | 1 | 0.66 (0.40–1.09) | 0.1020 | | |
| **Secondhand smoke** | | | | | |
| Campaign | 1 | 0.69 (0.62–0.78) | 0.0000 | | |
| Smoking ban | 2 | 2.21 (0.85–5.74) | 0.1049 | 98.4 (NA) | 18.8 (NA) |
| **E-cigarette consumption** | | | | | |
| Youth access policy | 4 | 0.97 (0.69–1.38) | 0.8221 | 81.6 (52.1–92.9) | 0.02 (0–5.14) |
| Campaign | 3 | 0.92 (0.78–1.09) | 0.3446 | 50.7 (0–85.8) | 0.16 (0–18.5) |
| Flavour ban | 3 | 0.63 (0.07–5.39) | 0.4470 | 94.3 (86.8–97.6) | 0.71 (0.16–0.36) |
| Smoking ban | 2 | 0.89 (0.82–0.96) | 0.0044 | 31.4 (NA) | 0.01 (NA) |
| Tobacco retail licensing | 2 | 0.90 (0.85–0.95) | 0.0001 | 74.6 (0–94.3) | 0.18 (NA) |
| E-cigarette ban | 1 | 0.68 (0.48–0.97) | 0.0316 | | |
| HW | 1 | 1.25 (0.91–1.70) | 0.1674 | | |
| PODB | 1 | 1.04 (0.99–1.09) | 0.1101 | | |
| Tax | 1 | 0.89 (0.83–0.96) | 0.0017 | | |

[a]Where two or more papers are included in the meta-analysis, the effect size (coefficient) is pooled; for single studies, the original effect size is presented. MPOWER is a set of six cost-effective and high-impact measures that help countries reduce demand for tobacco. These measures include monitoring tobacco use and prevention policies (M); protecting people from tobacco smoke (P); offering help to quit tobacco use (O); warning about the dangers of tobacco (W); enforcing bans on tobacco advertising, promotion and sponsorship (E); and raising taxes on tobacco (R).

Furthermore, reduced tobacco sales were reported in nine out of nine studies, primarily attributed to tax increases. All nine studies also indicated higher quit intentions, further highlighting the positive impact of tax increases. In addition, seven out of seven studies reported a significant positive effect of free/discounted NRT or Quitline help on quitting-related behaviour (Supplementary Table 12). However, there was a limited number of studies reporting on smoking intentions, secondhand smoke exposure, smoking relapse and nicotine concentration. The findings for these outcomes were mixed, with most studies indicating no discernible effects resulting from the implementation of new policies.

**Publication bias and sensitivity analysis.** We found evidence of publication bias in the effects of campaigns and health warnings on all outcomes related to smoking cessation (Supplementary Fig. 2). Further evaluation using the trim-and-fill estimation method, which hypothetically imputes the results from a few unpublished studies, confirmed these findings (Supplementary Fig. 2). Sensitivity analyses aimed at examining the source of heterogeneity are presented in Supplementary Information. These analyses included subgroup assessments by country, income category, policy implementation time and policy evaluation time (Supplementary Tables 13–15), as well as exclusions of low-quality studies, highly influential studies (that is, those with large sample sizes) and cross-sectional studies (Supplementary Figs. 3–5). In the subgroup analyses, no major differences were observed in the findings for policies implemented before or after the enactment of MPOWER (2008) ($P_{subgroup} > 0.05$), except for smoking bans and quit any behaviours ($P_{subgroup} = 0.04$) (Supplementary Table 14). However, when examining the influence of policy evaluation time, we observed that the positive effects of tax increases on quit-related outcomes were primarily driven by evaluations conducted within a 15-month timeframe ($P_{subgroup} = 0.03$) (Supplementary Table 15). Another notable distinction emerged for the impact of smoking bans on smoking prevalence, with positive effects being observed solely in studies evaluating policy impacts within 15 months ($P_{subgroup} = 0.04$). The findings of these sensitivity analyses consistently support the primary results (Supplementary Figs. 3–5), reaffirming that tax increases, health warnings and media campaigns were all significantly associated with increased odds of quitting smoking, quit attempts and quit intentions.

## Discussion

In this systematic review and meta-analysis of 476 studies, we found that tax/price increases, smoking bans and anti-smoking campaigns are the most effective tobacco policies for reducing smoking prevalence and cigarette consumption, as well as increasing quit rates, quit attempts and quit intentions. Health warnings on cigarette

https://doi.org/10.1038/s41562-024-02002-7

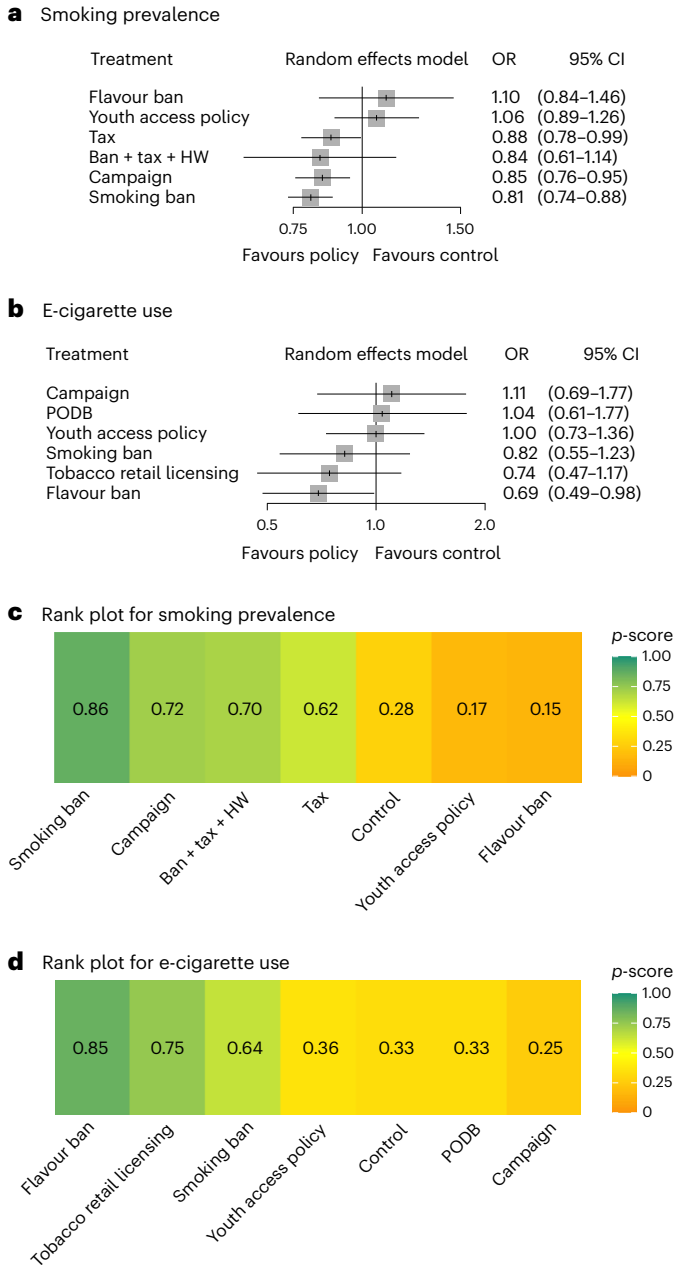


**Fig. 3 | Network meta-analysis of the effects of tobacco policies on smoking prevalence and e-cigarette use, by outcome type and policy category, ranked by effect magnitude. a**,**b**, Network forest plots. **c**,**d**, Rank plots. The axis ranges differ across panels. Two or more studies for each policy and outcome are included in the network meta-analysis as mentioned in Table 2. In **a** and **b**, the squares indicate pooled effect estimates, and the whiskers indicate 95% CIs. The *p*-score was used to rank interventions on the basis of their effectiveness, and **c** and **d** visually represent this ranking score by showing higher probabilities of effectiveness in dark green and lower probabilities in orange.

packages (graphical and/or textual), NRT and flavour bans are also significantly associated with higher odds of quitting smoking. Moreover, flavour bans are effective for reducing e-cigarette consumption.

In line with prior evidence on the price elasticity of tobacco products—indicating that smokers are more likely to quit as prices increase, especially among young adults and individuals with low socio-economic status[504]—we observed significant positive effects of tax/price increases on quit rates, quit attempts and quit intentions and significant negative effects on cigarette consumption and smoking prevalence. These findings were consistent in both the pairwise and network meta-analyses. Chaloupka et al. estimated the price elasticity of tobacco to average around −0.4 in HICs, meaning that a 10% increase in price reduces overall consumption by 4%, and around −0.5 in LMICs[505]. One possible explanation for this greater sensitivity to price in LMICs is that changes in income resulting from purchasing tobacco products tend to have a greater impact on consumption in resource-constrained settings[506]. Smokers from lower-income groups may therefore benefit the most from tax increases, as these populations typically bear a disproportionate burden of smoking-related health problems and fatalities[507]. Although the meta-analysis results did not show any significant association between tax/price increases and outcomes related to smoking cessation in LMICs, this may be attributed to the limited availability of evidence from these settings.

Our findings also indicate that anti-smoking campaigns have beneficial effects on smoking behaviour. These campaigns, typically conducted through mass media channels, were shown to increase quit rates and reduce smoking prevalence and consumption. However, previous studies have reported mixed effects[508]. While some high-quality studies showed beneficial effects on either quit rates or abstinence rates among adults[12], a recent meta-analysis reported a non-significant pooled estimate (OR, 1.14; 95% CI, 0.98–1.30) for smoking prevalence among women in the USA[23]. These mixed results may be explained by variations in campaign targets and content[4] and insufficient pilot testing before campaign launch[509]. Factors such as campaign intensity, duration and frequency also play a crucial role. The effect of mass media on smoking cessation was found to be greater for campaigns with higher reach, frequency and duration[510]. Additionally, mass media campaigns are often implemented as part of multicomponent programmes rather than as standalone interventions, making it challenging to determine the extent to which the observed effects can be attributed solely to the campaign. While anti-smoking campaigns can enhance the impact of other strategies such as taxation and smoking bans[511], our results suggest that they are also valuable as standalone policy tools against smoking.

Our results indicate that health warnings on cigarette packaging, whether in textual, graphical or pictorial form, are the most effective policy in improving outcomes related to smoking cessation. A previous review reported a lack of evidence regarding the beneficial effects of health warnings on smoking initiation, cessation or prevalence, although the number of studies available for analysis was limited ($n = 4$)[4]. It is worth noting that the effectiveness of health warnings varies significantly across different regions. For example, in Canada, the implementation of highly graphic health warnings had a substantial impact on smokers: 90% of smokers noticed these warnings, 43% became concerned about health risks and 44% expressed an intention to quit smoking[512]. In contrast, teenagers in the USA considered health warnings as "uninformative and irrelevant", despite being aware of them[513]. These mixed results align with the trend in HICs where smokers tend to understand the health consequences depicted by health warnings[514] but may not always act on them[246]. Other studies have reported significant increases in quit rates associated with large graphic health warnings (up to 2%)[508,515]. To maximize the effectiveness of health warnings, they should be prominent, placed on both the front and back surfaces of cigarette packages, and visually distinct from the package's overall design[516]. Similar to anti-smoking campaigns, health warnings serve as a means to convey messages about the health risks associated with tobacco consumption. They have been shown to reduce tobacco use, increase motivation and likelihood to quit, and improve the probability of remaining smoke-free after quitting[508]. Both strategies should be included in multicomponent programmes aimed at promoting smoking cessation. Notably, health warnings have the added advantage of being less expensive to implement[4].

Regarding policies that subsidize treatments for tobacco dependence, our analysis found a significant association between

https://doi.org/10.1038/s41562-024-02002-7

**Table 4 | Pairwise meta-analysis of the effect of tobacco policies on smoking consumption by policy category**

| Policy | No. of studies[a] | Pooled coefficient (95% CI) | *P* | Heterogeneity (95% CI) | |
|---|---|---|---|---|---|
| | | | | $I^2$ (%) | $\tau^2$ |
| **Cigarette consumption** | | | | | |
| Tax | 27 | −0.24 (−0.38 to −0.09) | 0.0012 | 99.9 (NA) | 0.18 (0.21 to 1.59) |
| Smoking ban | 8 | −0.09 (−0.22 to 0.04) | 0.1636 | 74.7 (55.3 to 85.7) | 0.03 (0.01 to 0.16) |
| E-cigarette tax increase | 5 | 0.01 (−0.01 to 0.02) | 0.2551 | 55.0 (0 to 80.7) | <0.001 (0 to 0) |
| Campaign | 2 | −0.02 (−0.05 to 0.02) | 0.3147 | 0 (0 to 84.7) | <0.001 (0 to 0.05) |
| Youth access policy | 4 | 0.01 (0.00 to 0.01) | 0.0959 | 43.1 (0 to 80.9) | 0 (0 to 0.35) |
| Flavour ban | 2 | −0.50 (−2.52 to 1.52) | 0.6289 | 91.2 (68 to 97.5) | 1.94 (NA) |
| Law | 2 | 0.34 (−0.62 to 1.29) | 0.4881 | 84.6 (54.3 to 94.8) | 0.56 (0.07 to 24.44) |
| E-cigarette ban | 1 | −0.21 (−1.05 to 0.63) | 0.6221 | | |
| HW | 1 | −1.10 (−2.12 to −0.07) | 0.0359 | | |
| MMC-EXP | 2 | 0.07 (−0.15 to 0.28) | 0.5342 | 85.8 (43.0 to 96.5) | 0.02 |
| Vaping restrictions | 1 | 12.51 (2.15 to 22.87) | 0.0179 | | |
| **E-cigarette consumption** | | | | | |
| Tax | 4 | 0.00 (0.00 to 0.01) | 0.0551 | 58.3 (0 to 86.1) | <0.001 (0.00 to 0.00) |
| E-cigarette tax increase | 4 | −0.01 (−0.01 to 0.00) | 0.0251 | 65.4 (0 to 88.2) | <0.001 (0 to 2.64) |
| Youth access policy | 3 | −0.09 (−0.30 to 0.11) | 0.3572 | 85.5 (57.4 to 95) | 0.02 (0 to 1.9) |
| Smoking ban | 1 | −0.77 (−2.42 to 0.88) | 0.3604 | | |
| E-cigarette ban | 1 | 0.23 (−0.80 to 1.26) | 0.6601 | | |
| Flavour ban | 2 | −1.21 (−1.99 to −0.43) | 0.0023 | 55.6 (0 to 89.2) | 0.53 (NA) |
| **Tobacco sales** | | | | | |
| Tax | 4 | −0.23 (−0.48 to 0.02) | 0.0697 | 86.4 (74.2 to 92.9) | 0.06 (0.02 to 33.64) |
| Smoking ban | 3 | −0.11 (−0.15 to −0.08) | 0.0000 | 0 (0 to 89.6) | <0.001 (0 to 0.02) |
| E-cigarette tax increase | 1 | 0.05 (0.01 to 0.09) | 0.0194 | | |
| Campaign | 1 | −0.09 (−0.16 to −0.02) | 0.0173 | | |
| Flavour ban | 1 | −15.9 (−63.75 to 31.95) | 0.5149 | | |
| **E-cigarette sales** | | | | | |
| Tax | 1 | 0.00 (0.00 to 0.01) | 0.1559 | | |
| E-cigarette tax increase | 1 | −0.01 (−0.07 to 0.05) | 0.7471 | | |
| **Quit attempt/rate** | | | | | |
| Tax | 1 | 0.87 (−3.91 to 5.64) | 0.7211 | | |
| Smoking ban | 2 | −0.08 (−0.24 to 0.08) | 0.3270 | 49.9 (0 to 81.6) | 0.15 (0 to 29.74) |
| Youth access policy | 1 | −0.14 (−0.31 to 0.03) | 0.0993 | | |
| PODB | 1 | 0.24 (0.07 to 0.40) | 0.0045 | | |
| NRT | 1 | 0.06 (−0.02 to 0.13) | 0.1452 | | |
| HW | 1 | 0.04 (−0.12 to 0.20) | 0.6328 | | |
| MMC-EXP | 1 | −0.01 (−0.03 to 0.01) | 0.2565 | | |
| **Smoking prevalence** | | | | | |
| Tax | 1 | −5.09 (−9.14 to −1.03) | 0.0139 | | |
| Smoking ban | 2 | −0.61 (−4.00 to 2.79) | 0.7255 | | |
| E-cigarette tax increase | 1 | 0.00 (0.00 to 0.01) | 0.0015 | | |
| E-cigarette ban | 2 | −0.01 (−0.03 to 0.02) | 0.6668 | 88.1 (54.1 to 96.9) | <0.001 (NA) |

[a]Where two or more papers are included in the meta-analysis, the effect size (coefficient) is pooled; for single studies, the original effect size is presented.

free/discounted NRT and quit rates. Offering modest doses of free NRT in various forms (for example, gum, transdermal patches, nasal spray, inhalers and oral tablets/lozenges) was estimated to increase quit rates by 9.8 percentage points (95% CI, 7.4–15.7)[25,511,517]. Moreover, when used in conjunction with physician advice, free NRT was shown to double the chance of successful smoking cessation[518]. However, it is important to recognize that the relatively high costs associated with these policies may pose challenges for implementation in low-resource settings. In our study, we found that flavour bans, whether applied to e-cigarettes or traditional cigarettes, can effectively increase quitting behaviour and reduce e-cigarette consumption. A recent qualitative review by Rogers et al. supported these findings, concluding that

https://doi.org/10.1038/s41562-024-02002-7

| Outcome | Tobacco policy | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Multicomponent tobacco control programme | | | Smoking ban | | | Tax increase | | | Mass media campaign | | | Pictorial health warning | | | Flavour ban | | | Miscellaneous policies | | |
| Quit attempt | 6 | 0 | 0 | 5 | 1 | 1 | 4 | 1 | 0 | 9 | 0 | 0 | 5 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| Quit intention | 0 | 0 | 0 | 5 | 0 | 1 | 5 | 0 | 0 | 1 | 0 | 1 | 6 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Quit rate | 9 | 1 | 2 | 8 | 0 | 1 | 8 | 1 | 3 | 9 | 0 | 4 | 7 | 0 | 4 | 4 | 0 | 0 | 6 | 0 | 0 |
| Smoking prevalence | 19 | 0 | 2 | 15 | 0 | 3 | 24 | 0 | 6 | 13 | 2 | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 2 |
| Smoking intention | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Secondhand smoke exposure | 0 | 0 | 0 | 2 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tobacco consumption | 13 | 0 | 2 | 16 | 1 | 4 | 35 | 2 | 3 | 13 | 0 | 7 | 5 | 0 | 2 | 3 | 0 | 0 | 1 | 2 | 3 |
| E-cigarette consumption | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 1 | 0 | 0 |
| Tobacco sales | 1 | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 3 | 0 | 0 |
| E-cigarette sales | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |

**Fig. 4 | Narrative summary of tobacco behaviour change following the implementation of different tobacco policies ($n$ = 238 studies).** The number of studies is indicated in each circle. 'Multicomponent tobacco control programme' includes different combinations of multiple tobacco control policies; miscellaneous policies include NRT, Quitline, point-of-sale tobacco display ban, ban on advertising, youth access laws and plain packaging mandates. Green indicates a positive effect of the tobacco policy—that is, a statistically significant increase or decrease in the targeted outcome favouring the policy. Orange indicates a negative effect of the tobacco policy—that is, a statistically significant increase or decrease in the targeted outcome favouring the control. Grey indicates no effect of the tobacco policy—that is, a statistically insignificant increase or decrease in the targeted outcome.

restrictions on the sale of flavoured or menthol tobacco products significantly and beneficially influenced tobacco consumption (sales), tobacco use prevalence and quitting behaviours[519]. Our findings are also supported by another literature review, concluding that the menthol ban had a substantial impact on smoking cessation and initiation[520]. The effectiveness of flavour bans, particularly on e-cigarettes and cigarettes featuring flavours such as fruit, candy or menthol, has been a subject of debate[519,520]. Some argue that such bans can diminish the appeal of these products to young individuals and discourage initiation. However, others contend that flavour bans may not significantly impact overall consumption, as individuals may switch to unflavoured options or alternative tobacco products. The present findings, along with previous evidence, suggest that bans on flavoured tobacco products may indeed lead to improvements in smoking behaviour.

We found that smoking bans significantly reduced smoking prevalence but did not show a consistent effect on behaviours related to tobacco cessation. Smoking bans at work or in public places are common strategies in tobacco control[521], yet there is insufficient evidence regarding their effectiveness on outcomes related to smoking cessation. Previous studies[13,522] have suggested that smoke-free workplaces can reduce smoking prevalence by up to 10%. A systematic review of meta-analyses, encompassing four studies, demonstrated that legislative smoking bans were associated with an approximately 28% reduction in smoking rates[23]. However, another review found that banning smoking in public places had limited effects on smoking cessation[8]. While the evidence on smoking bans' effects on smoking behaviour remains inconclusive, such policies may effectively protect non-smokers from exposure to secondhand smoke[523].

Our network meta-analyses allowed for a comparison and ranking of policy interventions in terms of their effectiveness in changing smoking behaviour. Given the large number of studies included in the meta-analysis, our findings can serve as a valuable reference for future research regarding effect size. The findings presented in this study are expressed in relative terms, providing a clearer understanding of the comparative effectiveness of various policies. Nevertheless, it is important to acknowledge the limitations of this study. First, although 476 studies were included in the review, only 265 were used to conduct pairwise and network meta-analyses. Second, the primary outcome variables in many cases relied on self-reported data, which incurs a higher risk of bias. Third, despite our diligent efforts and thorough manual searches on well-established organizational websites, it remains possible that we inadvertently missed certain grey literature sources. This could be due to some policy evaluations conducted by governments or non-governmental organizations not being intended for publication, or being less likely to be published if they yield non-significant results, introducing potential publication bias. Fourth, the implementation of different policies and methodologies varied considerably across settings, posing a significant challenge when attempting to draw meaningful comparisons of effects across various studies. In particular, the inclusion of a broad range of coordinated anti-smoking activities within media campaigns, targeting diverse audiences, may obscure the effectiveness of individual campaigns focused on specific population groups. Moreover, in quasi-experimental studies, the non-random allocation of study participants may result in residual confounding, potentially biasing the estimation of policy effects[521]. It is therefore crucial to approach the interpretation of pooled effect estimates for different policies with caution. Fifth, most of the included studies were conducted in HICs, limiting the generalizability of the findings to LMICs. Furthermore, the effect size derived from the quasi-experimental design may reflect a local average treatment effect that predominantly concerns specific subpopulations[524]. Sixth, pooling the results of studies with different designs (observational and quasi-experimental) always requires caution. Our sensitivity analyses by study design did not reveal any significant deviations from the

primary analyses. Finally, this study focused on population-level policy interventions and employed indirect comparisons of alternative policy options using a network meta-analysis. One of the critical assumptions of network meta-analysis is transitivity or similarity, meaning that potential effect modifiers (for example, baseline smoking, age and gender) are similarly distributed across interventions. We assessed the baseline distribution of the outcomes and the prevalence of selected modifiers (gender and age) in the included studies, of which more than 90% were from the USA, focused on adult smoking and included both male and female participants. In this assessment, we did not find that the similarity assumption was severely violated (see Methods for more detail). Nevertheless, we cannot exclude the possibility of violation of the assumption due to unobserved heterogeneity in the controlled groups across the included studies. The results should thus be interpreted with caution.

In addition to these limitations, a comprehensive assessment of local cultural and socio-economic contexts is needed to better understand the effectiveness of tobacco control policies. Furthermore, due to cross-country variations in policy schemes, it might be beneficial to consider additional types of predictor variables or model specifications to fine-tune the results. For example, extended analyses could account for the structure of tax policies (such as tax rates), other regulations and policymaking processes. Finally, it is important to acknowledge that there may be a selection bias in policy implementation across countries. Policies perceived as more likely to yield successful outcomes in a particular context are more likely to be implemented, and vice versa.

In summary, this study provides robust evidence supporting the effectiveness of certain policies in altering smoking behaviours. These policies include tax/price increases, health warnings on cigarette packages, information campaigns, smoking bans in public places and workplaces, flavour bans, and the free distribution of NRT. These findings provide a basis for integrating and funding evidence-based, population-level policies effective in promoting smoking cessation and reductions in tobacco consumption. They should be of particular value to policymakers and researchers seeking to design and implement effective tobacco control measures.

## Methods

### Public and patient involvement

No patients or members of the public were directly involved in this study as no primary data were collected.

### Search strategy and selection criteria

We searched five electronic databases (PubMed, Embase, CINAHL, Web of Science and EconLit) from their inception to 12 February 2021. The initial search was updated on 1 March 2022 and 3 August 2023. The search strategy comprised a combination of three sets of keywords: (1) tobacco-related terms (for example, 'cigarette', 'tobacco' and 'e-cigarette'), (2) intervention-related terms (for example, 'campaigns', 'advertising', 'smoking ban', 'health warnings', 'legislation', 'tax increase' and 'promotion') and (3) policy-related terms (for example, 'public policy', 'health policy', 'initiatives', 'program(me)s' and 'actions'). The details of the search strategy and results are presented in the supplementary material (Supplementary Tables 16–25). We also checked the reference lists of the included papers, previous systematic reviews, Google Scholar and leading organizational websites, including those of the World Health Organization, the World Bank and the Organisation for Economic Co-operation and Development. No data or language restrictions were applied. The inclusion criteria were quantitative studies that used individual-, community-, facility- or country-level data. All populations and individuals in all age groups were included. We included all study designs for policy impact evaluation in a real-world setting. Studies predominantly using simulation or model-based analyses were excluded. Evaluations of research-based interventions, such as lab or field experiments implemented as part of the research, were excluded to focus on public policies. Finally, letters, case series, reviews, commentaries and editorials were excluded. This study was registered on 27 March 2022 with PROSPERO (CRD 42022311392) (https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=311392) before the start of data extraction.

We considered all types of population-level policies and interventions, such as mass media campaigns, tax/price increases, tobacco bans, pictorial/textual health warnings, minimum legal age, flavour bans and free/discounted NRT implemented by governments or other organizations engaged in reducing tobacco consumption. Detailed information about the intervention characteristics is presented in the supplementary material (Supplementary Table 26). The primary outcome variable was the change in smoking behaviour, such as changes in smoking prevalence, tobacco consumption, quit intentions, quit attempts or quit rates. The secondary outcome variable was the change in tobacco sales.

### Data extraction

Two teams of paired reviewers independently used Rayyan QCRI (http://www.rayyan.ai/) to screen the identified records by title, abstract and full text. Any disagreement between reviewers was resolved through discussions with the project leader (S. Akter). Information was collected using a preconceived, standardized form (Supplementary Appendix 1). In summary, the following details were retrieved from the studies: the study ID, the title, the first author's last name, the study country, the publication year, the survey year, the study design, the sample size, the sample age, the sample gender, the study settings, the name of the policy, the policy brief, the policy implementation year, the policy evaluation time and the outcome variables. Additionally, detailed information was extracted on various effect sizes, including prevalence, mean, median, percentage change, OR, RR, HR, regression coefficient or correlation by the policy variables. Data were extracted from the primary studies and cross-checked by two independent reviewers, with disagreements resolved through consensus. If an article reported multiple effect estimates resulting from stratified analysis (for example, by sex, geographic area or age group), these estimates were combined to provide a single OR, RR, HR or coefficient for the overall study. When an article provided multiple effect estimates from statistical models adjusted for different covariates, we selected the one that was adjusted for the most variables or supported by the author's conclusions.

### Study quality assessment

The Newcastle–Ottawa Scale tool[525] was used to assess the quality (or risk of bias) of the observational studies. Controlled before-and-after, interrupted time series and other quasi-experimental studies were coded using Cochrane EPOC tools[526]. Study quality was based on the total score as follows: high (≥6), moderate (4–5) and low (0–3). The supplementary material presents the details of the study quality assessment (Appendix 2). Two reviewers independently assessed the study quality, which was then cross-checked by two other authors. Disagreements were resolved through discussion.

### Data analysis

The synthesis of the results was performed in two stages. First, a meta-analysis was conducted for studies that provided comprehensive data on effect sizes, such as ORs, RRs, HRs or regression coefficients, along with 95% CIs or standard errors. Second, for studies lacking sufficient quantitative data for meta-analysis or presenting data in a qualitative format, such as percentages or mean differences, a narrative synthesis was employed to summarize their findings. The primary goal of performing both pairwise and network meta-analyses was to identify the most effective tobacco policies for changing smoking behaviour. Effect sizes, especially ORs, RRs, HRs or regression coefficients, along with their CIs or standard errors, are considered the currency of meta-analysis. Continuous outcome variables were

generally reported with coefficients and 95% CIs or standard errors, while dichotomous outcome variables were reported with ORs, RRs or HRs with associated 95% CIs or standard errors. Both pairwise and network meta-analyses should use only one statistic scale—OR, RR or HR. Since most studies provided ORs for dichotomous outcome variables, our primary choice for both the pairwise and network meta-analyses was to use ORs. We assumed HRs were similar to RRs on the basis of previous studies[527]. When studies reported RRs, we converted them to ORs. If the incidence of the outcome of interest was less than 10%, we treated ORs as equivalent to RRs, as suggested by prior research[31]. When the incidence exceeded 10%, we applied the conversion formula recommended by Grant et al.[528]: $\mathrm{RR} = \mathrm{OR}/(1 - p_0 + (p_0 \times \mathrm{OR}))$, where $p_0$ is the control event rate (or baseline risk), which leads to the following:

$$\mathrm{OR} = \frac{(1 - p_0) \times \mathrm{RR}}{1 - \mathrm{RR} \times p_0}$$

Prior to conducting the pairwise and network meta-analyses, we applied a natural logarithm transformation to the effect sizes. This transformation helps stabilize the variance of the effect sizes and ensures that the analysis is based on comparable units. To summarize the effect size of each relevant combination of interventions and outcomes, we performed fixed- or random-effects meta-analysis, depending on the extent of heterogeneity. To assess heterogeneity across the included studies, we calculated $I^2$ and $\tau$ statistics[529]. Although $I^2$ is commonly used to assess heterogeneity in the literature, it is not a perfect measure. Its value heavily depends on the precision of the included studies, whereas the values of $\tau^2$ and $\tau$ are insensitive to that effect[529]. Therefore, for reader interest, comparability and accuracy, we reported both common approaches to assess heterogeneity.

To run the network meta-analysis, we log-transformed the effect sizes and used them to simultaneously compare different types of interventions[529]. Forest plots of relative treatment effects were used to visualize each comparison. The *p*-score was used to rank each intervention, with scores reflecting the degree of certainty that a given intervention was more effective than another[527]. The higher the *p*-score, the higher the probability that the intervention is more effective than others. If we had a minimum of two studies for a specific intervention and outcome, we included those studies in the network meta-analysis. To investigate the sources of heterogeneity, we performed subgroup analyses based on different criteria, including country income categories (HICs versus LMICs), policy implementation time (pre-2008 versus post-2008, following the introduction of the World Health Organization's MPOWER package in 2008) and policy evaluation timing relative to its introduction (within 15 months versus more than 16 months, using the median value). The MPOWER package encompasses evidence-based policies aimed at reducing tobacco consumption and its associated health consequences. Studies have consistently shown that implementing the six strategies outlined in MPOWER effectively reduces tobacco use and its related health complications. Our choice of the year 2008 as a cut-off point was influenced by the anticipation of increased global efforts in tobacco control following this milestone.

We also performed sensitivity analyses for smoking-cessation-related outcomes by including only high-quality studies, excluding highly influential studies with large sample sizes and small standard errors, and dropping cross-sectional studies. To check the direction of pooled results, we visually compared the pairwise and network meta-analysis results for each outcome. In network meta-analysis, similarity is assumed, suggesting that potential effect modifiers for assessing the association between each intervention and outcome are equally distributed. To assess the evidence of similarity, we looked at the baseline prevalence of some modifiers, including gender distribution, age and prevalence rates of outcomes, for selected tobacco policy measures, such as campaigns, health warnings, tax increases and smoking bans. The results indicated minimal differences across interventions (more than 90% of the studies were from the USA, included both male and female participants, and focused on adult participants), suggesting that the intervention itself influences effectiveness rather than modifier differences. Detailed information is presented in the supplementary material (Supplementary Table 24).

To investigate publication bias, we inspected funnel plots and conducted formal tests (Egger and Begg tests)[530–534]. In cases where publication bias was suspected, the missing study data were imputed using the Duval and Tweedie trim-and-fill method to adjust for funnel plot asymmetry, and small study effects were assessed[535]. Data management was performed using Stata (version 17.1 MP)[536], and meta-analysis was performed in R (version 3.6.4)[537]. We used a range of R libraries such as netmeta for network meta-analyses and meta for pairwise meta-analyses.

### Deviations from the registered protocol

During our initial screening, we identified a large number of potential outcomes, leading us to register multiple tobacco-consumption-related behavioural outcomes. After the final study selection and data extraction, we limited the outcomes to those with available quantitative data. Moreover, in the study protocol, we initially planned to use a Bayesian network meta-analysis. However, due to the complexity of the methods and practical computational challenges, we decided to switch to a frequentist network meta-analysis. The *p*-scores from the frequentist approach produce rankings of interventions that are nearly identical to those derived from the surface under the cumulative ranking curve in Bayesian approaches[527]. Finally, our registered protocol mentioned conducting a meta-analysis. However, we reported a 'pairwise meta-analysis' in this paper for clarity, as we performed two types of meta-analysis (pairwise and network meta-analyses).

### Reporting summary

Further information on research design is available in the Nature Portfolio Reporting Summary linked to this article.

## Data availability

This systematic review and meta-analysis was based on data published in previous studies. The data extracted from each original study used for pairwise and network meta-analysis can be found in the data repository system (https://github.com/ryotanakamura1/smoking).

## Code availability

The code for the meta-analysis and network meta-analysis for the current review can be found in the data repository system (https://github.com/ryotanakamura1/smoking).

## References

1. *WHO Report on the Global Tobacco Epidemic 2021: Addressing New and Emerging Products* (World Health Organization, 2021).
2. Leigh, J. et al. Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet* **396**, 1223–1249 (2020).
3. Carson, K. V. et al. Mass media interventions for preventing smoking in young people. *Cochrane Database Syst. Rev.* **6**, Cd001006 (2017).
4. Wilson, L. M. et al. Impact of tobacco control interventions on smoking initiation, cessation, and prevalence: a systematic review. *J. Environ. Public Health* **2012**, 961724 (2012).
5. Tackling NCDs: *'Best Buys' and Other Recommended Interventions for the Prevention and Control of Noncommunicable Diseases* (World Health Organization, 2017).
6. Akter, S. et al. Evaluation of population-level tobacco control interventions and health outcomes: a systematic review and meta-analysis. *JAMA Netw. Open* **6**, e2322341 (2023).

7. Flor, L. S., Reitsma, M. B., Gupta, V., Ng, M. & Gakidou, E. The effects of tobacco control policies on global smoking prevalence. *Nat. Med.* **27**, 239–243 (2021).
8. Bafunno, D. et al. Impact of tobacco control interventions on smoking initiation, cessation, and prevalence: a systematic review. *J. Thorac. Dis.* **12**, 3844–3856 (2020).
9. *WHO Report on the Global Tobacco Epidemic, 2008: The MPOWER Package* (World Health Organization, 2008).
10. Dubray, J., Schwartz, R., Chaiton, M., O'Connor, S. & Cohen, J. E. The effect of MPOWER on smoking prevalence. *Tob. Control* **24**, 540–542 (2015).
11. Ngo, A., Cheng, K. W., Chaloupka, F. J. & Shang, C. The effect of MPOWER scores on cigarette smoking prevalence and consumption. *Prev. Med.* **105 Suppl.**, S10–S14 (2017).
12. Bala, M. M., Strzeszynski, L. & Topor-Madry, R. Mass media interventions for smoking cessation in adults. *Cochrane Database Syst. Rev.* **11**, Cd004704 (2017).
13. Fichtenberg, C. M. & Glantz, S. A. Effect of smoke-free workplaces on smoking behaviour: systematic review. *Br. Med. J.* **325**, 188 (2002).
14. Callinan, J. E., Clarke, A., Doherty, K. & Kelleher, C. Legislative smoking bans for reducing secondhand smoke exposure, smoking prevalence and tobacco consumption. *Cochrane Database Syst. Rev.* **4**, CD005992 (2010).
15. Frazer, K. et al. Legislative smoking bans for reducing harms from secondhand smoke exposure, smoking prevalence and tobacco consumption. *Cochrane Database Syst. Rev.* **2**, Cd005992 (2016).
16. Galanti, M. R., Coppo, A., Jonsson, E., Bremberg, S. & Faggiano, F. Anti-tobacco policy in schools: upcoming preventive strategy or prevention myth? A review of 31 studies. *Tob. Control* **23**, 295–301 (2014).
17. Lovato, C., Watts, A. & Stead, L. F. Impact of tobacco advertising and promotion on increasing adolescent smoking behaviours. *Cochrane Database Syst. Rev.* **2011**, Cd003439 (2011).
18. Mosdøl, A., Lidal, I. B., Straumann, G. H. & Vist, G. E. Targeted mass media interventions promoting healthy behaviours to reduce risk of non-communicable diseases in adult, ethnic minorities. *Cochrane Database Syst. Rev.* **2**, Cd011683 (2017).
19. Noar, S. M., Barker, J., Bell, T. & Yzer, M. Does perceived message effectiveness predict the actual effectiveness of tobacco education messages? A systematic review and meta-analysis. *Health Commun.* **35**, 148–157 (2020).
20. Pang, B. et al. The effectiveness of graphic health warnings on tobacco products: a systematic review on perceived harm and quit intentions. *BMC Public Health* **21**, 884 (2021).
21. Quentin, W., Neubauer, S., Leidl, R. & König, H. H. Advertising bans as a means of tobacco control policy: a systematic literature review of time-series analyses. *Int. J. Public Health* **52**, 295–307 (2007).
22. Serra, C., Cabezas, C., Bonfill, X. & Pladevall-Vila, M. Interventions for preventing tobacco smoking in public places. *Cochrane Database Syst. Rev.* **3**, Cd001294 (2000).
23. Bird, Y., Kashaniamin, L., Nwankwo, C. & Moraros, J. Impact and effectiveness of legislative smoking bans and anti-tobacco media campaigns in reducing smoking among women in the US: a systematic review and meta-analysis. *Healthcare (Basel)* **8**, 20 (2020).
24. Peer, N., Naicker, A., Khan, M. & Kengne, A. P. A narrative systematic review of tobacco cessation interventions in sub-Saharan Africa. *SAGE Open Med.* **8**, 2050312120936907 (2020).
25. Levy, D. T., Tam, J., Kuo, C., Fong, G. T. & Chaloupka, F. The impact of implementing tobacco control policies: the 2017 tobacco control policy scorecard. *J. Public Health Manage. Pract.* **24**, 448–457 (2018).
26. Hopkins, D. P. et al. Smokefree policies to reduce tobacco use: a systematic review. *Am. J. Prev. Med.* **38**, S275–S289 (2010).
27. Chaloupka, F. J., Yurekli, A. & Fong, G. T. Tobacco taxes as a tobacco control strategy. *Tob. Control* **21**, 172–180 (2012).
28. Hopkinson, N. S. et al. Current smoking and COVID-19 risk: results from a population symptom app in over 2.4 million people. *Thorax* **76**, 714–722 (2021).
29. Rutter, H., Horton, R. & Marteau, T. M. The Lancet-Chatham House Commission on improving population health post COVID-19. *Lancet* **396**, 152–153 (2020).
30. Abdolahinia, A., Maadani, M. R. & Radmand, G. Pictorial warning labels and quit intention in smokers presenting to a smoking cessation clinic. *Tanaffos* **9**, 48–52 (2010).
31. Abdrakhmanova, S. & Keruyenova, Z. The current state of MPOWER policies in the Republic of Kazakhstan: data from the Global Adult Tobacco Survey 2014. *Iran. J. Public Health* **48**, 834–840 (2019).
32. Abouk, R. & Adams, S. Bans on electronic cigarette sales to minors and smoking among high school students. *J. Health Econ.* **54**, 17–24 (2017).
33. Abouk, R., Adams, S., Feng, B., Maclean, J. C. & Pesko, M. F. The effect of e-cigarette taxes on pre-pregnancy and prenatal smoking. *J. Policy Anal. Manage.* **42**, 908–940 (2023).
34. Abouk, R. et al. Intended and unintended effects of e-cigarette taxes on youth tobacco use. *J. Health Econ.* **87**, 102720 (2023).
35. Adda, J., Berlinski, S. & Machin, S. Short-run economic effects of the Scottish smoking ban. *Int. J. Epidemiol.* **36**, 149–154 (2007).
36. Adeniji, F. Consumption function and price elasticity of tobacco demand in Nigeria. *Tob. Prev. Cessat.* **5**, 48 (2019).
37. Agaku, I. T., Filippidis, F. T. & Vardavas, C. I. Effectiveness of text versus pictorial health warning labels and predictors of support for plain packaging of tobacco products within the European Union. *Eur. Addict. Res.* **21**, 47–52 (2014).
38. Agaku, I. T., Singh, T., Rolle, I. V. & Ayo-Yusuf, O. A. Exposure and response to current text-only smokeless tobacco health warnings among smokeless tobacco users aged ≥18years, United States, 2012–2013. *Prev. Med.* **87**, 200–206 (2016).
39. Ahijevych, K. & Ford, J. The relationships between menthol cigarette preference and state tobacco control policies on smoking behaviors of young adult smokers in the 2006–07 Tobacco Use Supplements to the Current Population Surveys (TUS CPS). *Addiction* **105**, 46–54 (2010).
40. Al-Dahshan, A. et al. Prevalence and predictors of smoking cessation among smokers receiving smoking cessation intervention in primary care in Qatar: a 6-month follow-up study. *Front. Public Health* **11**, 1166016 (2023).
41. Al-Tannir, M., Abu-Shaheen, A., Altannir, Y. & Altannir, M. Tobacco price increase and consumption behaviour among male smokers in Saudi Arabia: a community-based study. *East. Mediterr. Health J.* **26**, 1518–1524 (2020).
42. Alberg, A. J. et al. The influence of offering free transdermal nicotine patches on quit rates in a local health department's smoking cessation program. *Addict. Behav.* **29**, 1763–1778 (2004).
43. Alghamdi, A. et al. Smoking behaviour after enforcement of a 100% tax on tobacco products in Saudi Arabia: a cross-sectional study. *East. Mediterr. Health J.* **26**, 39–46 (2020).
44. Ali, F. R. M., Rice, K., Fang, X. & Xu, X. Tobacco 21 policies in California and Hawaii and sales of cigarette packs: a difference-in-differences analysis. *Tob. Control* **29**, 588–592 (2020).
45. Ali, F. R. M. et al. Evaluation of statewide restrictions on flavored e-cigarette sales in the US from 2014 to 2020. *JAMA Netw. Open* **5**, e2147813 (2022).
46. Aljuaid, S. O. et al. Taxation and tobacco plain packaging effect on Saudi smokers quitting intentions in Riyadh city, Saudi Arabia. *Saudi Med J.* **41**, 1121–1129 (2020).

47. Alkaff, F. F. et al. The effectivity of pictorial health warning to motivate smoking cessation in rural area: a study from Losari village, Indonesia. *J. Educ. Health Promot.* **9**, 67 (2020).
48. Alpert, H. R., Carpenter, D. & Connolly, G. N. Tobacco industry response to a ban on lights descriptors on cigarette packaging and population outcomes. *Tob. Control* **27**, 390–398 (2018).
49. Amato, M. S., Boyle, R. G. & Brock, B. Higher price, fewer packs: evaluating a tobacco tax increase with cigarette sales data. *Am. J. Public Health* **105**, e5–e8 (2015).
50. Amos, A., White, D. A. & Elton, R. A. Is a telephone helpline of value to the workplace smoker? *Occup. Med. (Oxf., Engl.)* **45**, 234–238 (1995).
51. An, D. T., Kibria, N., Huy, N. V., Hai, P. T. & Stillman, F. Establishing smoke-free hospitals in Vietnam: a pilot project. *Glob. Public Health* **10**, S5–S20 (2015).
52. An, L. C. et al. Increased reach and effectiveness of a statewide tobacco quitline after the addition of access to free nicotine replacement therapy. *Tob. Control* **15**, 286–293 (2006).
53. André Bonfrer, P. K. C., Roberts, J. H. & Corkindale, D. Assessing the sales impact of plain packaging regulation for cigarettes: evidence from Australia. *Mark. Sci.* **39**, 234–252 (2019).
54. Andreeva, T. I., Krasovsky, K. S. & Semenova, D. S. Correlates of smoking initiation among young adults in Ukraine: a cross-sectional study. *BMC Public Health* **7**, 106 (2007).
55. Anyanwu, P. E., Craig, P., Katikireddi, S. V. & Green, M. J. Impact of UK tobacco control policies on inequalities in youth smoking uptake: a natural experiment study. *Nicotine Tob. Res.* **22**, 1973–1980 (2020).
56. Apollonio, D. E., Dutra, L. M. & Glantz, S. A. Associations between smoking trajectories, smoke-free laws and cigarette taxes in a longitudinal sample of youth and young adults. *PLoS ONE* **16**, e0246321 (2021).
57. Asare, S. et al. Association of cigarette sales with comprehensive menthol flavor ban in Massachusetts. *JAMA Intern. Med.* **182**, 231–234 (2022).
58. Asare, S., Stoklosa, M., Drope, J. & Larsen, A. Effects of prices on youth cigarette smoking and tobacco use initiation in Ghana and Nigeria. *Int. J. Environ. Res. Public Health* **16**, 3114 (2019).
59. Astor, R. L. et al. Tobacco retail licensing and youth product use. *Pediatrics* **143**, e20173536 (2019).
60. Azagba, S., Burhoo, P., Chaloupka, F. J. & Fong, G. T. Effect of cigarette tax increase in combination with mass media campaign on smoking behaviour in Mauritius: findings from the ITC Mauritius Survey. *Tob. Control* **24**, iii71–iii75 (2015).
61. Azagba, S., Shan, L. & Latham, K. County smoke-free laws and cigarette smoking among U.S. adults, 1995–2015. *Am. J. Prev. Med.* **58**, 97–106 (2020).
62. Azagba, S. & Sharaf, M. F. The effect of graphic cigarette warning labels on smoking behavior: evidence from the Canadian experience. *Nicotine Tob. Res.* **15**, 708–717 (2013).
63. Baan, B. Prevention of smoking in young children in Holland: education and changing attitudes. *Lung* **168**, 320–326 (1990).
64. Bajoga, U., Lewis, S., McNeill, A. & Szatkowski, L. Does the introduction of comprehensive smoke-free legislation lead to a decrease in population smoking prevalence? *Addiction* **106**, 1346–1354 (2011).
65. Barber, J. J. & Grichting, W. L. Australia's media campaign against drug abuse. *Int. J. Addict.* **25**, 693–708 (1990).
66. Baskerville, N. B., Azagba, S., Norman, C., McKeown, K. & Brown, K. S. Effect of a digital social media campaign on young adult smoking cessation. *Nicotine Tob. Res.* **18**, 351–360 (2016).
67. Bauer, U. E., Johnson, T. M., Hopkins, R. S. & Brooks, R. G. Changes in youth cigarette use and intentions following implementation of a tobacco control program: findings from the Florida Youth Tobacco Survey, 1998–2000. *JAMA* **284**, 723–728 (2000).
68. Beard, E., Brown, J. & Shahab, L. Smoking prevalence following the announcement of tobacco tax increases in England between 2007 and 2019: an interrupted time-series analysis. *Addiction* **117**, 2481–2492 (2022).
69. Beard, E., Jackson, S. E., West, R., Kuipers, M. A. G. & Brown, J. Trends in attempts to quit smoking in England since 2007: a time series analysis of a range of population-level influences. *Nicotine Tob. Res.* **22**, 1476–1483 (2020).
70. Beard, E., Jackson, S. E., West, R., Kuipers, M. A. G. & Brown, J. Population-level predictors of changes in success rates of smoking quit attempts in England: a time series analysis. *Addiction* **115**, 315–325 (2020).
71. Becker, C. M., Lee, J. G. L., Hudson, S., Hoover, J. & Civils, D. A 14-year longitudinal study of the impact of clean indoor air legislation on state smoking prevalence, USA, 1997–2010. *Prev. Med.* **99**, 63–66 (2017).
72. Berg, C. J., Haardorfer, R., Windle, M., Solomon, M. & Kegler, M. C. Smoke-free policies in multiunit housing: smoking behavior and reactions to messaging strategies in support or in opposition. *Prev. Chronic Dis.* **12**, E98 (2015).
73. Best, C. S., Brown, A. & Hunt, K. Purchasing of tobacco-related and e-cigarette-related products within prisons before and after implementation of smoke-free prison policy: analysis of prisoner spend data across Scotland, UK. *BMJ Open* **12**, e058909 (2022).
74. Biener, L. Adult and youth response to the Massachusetts anti-tobacco television campaign. *J. Public Health Manage. Pract.* **6**, 40–44 (2000).
75. Biener, L., Aseltine, R. H. Jr., Cohen, B. & Anderka, M. Reactions of adult and teenaged smokers to the Massachusetts tobacco tax. *Am. J. Public Health* **88**, 1389–1391 (1998).
76. Biener, L., Harris, J. E. & Hamilton, W. Impact of the Massachusetts tobacco control programme: population based trend analysis. *Br. Med. J.* **321**, 351–354 (2000).
77. Bittencourt, L., Person, S. D., Cruz, R. C. & Scarinci, I. C. Pictorial health warnings on cigarette packs and the impact on women. *Rev. Saude Publica* **47**, 1123–1129 (2013).
78. Boes, S., Marti, J. & Maclean, J. C. The impact of smoking bans on smoking and consumer behavior: quasi-experimental evidence from Switzerland. *Health Econ.* **24**, 1502–1516 (2015).
79. Booras, A. et al. A longitudinal study of perceptions of the Massachusetts menthol ban and its impact on smoking behaviors among marginalized individuals. *Int. J. Environ. Res. Public Health* **20**, 5790 (2023).
80. Borland, R. & Balmford, J. Understanding how mass media campaigns impact on smokers. *Tob. Control* **12**, ii45–ii52 (2003).
81. Borland, R. et al. How reactions to cigarette packet health warnings influence quitting: findings from the ITC Four-Country survey. *Addiction* **104**, 669–675 (2009).
82. Bosdriesz, J. R., Willemsen, M. C., Stronks, K. & Kunst, A. E. Tobacco control policy and socio-economic inequalities in smoking in 27 European countries. *Drug Alcohol Depend.* **165**, 79–86 (2016).
83. Botello-Harbaum, M. T. et al. Tobacco control policy and adolescent cigarette smoking status in the United States. *Nicotine Tob. Res.* **11**, 875–885 (2009).
84. Boyle, R. G., Stanton, C. A., Sharma, E. & Tang, Z. Examining quit attempts and successful quitting after recent cigarette tax increases. *Prev. Med.* **118**, 226–231 (2019).
85. Boyle, R. G., Stilwell, J., Vidlak, L. M. & Huneke, J. T. 'Ready to quit chew?' Smokeless tobacco cessation in rural Nebraska. *Addict. Behav.* **24**, 293–297 (1999).
86. Brennan, E. et al. Are quitting-related cognitions and behaviours predicted by proximal responses to plain packaging with larger health warnings? Findings from a national cohort study with Australian adult smokers. *Tob. Control* **24**, ii33–ii41 (2015).

87. Brennan, E., Durkin, S. J., Cotter, T., Harper, T. & Wakefield, M. A. Mass media campaigns designed to support new pictorial health warnings on cigarette packets: evidence of a complementary relationship. *Tob. Control* **20**, 412–418 (2011).
88. Brenner, H. & Fleischle, B. Smoking regulations at the workplace and smoking behavior: a study from southern Germany. *Prev. Med.* **23**, 230–234 (1994).
89. Brown, J. et al. How effective and cost-effective was the national mass media smoking cessation campaign 'Stoptober'? *Drug Alcohol Depend.* **135**, 52–58 (2014).
90. Bush, T. et al. The 2009 US federal cigarette tax increase and quitline utilization in 16 states. *J. Environ. Public Health* **2012**, 314740 (2012).
91. Businelle, M. S. et al. Smoking policy change at a homeless shelter: attitudes and effects. *Addict. Behav.* **40**, 51–56 (2015).
92. Campion, P., Owen, L., McNeill, A. & McGuire, C. Evaluation of a mass media campaign on smoking and pregnancy. *Addiction* **89**, 1245–1254 (1994).
93. Cance, J. D., Talley, A. E. & Fromme, K. The impact of a city-wide indoor smoking ban on smoking and drinking behaviors across emerging adulthood. *Nicotine Tob. Res.* **18**, 177–185 (2016).
94. Cantrell, J., Hung, D., Fahs, M. C. & Shelley, D. Purchasing patterns and smoking behaviors after a large tobacco tax increase: a study of Chinese Americans living in New York City. *Public Health Rep.* **123**, 135–146 (2008).
95. Carpenter, C. & Cook, P. J. Cigarette taxes and youth smoking: new evidence from national, state, and local Youth Risk Behavior Surveys. *J. Health Econ.* **27**, 287–299 (2008).
96. Carpenter, C. S. & Sansone, D. Cigarette taxes and smoking among sexual minority adults. *J. Health Econ.* **79**, 102492 (2021).
97. CDC. Impact of promotion of the Great American Smokeout and availability of over-the-counter nicotine medications, 1996. *MMWR Morb. Mortal. Wkly Rep.* **46**, 867–871 (1997).
98. CDC. Decline in smoking prevalence—New York City, 2002–2006. *MMWR Morb. Mortal. Wkly Rep.* **56**, 604–608 (2007).
99. CDC. Decrease in smoking prevalence—Minnesota, 1999–2010. *MMWR Morb. Mortal. Wkly Rep.* **60**, 138–141 (2011).
100. Cetin, T. The effect of taxation and regulation on cigarette smoking: fresh evidence from Turkey. *Health Policy* **121**, 1288–1295 (2017).
101. Chaaya, M., Nakkash, R., Saab, D., Kadi, L. & Afifi, R. Effect of tobacco control policies on intention to quit smoking cigarettes: a study from Beirut, Lebanon. *Tob. Induc. Dis.* **17**, 63 (2019).
102. Chaiton, M. et al. Product substitution after a real-world menthol ban: a cohort study. *Tob. Regul. Sci.* **6**, 205–212 (2020).
103. Chaiton, M. et al. Prior daily menthol smokers more likely to quit 2 years after a menthol ban than non-menthol smokers: a population cohort study. *Nicotine Tob. Res.* **23**, 1584–1589 (2021).
104. Chaiton, M., Schwartz, R., Shuldiner, J., Tremblay, G. & Nugent, R. Evaluating a real world ban on menthol cigarettes: an interrupted time-series analysis of sales. *Nicotine Tob. Res.* **22**, 576–579 (2020).
105. Chaiton, M. O. et al. Ban on menthol-flavoured tobacco products predicts cigarette cessation at 1 year: a population cohort study. *Tob. Control* **29**, 341–347 (2020).
106. Chaiton, M. O., Schwartz, R., Tremblay, G. & Nugent, R. Association of flavoured cigar regulations with wholesale tobacco volumes in Canada: an interrupted time series analysis. *Tob. Control* **28**, 457–461 (2019).
107. Chaloupka, F. J. & Grossman, M. *Price, Tobacco Control Policies and Youth Smoking* NBER Working Paper No. 5740 (NBER, 1996).
108. Chaloupka, F. J., Grossman, M. & Tauras, J. *Public policy and youth smokeless tobacco use.* NBER Working Paper No. 5524 (National Bureau of Economic Research, 1996).
109. Chaloupka, F. J. & Pacula, R. L. *An examination of gender and race differences in youth smoking responsiveness to price and tobacco control policies.* NBER Working Paper No. 6541 (National Bureau of Economic Research, 1998).
110. Chaloupka, F. J. & Wechsler, H. Price, tobacco control policies and smoking among young adults. *J. Health Econ.* **16**, 359–373 (1997).
111. Chang, F. C., Sung, H. Y., Zhu, S. H. & Chiou, S. T. Impact of the 2009 Taiwan Tobacco Hazards Prevention Act on smoking cessation. *Addiction* **109**, 140–146 (2014).
112. Chapman, S. & Richardson, J. Tobacco excise and declining tobacco consumption: the case of Papua New Guinea. *Am. J. Public Health* **80**, 537–540 (1990).
113. Cheng, K. J. G. & Estrada, M. A. G. Price elasticity of cigarette smoking demand in the Philippines after the 2012 Sin Tax Reform Act. *Prev. Med.* **134**, 106042 (2020).
114. Choi, S. E. Are lower income smokers more price sensitive? The evidence from Korean cigarette tax increases. *Tob. Control* **25**, 141–146 (2016).
115. Choi, T. C., Toomey, T. L., Chen, V. & Forster, J. L. Awareness and reported consequences of a cigarette tax increase among older adolescents and young adults. *Am. J. Health Promot.* **25**, 379–386 (2011).
116. Chow, C. K. et al. Tobacco control environment: cross-sectional survey of policy implementation, social unacceptability, knowledge of tobacco health harms and relationship to quit ratio in 17 low-income, middle-income and high-income countries. *BMJ Open* **7**, e013817 (2017).
117. Chung-Hall, J. 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* **31**, 556–563 (2022).
118. Chung-Hall, J. et al. Effectiveness of text-only cigarette health warnings in Japan: findings from the 2018 International Tobacco Control (ITC) Japan survey. *Int. J. Environ. Res. Public Health* **17**, 952 (2020).
119. Chyderiotis, S., Beck, F., Andler, R., Hitchman, S. C. & Benmarhnia, T. How to reduce biases coming from a before and after design: the impact of the 2007–08 French smoking ban policy. *Eur. J. Public Health* **29**, 372–377 (2019).
120. Coady, M. H. et al. Awareness and impact of New York City's graphic point-of-sale tobacco health warning signs. *Tob. Control* **22**, e51–e56 (2013).
121. Cole, A. G., Aleyan, S., Qian, W. & Leatherdale, S. T. Assessing the strength of secondary school tobacco policies of schools in the COMPASS study and the association to student smoking behaviours. *Can. J. Public Health* **110**, 236–243 (2019).
122. Cole, S., Suter, C., Nash, C. & Pollard, J. Impact of a temporary NRT enhancement in a state quitline and web-based program. *Am. J. Health Promot.* **32**, 1206–1213 (2018).
123. Cooper, M. T. & Pesko, M. F. The effect of e-cigarette indoor vaping restrictions on adult prenatal smoking and birth outcomes. *J. Health Econ.* **56**, 178–190 (2017).
124. Costa, J. & Mossialos, E. Which policies effectively enable smoking cessation? Evidence from the European Union. *Int. J. Soc. Econ.* **33**, 77–100 (2006).
125. Cotti, C. et al. The effects of e-cigarette taxes on e-cigarette prices and tobacco product sales: evidence from retail panel data. *J. Health Econ.* **86**, 102676 (2022).
126. Courtemanche, C. J., Palmer, M. K. & Pesko, M. F. Influence of the flavored cigarette ban on adolescent tobacco use. *Am. J. Prev. Med.* **52**, e139–e146 (2017).
127. Cummings, K. M., Sciandra, R. & Markello, S. Impact of a newspaper mediated quit smoking program. *Am. J. Public Health* **77**, 1452–1453 (1987).

128. Curry, L. E. et al. Changes in reported secondhand smoke incursions and smoking behavior after implementation of a Federal Smoke-Free Rule in New York State federally subsidized public housing. *Int. J. Environ. Res. Public Health* **19**, 3513 (2022).
129. Dauchy, E. & Ross, H. The effect of price and tax policies on the decision to smoke among men in Kenya. *Addiction* **114**, 1249–1263 (2019).
130. Dave, D., Feng, B. & Pesko, M. F. The effects of e-cigarette minimum legal sale age laws on youth substance use. *Health Econ.* **28**, 419–436 (2019).
131. Davis, K. C., Farrelly, M. C., Duke, J., Kelly, L. & Willett, J. Antismoking media campaign and smoking cessation outcomes, New York State, 2003–2009. *Prev. Chronic Dis.* **9**, E40 (2012).
132. Davis, K. C., Farrelly, M. C., Messeri, P. & Duke, J. The impact of national smoking prevention campaigns on tobacco-related beliefs, intentions to smoke and smoking initiation: results from a longitudinal survey of youth in the United States. *Int. J. Environ. Res. Public Health* **6**, 722–740 (2009).
133. De Silva, W. D., Sinha, D. N. & Kahandawaliyanag, A. An assessment of the effectiveness of tobacco control measures on behavior changes related to tobacco use among adolescents and young adults in a district in Sri Lanka. *Indian J. Cancer* **49**, 438–442 (2012).
134. Debchoudhury, I., Farley, S. M., Roods, K., Talati, A. & Jasek, J. E-cigarette use among middle and high school students in New York City before and after passage of Tobacco 21. *Tob. Use Insights* **15**, 1179173X211065997 (2022).
135. DeCicca, P., Kenkel, D. & Mathios, A. Cigarette taxes and the transition from youth to adult smoking: smoking initiation, cessation, and participation. *J. Health Econ.* **27**, 904–917 (2008).
136. Decicca, P., Kenkel, D., Mathios, A., Shin, Y. J. & Lim, J. Y. Youth smoking, cigarette prices, and anti-smoking sentiment. *Health Econ.* **17**, 733–749 (2008).
137. Decicca, P., Kenkel, D. S. & Mathios, A. Putting out the fires: will higher taxes reduce the onset of youth smoking? *J. Polit. Econ.* **110**, 144–169 (2002).
138. Del Bono, E. & Vuri, D. Smoking behaviour and individual well-being: a fresh look at the effects of the 2005 public smoking ban in Italy. *Oxf. Econ. Pap.* **70**, 741–762 (2018).
139. Delnevo, C. D., Hrywna, M., Foulds, J. & Steinberg, M. B. Cigar use before and after a cigarette excise tax increase in New Jersey. *Addict. Behav.* **29**, 1799–1807 (2004).
140. Delva, J., Dietz, N. A., Perron, B., Sanchez, N. & Woolley, M. E. Adult awareness of a youth-focused anti-tobacco campaign: does having children matter? *Subst. Use Misuse* **44**, 763–774 (2009).
141. Demir, M. et al. The impact of anti-smoking laws on high school students in Ankara, Turkey. *J. Bras. Pneumol.* **41**, 523–529 (2015).
142. Dietz, N. A., Delva, J., Woolley, M. E. & Russello, L. The reach of a youth-oriented anti-tobacco media campaign on adult smokers. *Drug Alcohol Depend.* **93**, 180–184 (2008).
143. Dietz, N. A. et al. Changes in youth cigarette use following the dismantling of an antitobacco media campaign in Florida. *Prev. Chronic Dis.* **7**, A65 (2010).
144. Dinno, A. & Glantz, S. Tobacco control policies are egalitarian: a vulnerabilities perspective on clean indoor air laws, cigarette prices, and tobacco use disparities. *Soc. Sci. Med.* **68**, 1439–1447 (2009).
145. Donatos, G. S. Advertising, anti-smoking campaign and cigarette consumption in Greece. *Eur. Res. Stud. J.* **0**, 3–16 (2004).
146. Dono, J., Bowden, J., Kim, S. & Miller, C. Taking the pressure off the spring: the case of rebounding smoking rates when antitobacco campaigns ceased. *Tob. Control* **28**, 233–236 (2019).
147. Dove, M. S., Gee, K. & Tong, E. K. Flavored tobacco sales restrictions and teen e-cigarette use: quasi-experimental evidence from California. *Nicotine Tob. Res.* **25**, 127–134 (2023).
148. Doxiadis, S. A., Trihopoulos, D. V. & Phylactou, H. D. Impact of a nationwide anti-smoking campaign. *Lancet* **2**, 712–713 (1985).
149. Driller, G., Plasencia, E. & Apollonio, D. E. Retrospective review of nicotine exposures in California from 2012 to 2018 and analysis of the impacts of e-cigarette regulations. *BMJ Open* **11**, e043133 (2021).
150. Du, Y. et al. Association of electronic cigarette regulations with electronic cigarette use among adults in the United States. *JAMA Netw. Open* **3**, e1920255 (2020).
151. Duan, Z., Wang, Y., Huang, J., Redmon, P. B. & Eriksen, M. P. Secondhand smoke (SHS) exposure before and after the implementation of the Tobacco Free Cities (TFC) initiative in five Chinese cities: a pooled cross-sectional study. *BMJ Open* **10**, e044570 (2020).
152. Duke, J. C. et al. Youth's awareness of and reactions to the Real Cost national tobacco public education campaign. *PLoS ONE* **10**, e0144827 (2015).
153. Duke, J. C. et al. Impact of a U.S. antismoking national media campaign on beliefs, cognitions and quit intentions. *Health Educ. Res.* **30**, 466–483 (2015).
154. Duke, J. C. et al. Impact of the Real Cost media campaign on youth smoking initiation. *Am. J. Prev. Med.* **57**, 645–651 (2019).
155. Duke, J. C. et al. The impact of a state-sponsored mass media campaign on use of telephone quitline and web-based cessation services. *Prev. Chronic Dis.* **11**, E225 (2014).
156. Duke, J. C. et al. Effect of a statewide media campaign on smoking cessation among Florida adults. *Prev. Chronic Dis.* **17**, E17 (2020).
157. Dunbar, M. S., Nicosia, N. & Kilmer, B. Estimating the impact of state cigarette tax rates on smoking behavior: addressing endogeneity using a natural experiment. *Drug Alcohol Depend.* **225**, 108807 (2021).
158. Dunlop, S. M., Cotter, T. F. & Perez, D. A. Impact of the 2010 tobacco tax increase in Australia on short-term smoking cessation: a continuous tracking survey. *Med. J. Aust.* **195**, 469–472 (2011).
159. Durkin, S. et al. Short-term changes in quitting-related cognitions and behaviours after the implementation of plain packaging with larger health warnings: findings from a national cohort study with Australian adult smokers. *Tob. Control* **24**, ii26–ii32 (2015).
160. Dutra, L. M. et al. Differential relationship between tobacco control policies and U.S. adult current smoking by poverty. *Int. J. Environ. Res. Public Health* **16**, 4130 (2019).
161. Dutra, L. M., Glantz, S. A., Arrazola, R. A. & King, B. A. Impact of e-cigarette minimum legal sale age laws on current cigarette smoking. *J. Adolesc. Health.* **62**, 532–538 (2018).
162. Dwyer, T., Pierce, J. P., Hannam, C. D. & Burke, N. Evaluation of the Sydney 'Quit. For Life' anti-smoking campaign. Part 2. Changes in smoking prevalence. *Med. J. Aust.* **144**, 344–347 (1986).
163. Edwards, C., Oakes, W. & Bull, D. Out of the smokescreen II: will an advertisement targeting the tobacco industry affect young people's perception of smoking in movies and their intention to smoke? *Tob. Control* **16**, 177–181 (2007).
164. Edwards, C. A., Harris, W. C., Cook, D. R., Bedford, K. F. & Zuo, Y. Out of the smokescreen: does an anti-smoking advertisement affect young women's perception of smoking in movies and their intention to smoke? *Tob. Control* **13**, 277–282 (2004).
165. Edwards, R., Ajmal, A., Healey, B. & Hoek, J. Impact of removing point-of-sale tobacco displays: data from a New Zealand youth survey. *Tob. Control* **26**, 392–398 (2017).
166. Elder, J. P. et al. Independent evaluation of the California Tobacco Education Program. *Public Health Rep.* **111**, 353–358 (1996).
167. Elton-Marshall, T. et al. The lower effectiveness of text-only health warnings in China compared to pictorial health warnings in Malaysia. *Tob. Control* **24**, iv6–iv13 (2015).

168. Emery, S. et al. The effects of smoking-related television advertising on smoking and intentions to quit among adults in the United States: 1999–2007. *Am. J. Public Health* **102**, 751–757 (2012).
169. Emery, S. et al. Televised state-sponsored antitobacco advertising and youth smoking beliefs and behavior in the United States, 1999–2000. *Arch. Pediatr. Adolesc. Med.* **159**, 639–645 (2005).
170. Emont, S. L., Choi, W. S., Novotny, T. E. & Giovino, G. A. Clean indoor air legislation, taxation, and smoking behaviour in the United States: an ecological analysis. *Tob. Control* **2**, 13–17 (1993).
171. England, L. et al. Evaluation of a federally funded mass media campaign and smoking cessation in pregnant women: a population-based study in three states. *BMJ Open* **7**, e016826 (2017).
172. Evans-Whipp, T. J., Bond, L., Ukoumunne, O. C., Toumbourou, J. W. & Catalano, R. F. The impact of school tobacco policies on student smoking in Washington State, United States and Victoria, Australia. *Int. J. Environ. Res. Public Health* **7**, 698–710 (2010).
173. Farley, S. M. & Johns, M. New York City flavoured tobacco product sales ban evaluation. *Tob. Control* **26**, 78–84 (2017).
174. Farrelly, M. C., Davis, K. C., Duke, J. & Messeri, P. Sustaining 'truth': changes in youth tobacco attitudes and smoking intentions after 3 years of a national antismoking campaign. *Health Educ. Res.* **24**, 42–48 (2009).
175. Farrelly, M. C., Davis, K. C., Haviland, M. L., Messeri, P. & Healton, C. G. Evidence of a dose–response relationship between 'truth' antismoking ads and youth smoking prevalence. *Am. J. Public Health* **95**, 425–431 (2005).
176. Farrelly, M. C. et al. Promotion of smoking cessation with emotional and/or graphic antismoking advertising. *Am. J. Prev. Med.* **43**, 475–482 (2012).
177. Farrelly, M. C. et al. Association between the Real Cost media campaign and smoking initiation among youths—United States, 2014–2016. *MMWR Morb. Mortal. Wkly Rep.* **66**, 47–50 (2017).
178. Farrelly, M. C., Nonnemaker, J., Davis, K. C. & Hussin, A. The influence of the national truth campaign on smoking initiation. *Am. J. Prev. Med.* **36**, 379–384 (2009).
179. Farrelly, M. C. et al. Changes in hospitality workers' exposure to secondhand smoke following the implementation of New York's smoke-free law. *Tob. Control* **14**, 236–241 (2005).
180. Farrelly, M. C., Pechacek, T. F., Thomas, K. Y. & Nelson, D. The impact of tobacco control programs on adult smoking. *Am. J. Public Health* **98**, 304–309 (2008).
181. Fathallah, N., Maurel-Donnarel, E., Baumstarck-Barrau, K. & Lehucher-Michel, M. P. Three-year follow-up of attitudes and smoking behaviour among hospital nurses following enactment of France's national smoke-free workplace law. *Int. J. Nurs. Stud.* **49**, 803–810 (2012).
182. Federico, B., Mackenbach, J. P., Eikemo, T. A. & Kunst, A. E. Impact of the 2005 smoke-free policy in Italy on prevalence, cessation and intensity of smoking in the overall population and by educational group. *Addiction* **107**, 1677–1686 (2012).
183. Feigl, A. B., Salomon, J. A., Danaei, G., Ding, E. L. & Calvo, E. Teenage smoking behaviour following a high-school smoking ban in Chile: interrupted time-series analysis. *Bull. World Health Organ.* **93**, 468–475 (2015).
184. Feliu, A. et al. Impact of tobacco control policies on smoking prevalence and quit ratios in 27 European Union countries from 2006 to 2014. *Tob. Control* **28**, 101–109 (2019).
185. Fichtenberg, C. M. & Glantz, S. A. Association of the California Tobacco Control Program with declines in cigarette consumption and mortality from heart disease. *N. Engl. J. Med.* **343**, 1772–1777 (2000).
186. Fleischer, N. L. et al. Taxation reduces smoking but may not reduce smoking disparities in youth. *Tob. Control* **30**, 264–272 (2021).
187. Fleischer, N. L. et al. Disentangling the roles of point-of-sale ban, tobacco retailer density and proximity on cessation and relapse among a cohort of smokers: findings from ITC Canada Survey. *Tob. Control* **28**, 81–87 (2019).
188. Flynn, B. S. et al. Prevention of cigarette smoking through mass media intervention and school programs. *Am. J. Public Health* **82**, 827–834 (1992).
189. Flynn, B. S. et al. Mass media and school interventions for cigarette smoking prevention: effects 2 years after completion. *Am. J. Public Health* **84**, 1148–1150 (1994).
190. Fong, G. T. et al. Impact of Canada's menthol cigarette ban on quitting among menthol smokers: pooled analysis of pre-post evaluation from the ITC Project and the Ontario Menthol Ban Study and projections of impact in the USA. *Tob. Control* **32**, 734–738 (2023).
191. Forster, M. & Jones, A. M. The role of tobacco taxes in starting and quitting smoking: duration analysis of British data. *J. R. Stat. Soc. A* **164**, 517–547 (2001).
192. Frieden, T. R. et al. Adult tobacco use levels after intensive tobacco control measures: New York City, 2002–2003. *Am. J. Public Health* **95**, 1016–1023 (2005).
193. Friedman, A. S. How does electronic cigarette access affect adolescent smoking? *J. Health Econ.* **44**, 300–308 (2015).
194. Friedman, A. S. A difference-in-differences analysis of youth smoking and a ban on sales of flavored tobacco products in San Francisco, California. *JAMA Pediatr.* **175**, 863–865 (2021).
195. Friedman, A. S., Buckell, J. & Sindelar, J. L. Tobacco-21 laws and young adult smoking: quasi-experimental evidence. *Addiction* **114**, 1816–1823 (2019).
196. Friedman, A. S. & Pesko, M. F. Young adult responses to taxes on cigarettes and electronic nicotine delivery systems. *Addiction* **117**, 3121–3128 (2022).
197. Gagné, L. The 2005 British Columbia smoking cessation mass media campaign and short-term changes in smoking. *J. Public Health Manage. Pract.* **13**, 296–306 (2007).
198. Gjika, A., Zhllima, E., Rama, K. & Imami, D. Analysis of tobacco price elasticity in Albania using household level data. *Int. J. Environ. Res. Public Health* **17**, 432 (2020).
199. Glantz, S. A. Changes in cigarette consumption, prices, and tobacco industry revenues associated with California's Proposition 99. *Tob. Control* **2**, 311–314 (1993).
200. Goel, R. K. & Nelson, M. A. Tobacco policy and tobacco use: differences across tobacco types, gender and age. *Appl. Econ.* **37**, 765–771 (2005).
201. Goel, R. K. & Nelson, M. A. Cigarette demand and effectiveness of U.S. smoking control policies: state-level evidence for more than half a century. *Empir. Econ.* **42**, 1079–1095 (2012).
202. Gonzalez-Rozada, M. & Montamat, G. How raising tobacco prices affects the decision to start and quit smoking: evidence from Argentina. *Int. J. Environ. Res. Public Health* **16**, 3622 (2019).
203. Goodchild, M. & Zheng, R. Early assessment of China's 2015 tobacco tax increase. *Bull. World Health Organ.* **96**, 506–512 (2018).
204. Gravely, S. et al. An examination of the effectiveness of health warning labels on smokeless tobacco products in four states in India: findings from the TCP India cohort survey. *BMC Public Health* **16**, 1246 (2016).
205. Gravely, S. et al. Responses to potential nicotine vaping product flavor restrictions among regular vapers using non-tobacco flavors: findings from the 2020 ITC Smoking and Vaping Survey in Canada, England and the United States. *Addict. Behav.* **125**, 107152 (2022).

206. Grube, J. W., Lipperman-Kreda, S., Garcia-Ramirez, G., Paschall, M. J. & Abadi, M. H. California's Tobacco 21 minimum sales age law and adolescents' tobacco and nicotine use: differential associations among racial and ethnic groups. *Tob. Control* **31**, e126–e133 (2022).
207. Gruder, C. L., Warnecke, R. B., Jason, L. A., Flay, B. R. & Peterson, P. A televised, self-help, cigarette smoking cessation intervention. *Addict. Behav.* **15**, 505–516 (1990).
208. Guignard, R., Gallopel-Morvan, K., Mons, U., Hummel, K. & Nguyen-Thanh, V. Impact of a negative emotional antitobacco mass media campaign on French smokers: a longitudinal study. *Tob. Control* **27**, 670–676 (2018).
209. Gunadi, C. et al. Tobacco price and use following California Proposition 56 tobacco tax increase. *PLoS ONE* **16**, e0257553 (2021).
210. Guydish, J. et al. Do cigarette graphic warnings encourage smokers to attend a smoking cessation programme: a quasi-experimental study. *Tob. Control* **27**, 43–49 (2018).
211. Guydish, J. et al. Smoking-related outcomes and associations with tobacco-free policy in addiction treatment, 2015–2016. *Drug Alcohol Depend.* **179**, 355–361 (2017).
212. Hafstad, A. & Aarø, L. E. Activating interpersonal influence through provocative appeals: evaluation of a mass media-based antismoking campaign targeting adolescents. *Health Commun.* **9**, 253–272 (1997).
213. Hafstad, A. et al. Provocative appeals in anti-smoking mass media campaigns targeting adolescents—the accumulated effect of multiple exposures. *Health Educ. Res.* **12**, 227–236 (1997).
214. Hafstad, A., Stray-Pedersen, B. & Langmark, F. Use of provocative emotional appeals in a mass media campaign designed to prevent smoking among adolescents. *Eur. J. Public Health* **7**, 122–127 (1997).
215. Hahn, E. J. et al. Smoke-free laws and adult smoking prevalence. *Prev. Med.* **47**, 206–209 (2008).
216. Hahn, E. J., Rayens, M. K., Langley, R. E., Adkins, S. M. & Dignan, M. Do smoke-free laws in rural, distressed counties encourage cessation? *Policy Polit. Nurs. Pract.* **11**, 302–308 (2010).
217. Hallingberg, B. et al. Do stronger school smoking policies make a difference? Analysis of the Health Behaviour in School-Aged Children survey. *Eur. J. Public Health* **26**, 964–968 (2016).
218. Hallit, S. et al. The impact of textual and pictorial warnings on tumbac (waterpipe tobacco) boxes on the motivation and intention to quit waterpipe smoking in Lebanon: a cross-sectional study. *Environ. Sci. Pollut. Res. Int.* **26**, 36647–36657 (2019).
219. Hamilton, V. H., Levinton, C., St-Pierre, Y. & Grimard, F. The effect of tobacco tax cuts on cigarette smoking in Canada. *Can. Med. Assoc. J.* **156**, 187–191 (1997).
220. Hammond, D., Fong, G. T., McDonald, P. W., Cameron, R. & Brown, K. S. Impact of the graphic Canadian warning labels on adult smoking behaviour. *Tob. Control* **12**, 391–395 (2003).
221. Han, J. O. et al. Association of cigarette prices with the prevalence of smoking in Korean university students: analysis of effects of the tobacco control policy. *Asian Pac. J. Cancer Prev.* **16**, 5531–5536 (2015).
222. Hanewinkel, R. & Isensee, B. Five in a row—reactions of smokers to tobacco tax increases: population-based cross-sectional studies in Germany 2001–2006. *Tob. Control* **16**, 34–37 (2007).
223. Hansen, B. C., Sabia, J. J. & Rees, D. I. Have cigarette taxes lost their bite? New estimates of the relationship between cigarette taxes and youth smoking. *Am. J. Health Econ.* **3**, 60–75 (2017).
224. Havard, A. et al. Tobacco policy reform and population-wide antismoking activities in Australia: the impact on smoking during pregnancy. *Tob. Control* **27**, 552–559 (2018).
225. Hawkins, S. S., Bach, N. & Baum, C. F. Impact of tobacco control policies on adolescent smoking. *J. Adolesc. Health* **58**, 679–685 (2016).
226. Hawkins, S. S., Bach, N. & Baum, C. F. Impact of tobacco control policies on adolescent smokeless tobacco and cigar use: a difference-in-differences approach. *BMC Public Health* **18**, 154 (2018).
227. Hawkins, S. S., Chandra, A. & Berkman, L. The impact of tobacco control policies on disparities in children's secondhand smoke exposure: a comparison of methods. *Matern. Child Health J.* **16**, S70–S77 (2012).
228. Hawkins, S. S., Kruzik, C., O'Brien, M. & Levine Coley, R. Flavoured tobacco product restrictions in Massachusetts associated with reductions in adolescent cigarette and e-cigarette use. *Tob. Control* **31**, 576–579 (2022).
229. He, Y., Shang, C., Huang, J., Cheng, K. W. & Chaloupka, F. J. Global evidence on the effect of point-of-sale display bans on smoking prevalence. *Tob. Control* **27**, e98–e104 (2018).
230. Heloma, A. & Jaakkola, M. S. Four-year follow-up of smoke exposure, attitudes and smoking behaviour following enactment of Finland's national smoke-free work-place law. *Addiction* **98**, 1111–1117 (2003).
231. Hersey, J. C. et al. How state counter-industry campaigns help prime perceptions of tobacco industry practices to promote reductions in youth smoking. *Tob. Control* **14**, 377–383 (2005).
232. Heydari, G. R., Ramezankhani, A. & Talischi, F. The impacts of cigarette packaging pictorial warning labels on smokers in the city of Tehran. *Tanaffos* **10**, 40–47 (2011).
233. Higashi, H. et al. Cost effectiveness of tobacco control policies in Vietnam: the case of population-level interventions. *Appl. Health Econ. Health Policy* **9**, 183–196 (2011).
234. Hiscock, R., Augustin, N. H., Branston, J. R. & Gilmore, A. B. Longitudinal evaluation of the impact of standardised packaging and minimum excise tax on tobacco sales and industry revenue in the UK. *Tob. Control* **30**, 515–522 (2021).
235. Hnin, T. T., Shein, N. N. N. & Aye, S. K. K. Awareness and perceptions on health warning labels on cigarette packs among smokers: a cross-sectional study. *BioMed. Res. Int.* **2020**, 9462903 (2020).
236. Hu, T.-w., Keeler, T. E., Sung, H.-y. & Barnett, P. The impact of California anti-smoking legislation on cigarette sales, consumption, and prices. *Tob. Control* **4**, S34–S38 (1995).
237. Hu, T.-w., Sung, H.-y. & Keeler, T. E. *Tobacco taxes and the anti-smoking media campaign: the California experience*. Economics Working Papers. 94–225 (University of California at Berkeley, 1994).
238. Hu, T. W., Sung, H. Y. & Keeler, T. E. Reducing cigarette consumption in California: tobacco taxes vs an anti-smoking media campaign. *Am. J. Public Health* **85**, 1218–1222 (1995).
239. Huang, J., Chaloupka, F. J. & Fong, G. T. Cigarette graphic warning labels and smoking prevalence in Canada: a critical examination and reformulation of the FDA regulatory impact analysis. *Tob. Control* **23**, i7–i12 (2014).
240. Huang, L. L. et al. The U.S. national Tips from Former Smokers antismoking campaign: promoting awareness of smoking-related risks, cessation resources, and cessation behaviors. *Health Educ. Behav.* **42**, 480–486 (2015).
241. Huang, S. L., Lin, I. F., Chen, C. Y. & Tsai, T. I. Impact of tobacco control policies on adolescent smoking: findings from the Global Youth Tobacco Survey in Taiwan. *Addiction* **108**, 1829–1835 (2013).
242. Hublet, A. et al. Association between tobacco control policies and smoking behaviour among adolescents in 29 European countries. *Addiction* **104**, 1918–1926 (2009).
243. Huf, S. W., Volpp, K. G., Asch, D. A., Bair, E. & Venkataramani, A. Association of Medicaid healthy behavior incentive programs with smoking cessation, weight loss, and annual preventive health visits. *JAMA Netw. Open* **1**, e186185 (2018).
244. Hyland, A. et al. State and community tobacco-control programs and smoking-cessation rates among adult smokers: what can we learn from the COMMIT intervention cohort? *Am. J. Health Promot.* **20**, 272–281 (2006).

245. Hyland, A., Wakefield, M., Higbee, C., Szczypka, G. & Cummings, K. M. Anti-tobacco television advertising and indicators of smoking cessation in adults: a cohort study. *Health Educ. Res.* **21**, 296–302 (2006).
246. Ibarra-Salazar, J., Romero-Rojas, J. C. & Ayala-Gaytán, E. The duration effect of pictorial health warnings on tobacco consumption in Mexico. *Glob. Public Health* **16**, 1656–1674 (2021).
247. Ickes, M. J., Wiggins, A. T., Rayens, M. K. & Hahn, E. J. Student tobacco use behaviors on college campuses by strength of tobacco campus policies. *Am. J. Health Promot.* **34**, 747–753 (2020).
248. Immurana, M., Boachie, M. K. & Iddrisu, A. A. The effects of tobacco taxation and pricing on the prevalence of smoking in Africa. *Glob. Health Res. Policy* **6**, 14 (2021).
249. Jackson, S. E., Beard, E., West, R. & Brown, J. Evaluation of the London Smoking Cessation Transformation Programme: a time-series analysis. *Addiction* **116**, 1558–1568 (2021).
250. Jackson, S. E., Shahab, L. & Brown, J. Examining the influence of tobacco control mass media campaign expenditure on the association between motivation to stop smoking and quit attempts: a prospective study in England. *Addict. Behav.* **144**, 107744 (2023).
251. Jankowski, M. et al. Self-reported secondhand smoke exposure following the adoption of a national smoke-free policy in Poland: analysis of serial, cross-sectional, representative surveys, 2009–2019. *BMJ Open* **10**, e039918 (2020).
252. Jayawardhana, J., Bolton, H. E. & Gaughan, M. The association between school tobacco control policies and youth smoking behavior. *Int. J. Behav. Med.* **26**, 658–664 (2019).
253. Jenkins, C. N. et al. The effectiveness of a media-led intervention to reduce smoking among Vietnamese-American men. *Am. J. Public Health* **87**, 1031–1034 (1997).
254. Jensen, J. K., Ko, H., Kim, J., Delnevo, C. D. & Azagba, S. The impact of cigar pack size and pricing policies on youth and adult cigar use in the US. *Drug Alcohol Depend.* **248**, 109897 (2023).
255. Jiang, N., Gonzalez, M., Ling, P. M. & Glantz, S. A. Relationship of smokefree laws and alcohol use with light and intermittent smoking and quit attempts among US adults and alcohol users. *PLoS ONE* **10**, e0137023 (2015).
256. Jones, A. M., Laporte, A., Rice, N. & Zucchelli, E. Do public smoking bans have an impact on active smoking? Evidence from the UK. *Health Econ.* **24**, 175–192 (2015).
257. Joo, H. J., Joo, J. H., Kim, S. H., Park, E. C. & Jang, S. I. Association between graphic health warning labels on cigarette packs and smoking cessation attempts in Korean adolescent smokers: a cross-sectional study. *Front. Public Health* **10**, 789707 (2022).
258. Callison, K. & Kaestner, R. Do higher tobacco taxes reduce adult smoking? New evidence of the effect of recent cigarette tax increases on adult smoking. *Econ. Inq.* **52**, 155–172 (2014).
259. Kalousova, L. et al. Cigarette taxes, prices, and disparities in current smoking in the United States. *SSM Popul. Health* **12**, 100686 (2020).
260. Kamiński, M., Nowak, J. K., Kręgielska-Narożna, M. & Bogdański, P. Effect of the introduction of pictorial cigarette pack warnings in Poland: a retrospective analysis of the market sales data of a large convenience store franchise. *Pol. Arch. Intern. Med.* **131**, 90–92 (2021).
261. Kandra, K. L. et al. The evaluation of North Carolina's state-sponsored youth tobacco prevention media campaign. *Health Educ. Res.* **28**, 1–14 (2013).
262. Karinagannanavar, A., Raghavendra, B., Hemagiri, K. & Goud, T. G. Awareness about pictorial warnings on tobacco products and its impact on tobacco consumers in Bellary, India. *Asian Pac. J. Cancer Prev.* **12**, 2485–2489 (2011).
263. Katchmar, A., Gunawan, A. & Siegel, M. Effect of Massachusetts House Bill No. 4196 on electronic cigarette use: a mixed-methods study. *Harm Reduct. J.* **18**, 50 (2021).
264. Keeler, C. et al. Effects of cigarette prices on intention to quit, quit attempts, and successful cessation among African American smokers. *Nicotine Tob. Res.* **22**, 522–531 (2020).
265. Keeler, C. et al. The association of California's Proposition 56 tobacco tax increase with smoking behavior across racial and ethnic groups and by income. *Nicotine Tob. Res.* **23**, 2091–2101 (2021).
266. Kelder, S. H. et al. A middle school program to prevent e-cigarette use: a pilot study of 'CATCH My Breath'. *Public Health Rep.* **135**, 220–229 (2020).
267. Kengganpanich, M., Termsirikulchai, L. & Benjakul, S. The impact of cigarette tax increase on smoking behavior of daily smokers. *J. Med. Assoc. Thail.* **92**, S46–S53 (2009).
268. Kim, H. & Clark, P. I. Cigarette smoking transition in females of low socioeconomic status: impact of state, school, and individual factors. *J. Epidemiol. Community Health* **60**, 13–19 (2006).
269. Kim, I. & Khang, Y. H. Differential changes in quitting smoking by daily cigarette consumption and intention to quit after the introduction of a tobacco tax increase and pictorial cigarette pack warnings in Korea, 2013–2017. *Drug Alcohol Depend.* **213**, 108085 (2020).
270. Kim, S. & Cho, S. I. Smoking-related behaviour changes among Korean men after the 2015 tobacco price increase: assessing the implications for the tobacco endgame using a reconstructed retrospective cohort study. *BMJ Open* **12**, e051712 (2022).
271. Kim, S. et al. Effects of municipal smoke-free ordinances on secondhand smoke exposure in the Republic of Korea. *Front. Public Health* **11**, 1062753 (2023).
272. King, J. L., Reboussin, B. A., Cornacchione Ross, J. & Sutfin, E. L. Waterpipe tobacco package warning exposure's impact on risk perceptions and use among young adults in the USA: a longitudinal analysis of the Population Assessment of Tobacco and Health Study. *Tob. Control* **28**, e16–e23 (2019).
273. Kingsley, M. et al. Short-term impact of a flavored tobacco restriction: changes in youth tobacco use in a Massachusetts community. *Am. J. Prev. Med.* **57**, 741–748 (2019).
274. Kingsley, M. et al. Longer-term impact of the flavored tobacco restriction in two Massachusetts communities: a mixed-methods study. *Nicotine Tob. Res.* **23**, 1928–1935 (2021).
275. Korhonen, T., McAlister, A., Laaksonen, M., Laatikainen, T. & Puska, P. International Quit and Win 1996: standardized evaluation in selected campaign countries. *Prev. Med.* **31**, 742–751 (2000).
276. Korhonen, T. et al. Quit and Win campaigns as a long-term anti-smoking intervention in North Karelia and other parts of Finland. *Tob. Control* **8**, 175–181 (1999).
277. Korhonen, T., Uutela, A., Korhonen, H. J. & Puska, P. Impact of mass media and interpersonal health communication on smoking cessation attempts: a study in North Karelia, 1989–1996. *J. Health Commun.* **3**, 105–118 (1998).
278. Krasovsky, K. Sharp changes in tobacco products affordability and the dynamics of smoking prevalence in various social and income groups in Ukraine in 2008–2012. *Tob. Induc. Dis.* **11**, 21 (2013).
279. Kuipers, M. A. et al. Impact on smoking of England's 2012 partial tobacco point of sale display ban: a repeated cross-sectional national study. *Tob. Control* **26**, 141–148 (2017).
280. Kuipers, M. A. G., Beard, E., West, R. & Brown, J. Associations between tobacco control mass media campaign expenditure and smoking prevalence and quitting in England: a time series analysis. *Tob. Control* **27**, 455–462 (2018).
281. Kuipers, M. A. G., West, R., Beard, E. V. & Brown, J. Impact of the 'Stoptober' smoking cessation campaign in England from 2012 to 2017: a quasiexperimental repeat cross-sectional study. *Nicotine Tob. Res.* **22**, 1453–1459 (2020).

282. Kulhanek, A., Lukavska, K., Svancarova, I., Fidesova, H. & Gabrhelik, R. Changes in tobacco use patterns and motivation to quit related to the new smoke-free legislation in the Czech Republic. *J. Public Health (Oxf.)* **43**, 348–354 (2021).
283. Kumar, S. et al. Knowledge and awareness of oral cancer and impact of pictorial warnings on the willingness to quit tobacco in young tobacco consumers in India. *Int. J. Adolesc. Med. Health* **33**, (2018).
284. Kwon, D. S. et al. Positive effects of the national cigarette price increase policy on smoking cessation in South Korea. *Tuberc. Respir. Dis. (Seoul)* **83**, 71–80 (2020).
285. Langley, T. et al. The freeze on mass media campaigns in England: a natural experiment of the impact of tobacco control campaigns on quitting behaviour. *Addiction* **109**, 995–1002 (2014).
286. Laugesen, M. & Swinburn, B. New Zealand's tobacco control programme 1985–1998. *Tob. Control* **9**, 155–162 (2000).
287. Layoun, N. et al. Motivation to quit smoking and acceptability of shocking warnings on cigarette packages in Lebanon. *Patient Prefer. Adherence* **11**, 331–342 (2017).
288. Leas, E. C., Myers, M. G., Strong, D. R., Hofstetter, C. R. & Al-Delaimy, W. K. Recall of anti-tobacco advertisements and effects on quitting behavior: results from the California smokers cohort. *Am. J. Public Health* **105**, e90–e97 (2015).
289. Leavens, E. L. S. et al. Electronic cigarette and combustible cigarette use following a campus-wide ban: prevalence of use and harm perceptions. *J. Am. Coll. Health* **68**, 332–335 (2020).
290. Lee, B. & Seo, D. C. Effects of an 80% cigarette price increase on quit attempts, successful quitting and smoking intensity among Korean adult smokers: results from nationally representative longitudinal panel data. *Tob. Control* **30**, 336–343 (2021).
291. Lee, J. M. Effect of a large increase in cigarette tax on cigarette consumption: an empirical analysis of cross-sectional survey data. *Public Health* **122**, 1061–1067 (2008).
292. Lee, J. M., Liao, D. S., Ye, C. Y. & Liao, W. Z. Effect of cigarette tax increase on cigarette consumption in Taiwan. *Tob. Control* **14**, i71–i75 (2005).
293. Levy, D. T., Mumford, E. A. & Compton, C. Tobacco control policies and smoking in a population of low education women, 1992–2002. *J. Epidemiol. Community Health* **60**, 20–26 (2006).
294. Levy, D. T., Mumford, E. A. & Gerlowski, D. A. Examining trends in quantity smoked. *Nicotine Tob. Res.* **9**, 1287–1296 (2007).
295. Levy, D. T., Romano, E. & Mumford, E. The relationship of smoking cessation to sociodemographic characteristics, smoking intensity, and tobacco control policies. *Nicotine Tob. Res.* **7**, 387–396 (2005).
296. Lewis, S. et al. The effectiveness of tobacco control television advertisements in increasing the prevalence of smoke-free homes. *BMC Public Health* **15**, 869 (2015).
297. Lewit, E. M., Hyland, A., Kerrebrock, N. & Cummings, K. M. Price, public policy, and smoking in young people. *Tob. Control* **6**, S17–S24 (1997).
298. Li, J., Newcombe, R., Guiney, H. & Walton, D. Impact on smoking behavior of the New Zealand annual increase in tobacco tax: data for the fifth and sixth year of increases. *Nicotine Tob. Res.* **19**, 1491–1498 (2017).
299. Li, L. et al. Reported exposures to anti-smoking messages and their impact on Chinese smoker's subsequent quit attempts. *Int. J. Behav. Med.* **21**, 667–676 (2014).
300. Lightwood, J. & Glantz, S. Effect of the Arizona tobacco control program on cigarette consumption and healthcare expenditures. *Soc. Sci. Med.* **72**, 166–172 (2011).
301. Longo, D. R. et al. Hospital smoking bans and employee smoking behavior: results of a national survey. *JAMA* **275**, 1252–1257 (1996).
302. Longo, D. R., Johnson, J. C., Kruse, R. L., Brownson, R. C. & Hewett, J. E. A prospective investigation of the impact of smoking bans on tobacco cessation and relapse. *Tob. Control* **10**, 267–272 (2001).
303. López-Nicolás, A., Badillo-Amador, L. & Cobacho-Tornel, M. B. Will the European Union's new tobacco tax legislation lead to reductions in smoking prevalence? Evidence from a quasi-experiment in Spain. *Nicotine Tob. Res.* **15**, 1963–1970 (2013).
304. MacFarlane, K., Paynter, J., Arroll, B. & Youdan, B. Tax as a motivating factor to make a quit attempt from smoking: a study before and after the April 2010 tax increase. *J. Prim. Health Care* **3**, 283–288 (2011).
305. Macinko, J. & Silver, D. Impact of New York City's 2014 increased minimum legal purchase age on youth tobacco use. *Am. J. Public Health* **108**, 669–675 (2018).
306. Mader, E. M., Lapin, B., Cameron, B. J., Carr, T. A. & Morley, C. P. Update on performance in tobacco control: a longitudinal analysis of the impact of tobacco control policy and the US adult smoking rate, 2011–2013. *J. Public Health Manage. Pract.* **22**, E29–E35 (2016).
307. Manivong, P., Harper, S. & Strumpf, E. The contribution of excise cigarette taxes on the decline in youth smoking in Canada during the time of the Federal Tobacco Control Strategy (2002–2012). *Can. J. Public Health* **108**, e117–e123 (2017).
308. Manley, M. W. et al. Impact of the American Stop Smoking Intervention Study on cigarette consumption. *Tob. Control* **6**, S12–S16 (1997).
309. Mann, N. et al. Comparing the New York State Smokers' quitline reach, services offered, and quit outcomes to 44 other state quitlines, 2010 to 2015. *Am. J. Health Promot.* **32**, 1264–1272 (2018).
310. Mannocci, A. et al. The impact of pictorial health warnings on tobacco products in smokers behaviours and knowledge: the first quasi-experimental field trial after the implementation of the tobacco law in Italy. *Ann. Ist. Super. Sanita* **55**, 186–194 (2019).
311. Marti, J. The impact of tobacco control expenditures on smoking initiation and cessation. *Health Econ.* **23**, 1397–1410 (2014).
312. Matsubayashi, K., Tabuchi, T. & Iso, H. Tobacco price increase and successful smoking cessation for two or more years in Japan. *Nicotine Tob. Res.* **23**, 716–723 (2021).
313. Matsuyama, Y. & Tabuchi, T. Stepwise tobacco price increase and smoking behavioral changes in Japan: the Japan 'Society and New Tobacco' internet survey 2017–2021 longitudinal study. *Nicotine Tob. Res.* **25**, 657–664 (2023).
314. Mayerl, H., Stolz, E. & Freidl, W. Responses to textual and pictorial cigarette pack health warnings: findings from an exploratory cross-sectional survey study in Austria. *BMC Public Health* **18**, 442 (2018).
315. Mayne, S. L. et al. Associations of smoke-free policies in restaurants, bars, and workplaces with blood pressure changes in the CARDIA study. *J. Am. Heart Assoc.* **7**, e009829 (2018).
316. McAfee, T., Davis, K. C., Alexander, R. L. Jr., Pechacek, T. F. & Bunnell, R. Effect of the first federally funded US antismoking national media campaign. *Lancet* **382**, 2003–2011 (2013).
317. McLellan, D. L., Hodgkin, D., Fagan, P., Reif, S. & Horgan, C. M. Unintended consequences of cigarette price changes for alcohol drinking behaviors across age groups: evidence from pooled cross sections. *Subst. Abuse Treat. Prev. Policy* **7**, 28 (2012).
318. McMullen, K. M., Brownson, R. C., Luke, D. & Chriqui, J. Strength of clean indoor air laws and smoking related outcomes in the USA. *Tob. Control* **14**, 43–48 (2005).
319. McVey, D. & Stapleton, J. Can anti-smoking television advertising affect smoking behaviour? Controlled trial of the Health Education Authority for England's anti-smoking TV campaign. *Tob. Control* **9**, 273–282 (2000).
320. Mead, E. L. et al. Association between Florida's smoke-free policy and acute myocardial infarction by race: a time series analysis, 2000–2013. *Prev. Med.* **92**, 169–175 (2016).

321. Meeyai, A., Yunibhand, J., Punkrajang, P. & Pitayarangsarit, S. An evaluation of usage patterns, effectiveness and cost of the national smoking cessation quitline in Thailand. *Tob. Control* **24**, 481–488 (2015).
322. Melard, N. et al. School tobacco policies and adolescent smoking in six European cities in 2013 and 2016: a school-level longitudinal study. *Prev. Med.* **138**, 106142 (2020).
323. Meshack, A. F. et al. Texas tobacco prevention pilot initiative: processes and effects. *Health Educ. Res.* **19**, 657–668 (2004).
324. Middlestadt, S. E., Macy, J. T., Seo, D. C., Jay, S. J. & Kolbe, L. J. The combined effect of behavioral intention and exposure to a smoke-free air law on taking measures to quit smoking. *Health Promot. Pract.* **13**, 553–558 (2012).
325. Milicic, S., DeCicca, P., Pierard, E. & Leatherdale, S. T. An evaluation of school-based e-cigarette control policies' impact on the use of vaping products. *Tob. Induc. Dis.* **16**, 35 (2018).
326. Miller, C. L., Hill, D. J., Quester, P. G. & Hiller, J. E. Response of mass media, tobacco industry and smokers to the introduction of graphic cigarette pack warnings in Australia. *Eur. J. Public Health* **19**, 644–649 (2009).
327. Miller, C. L., Wakefield, M. & Roberts, L. Uptake and effectiveness of the Australian telephone Quitline service in the context of a mass media campaign. *Tob. Control* **12**, ii53–ii58 (2003).
328. Mons, U. et al. Impact of national smoke-free legislation on home smoking bans: findings from the International Tobacco Control Policy Evaluation Project Europe Surveys. *Tob. Control* **22**, e2–e9 (2013).
329. Moodie, C., MacKintosh, A. M. & Hammond, D. Adolescents' response to text-only tobacco health warnings: results from the 2008 UK Youth Tobacco Policy Survey. *Eur. J. Public Health* **20**, 463–469 (2010).
330. Moore, G. et al. Young people's use of e-cigarettes in Wales, England and Scotland before and after introduction of EU Tobacco Products Directive regulations: a mixed-method natural experimental evaluation. *Int. J. Drug Policy* **85**, 102795 (2020).
331. Morean, M. E. et al. High school students' use of JUUL pod flavors before and after JUUL implemented voluntary sales restrictions on certain flavors in 2018. *PLoS ONE* **15**, e0243368 (2020).
332. Mostafa, A. et al. Do pictorial health warnings on waterpipe tobacco packs matter? Recall effectiveness among Egyptian waterpipe smokers & non-smokers. *PLoS ONE* **13**, e0208590 (2018).
333. Mudde, A. N. & De Vries, H. The reach and effectiveness of a national mass media-led smoking cessation campaign in the Netherlands. *Am. J. Public Health* **89**, 346–350 (1999).
334. Mullen, K. A. et al. Nicotine replacement therapy 'gift cards' for hospital inpatients who smoke: a prospective before-and-after controlled pilot evaluation. *Tob. Control* **32**, 546–552 (2023).
335. Murnaghan, D. A., Sihvonen, M., Leatherdale, S. T. & Kekki, P. The relationship between school-based smoking policies and prevention programs on smoking behavior among grade 12 students in Prince Edward Island: a multilevel analysis. *Prev. Med.* **44**, 317–322 (2007).
336. Murray, D. M., Prokhorov, A. V. & Harty, K. C. Effects of a statewide antismoking campaign on mass media messages and smoking beliefs. *Prev. Med.* **23**, 54–60 (1994).
337. Murukutla, N. et al. Results of a national mass media campaign in India to warn against the dangers of smokeless tobacco consumption. *Tob. Control* **21**, 12–17 (2012).
338. Murukutla, N. et al. Cost-effectiveness of a smokeless tobacco control mass media campaign in India. *Tob. Control* **27**, 547–551 (2018).
339. Neff, L. J. et al. Evaluation of the national Tips from Former Smokers campaign: the 2014 longitudinal cohort. *Prev. Chronic Dis.* **13**, E42 (2016).
340. Nesson, E. Heterogeneity in smokers' responses to tobacco control policies. *Health Econ.* **26**, 206–225 (2017).
341. Ngan, T. T., Anh le, V., My, N. T. & Bich, N. N. Changes in Vietnamese male smokers' reactions towards new pictorial cigarette pack warnings over time. *Asian Pac. J. Cancer Prev.* **17**, 71–78 (2016).
342. Ngo, A., Fong, G. T., Craig, L. V. & Shang, C. Analysis of gender differences in the impact of taxation and taxation structure on cigarette consumption in 17 ITC countries. *Int. J. Environ. Res. Public Health* **16**, 1275 (2019).
343. Nguyen, H. V. Association of Canada's provincial bans on electronic cigarette sales to minors with electronic cigarette use among youths. *JAMA Pediatr.* **174**, e193912 (2020).
344. Nicksic, N. E., Do, E. K. & Barnes, A. J. Cannabis legalization, tobacco prevention policies, and cannabis use in E-cigarettes among youth. *Drug Alcohol Depend.* **206**, 107730 (2020).
345. Niederdeppe, J., Fiore, M. C., Baker, T. B. & Smith, S. S. Smoking-cessation media campaigns and their effectiveness among socioeconomically advantaged and disadvantaged populations. *Am. J. Public Health* **98**, 916–924 (2008).
346. Nogueira, S. O. et al. Impact of anti-smoking advertising on health-risk knowledge and quit attempts across 6 European countries from the EUREST-PLUS ITC Europe Survey. *Tob. Induc. Dis.* **16**, A5 (2018).
347. Nonnemaker, J. M. et al. The influence of antismoking television advertisements on cessation by race/ethnicity, socioeconomic status, and mental health status. *PLoS ONE* **9**, e102943 (2014).
348. Nonnemaker, J. M., Dench, D., Homsi, G., MacMonegle, A. & Duke, J. The effect of exposure to media campaign messages on adult cessation. *Addict. Behav.* **49**, 13–19 (2015).
349. Nonnemaker, J. M. & Farrelly, M. C. Smoking initiation among youth: the role of cigarette excise taxes and prices by race/ethnicity and gender. *J. Health Econ.* **30**, 560–567 (2011).
350. Norman, G. J., Ribisl, K. M., Howard-Pitney, B., Howard, K. A. & Unger, J. B. The relationship between home smoking bans and exposure to state tobacco control efforts and smoking behaviors. *Am. J. Health Promot.* **15**, 81–88 (2000).
351. Ohmi, H., Okizaki, T., Meadows, M., Terayama, K. & Mochizuki, Y. An exploratory analysis of the impact of a university campus smoking ban on staff and student smoking habits in Japan. *Tob. Induc. Dis.* **11**, 19 (2013).
352. Osinubi, O. Y. et al. Efficacy of tobacco dependence treatment in the context of a 'smoke-free grounds' worksite policy: a case study. *Am. J. Ind. Med.* **46**, 180–187 (2004).
353. Owen, L. Impact of a telephone helpline for smokers who called during a mass media campaign. *Tob. Control* **9**, 148–154 (2000).
354. Owen, N. & Borland, R. Delayed compensatory cigarette consumption after a workplace smoking ban. *Tob. Control* **6**, 131–135 (1997).
355. Palali, A. & van Ours, J. C. The impact of tobacco control policies on smoking initiation in eleven European countries. *Eur. J. Health Econ.* **20**, 1287–1301 (2019).
356. Parks, M. J., Kingsbury, J. H., Boyle, R. G. & Choi, K. Behavioral change in response to a statewide tobacco tax increase and differences across socioeconomic status. *Addict. Behav.* **73**, 209–215 (2017).
357. Parks, M. J., Slater, J. S., Rothman, A. J. & Nelson, C. L. Interpersonal communication and smoking cessation in the context of an incentive-based program: survey evidence from a telehealth intervention in a low-income population. *J. Health Commun.* **21**, 125–133 (2016).
358. Partos, T. R., Borland, R., Yong, H. H., Thrasher, J. & Hammond, D. Cigarette packet warning labels can prevent relapse: findings from the International Tobacco Control 4-Country policy evaluation cohort study. *Tob. Control* **22**, e43–e50 (2013).

359. Pesko, M. F. Effects of e-cigarette minimum legal sales ages on youth tobacco use in the United States. *J. Risk Uncertain.* **66**, 261–277 (2023).
360. Pesko, M. F., Courtemanche, C. J. & Maclean, J. C. The effects of traditional cigarette and e-cigarette tax rates on adult tobacco product use. *J. Risk Uncertain.* **60**, 229–258 (2020).
361. Pesko, M. F. & Currie, J. M. E-cigarette minimum legal sale age laws and traditional cigarette use among rural pregnant teenagers. *J. Health Econ.* **66**, 71–90 (2019).
362. Pesko, M. F. & Warman, C. Re-exploring the early relationship between teenage cigarette and e-cigarette use using price and tax changes. *Health Econ.* **31**, 137–153 (2022).
363. Peterson, D. E., Zeger, S. L., Remington, P. L. & Anderson, H. A. The effect of state cigarette tax increases on cigarette sales, 1955 to 1988. *Am. J. Public Health* **82**, 94–96 (1992).
364. Pierce, J. P. et al. Reducing tobacco consumption in California: Proposition 99 seems to work. *JAMA* **265**, 1257–1258 (1991).
365. Pierce, J. P. et al. Evaluation of the Sydney 'Quit. For Life' anti-smoking campaign. Part 1. Achievement of intermediate goals. *Med. J. Aust.* **144**, 341–344 (1986).
366. Pierce, J. P. et al. Has the California tobacco control program reduced smoking? *JAMA* **280**, 893–899 (1998).
367. Pierce, J. P., Macaskill, P. & Hill, D. Long-term effectiveness of mass media led antismoking campaigns in Australia. *Am. J. Public Health* **80**, 565–569 (1990).
368. Pinilla, J., López-Valcárcel, B. G. & Negrín, M. A. Impact of the Spanish smoke-free laws on cigarette sales, 2000–2015: partial bans on smoking in public places failed and only a total tobacco ban worked. *Health Econ. Policy Law* **14**, 536–552 (2019).
369. Pizacani, B. A. et al. Smoking patterns in Oregon youth: effects of funding and defunding of a comprehensive state tobacco control program. *J. Adolesc. Health* **44**, 229–236 (2009).
370. Platt, S., Tannahill, A., Watson, J. & Fraser, E. Effectiveness of antismoking telephone helpline: follow up survey. *Br. Med. J.* **314**, 1371–1375 (1997).
371. Popham, W. J. et al. Do anti-smoking media campaigns help smokers quit? *Public Health Rep.* **108**, 510–513 (1993).
372. Popham, W. J. et al. Effectiveness of the California 1990–1991 tobacco education media campaign. *Am. J. Prev. Med.* **10**, 319–326 (1994).
373. Puljevic, C. et al. 'Money up in smoke': the financial benefits of smoking cessation may be more motivating to people who are homeless than potential health gains. *Drug Alcohol Rev.* **40**, 1308–1314 (2021).
374. Rana, K., Goel, S. & Prinja, S. Perceived effect of increased pricing on smoked tobacco products quit rates: a cross-sectional study in a block of Haryana. *Indian J. Public Health* **65**, 28–33 (2021).
375. Ratcliffe, J., Cairns, J. & Platt, S. Cost effectiveness of a mass media-led anti-smoking campaign in Scotland. *Tob. Control* **6**, 104–110 (1997).
376. Rath, J. et al. Effects of branded health messages on e-cigarette attitudes, intentions, and behaviors: a longitudinal study among youth and young adults. *BMC Public Health* **21**, 1144 (2021).
377. Reddy, P. et al. A decade of tobacco control: the South African case of politics, health policy, health promotion and behaviour change. *South Afr. Med. J.* **103**, 835–840 (2013).
378. Ringel, J. S. & Evans, W. N. Cigarette taxes and smoking during pregnancy. *Am. J. Public Health* **91**, 1851–1856 (2001).
379. Rivard, C., Brown, A., Kasza, K., Bansal-Travers, M. & Hyland, A. Home tobacco use policies and exposure to secondhand tobacco smoke: findings from waves 1 through 4 of the Population Assessment of Tobacco and Health (PATH) study. *Int. J. Environ. Res. Public Health* **18**, 9719 (2021).
380. Rogers, T. et al. Compliance with a sales policy on flavored non-cigarette tobacco products. *Tob. Regul. Sci.* **3**, S84–S93 (2017).
381. Rohrbach, L. A. et al. Independent evaluation of the California Tobacco Control Program: relationships between program exposure and outcomes, 1996–1998. *Am. J. Public Health* **92**, 975–983 (2002).
382. Romano, I. et al. Evaluating the short-term impact of a tobacco-free policy in an inpatient addiction treatment setting. *J. Subst. Abuse Treat.* **107**, 50–59 (2019).
383. Ronda, G. et al. The Dutch Heart Health Community Intervention 'Hartslag Limburg': effects on smoking behaviour. *Eur. J. Public Health* **14**, 191–193 (2004).
384. Ross, H., Stoklosa, M. & Krasovsky, K. Economic and public health impact of 2007–2010 tobacco tax increases in Ukraine. *Tob. Control* **21**, 429–435 (2012).
385. Rossheim, M. E. et al. Cigarette use before and after the 2009 flavored cigarette ban. *J. Adolesc. Health* **67**, 432–437 (2020).
386. Rozema, A. D., Hiemstra, M., Mathijssen, J. J. P., Jansen, M. W. J. & van Oers, H. Impact of an outdoor smoking ban at secondary schools on cigarettes, e-cigarettes and water pipe use among adolescents: an 18-month follow-up. *Int. J. Environ. Res. Public Health* **15**, 205 (2018).
387. Rozema, A. D., Mathijssen, J. J. P., van Kesteren, J. N., van Oers, J. A. M. & Jansen, M. W. J. Results of outdoor smoking bans at secondary schools on adolescents smoking behaviour: a quasi-experimental study. *Eur. J. Public Health* **29**, 765–771 (2019).
388. Rungruanghiranya, S. & Ekpanyaskul, C. Impact of tobacco control campaigns on smoking behaviors in Thai medical schools. *J. Med. Assoc. Thail.* **100**, 339–346 (2017).
389. Ruscitti, L. E. et al. Smoking at the workplaces in Italy after the smoking ban in the Lazio Region. *Med. Lav.* **112**, 44–57 (2021).
390. Saenz-de-Miera, B. et al. Self-reported price of cigarettes, consumption and compensatory behaviours in a cohort of Mexican smokers before and after a cigarette tax increase. *Tob. Control* **19**, 481–487 (2010).
391. Saffer, H., Dench, D., Grossman, M. & Dave, D. E-cigarettes and adult smoking: evidence from Minnesota. *J. Risk Uncertain.* **60**, 207–228 (2020).
392. Salonen, J. T., Puska, P., Kottke, T. E. & Tuomilehto, J. Changes in smoking, serum cholesterol and blood pressure levels during a community-based cardiovascular disease prevention program—the North Karelia Project. *Am. J. Epidemiol.* **114**, 81–94 (1981).
393. Sanders, A. & Slade, G. State cigarette excise tax, secondhand smoke exposure, and periodontitis in US nonsmokers. *Am. J. Public Health* **103**, 740–746 (2013).
394. Schiff, S. et al. E-cigarette and cigarette purchasing among young adults before and after implementation of California's Tobacco 21 policy. *Tob. Control* **30**, 206–211 (2021).
395. Schneider, S. K., Buka, S. L., Dash, K., Winickoff, J. P. & O'Donnell, L. Community reductions in youth smoking after raising the minimum tobacco sales age to 21. *Tob. Control* **25**, 355–359 (2016).
396. Schnohr, C. W. et al. The role of national policies intended to regulate adolescent smoking in explaining the prevalence of daily smoking: a study of adolescents from 27 European countries. *Addiction* **103**, 824–831 (2008).
397. Secker-Walker, R. H., Worden, J. K., Holland, R. R., Flynn, B. S. & Detsky, A. S. A mass media programme to prevent smoking among adolescents: costs and cost effectiveness. *Tob. Control* **6**, 207–212 (1997).
398. Sen, A. & Wirjanto, T. Estimating the impacts of cigarette taxes on youth smoking participation, initiation, and persistence: empirical evidence from Canada. *Health Econ.* **19**, 1264–1280 (2010).

399. Septiono, W., Kuipers, M. A. G., Ng, N. & Kunst, A. E. The impact of local smoke-free policies on smoking behaviour among adults in Indonesia: a quasi-experimental national study. *Addiction* **115**, 2382–2392 (2020).
400. Serrano-Alarcón, M., Kunst, A. E., Bosdriesz, J. R. & Perelman, J. Tobacco control policies and smoking among older adults: a longitudinal analysis of 10 European countries. *Addiction* **114**, 1076–1085 (2019).
401. Shang, C. The effect of smoke-free air law in bars on smoking initiation and relapse among teenagers and young adults. *Int. J. Environ. Res. Public Health* **12**, 504–520 (2015).
402. Shang, C., Chaloupka, F. & Kostova, D. Who quits? An overview of quitters in low- and middle-income countries. *Nicotine Tob. Res.* **16**, S44–S55 (2014).
403. Shang, C., Chaloupka, F. J., Fong, G. T., Gupta, P. C. & Pednekar, M. S. The association between state value-added taxes and tobacco use in India—evidence from GATS and TCP India survey. *Nicotine Tob. Res.* **20**, 1344–1352 (2018).
404. Shang, C., Huang, J., Cheng, K. W., He, Y. & Chaloupka, F. J. The association between warning label requirements and cigarette smoking prevalence by education—findings from the Global Adult Tobacco Survey (GATS). *Int. J. Environ. Res. Public Health* **14**, 98 (2017).
405. Shang, C., Huang, J., Cheng, K. W., Li, Q. & Chaloupka, F. J. Global evidence on the association between POS advertising bans and youth smoking participation. *Int. J. Environ. Res. Public Health* **13**, 306 (2016).
406. Sharbaugh, M. S. et al. Impact of cigarette taxes on smoking prevalence from 2001–2015: a report using the Behavioral and Risk Factor Surveillance Survey (BRFSS). *PLoS ONE* **13**, e0204416 (2018).
407. Sharma, S. K., Jelly, P., Thakur, K. & Gupta, M. Effect of magnification and changes in tobacco pictorial warning on asceticism of tobacco use: an exploratory survey. *J. Fam. Med. Prim. Care* **9**, 6051–6060 (2020).
408. Shavers, V. L. et al. Workplace and home smoking restrictions and racial/ethnic variation in the prevalence and intensity of current cigarette smoking among women by poverty status, TUS-CPS 1998–1999 and 2001–2002. *J. Epidemiol. Community Health* **60**, 34–43 (2006).
409. Sims, M. et al. Effectiveness of tobacco control television advertisements with different types of emotional content on tobacco use in England, 2004–2010. *Tob. Control* **25**, 21–26 (2016).
410. Sims, M. et al. Effectiveness of tobacco control television advertising in changing tobacco use in England: a population-based cross-sectional study. *Addiction* **109**, 986–994 (2014).
411. Singh, V., Sharma, B. B., Saxena, P., Meena, H. & Mangal, D. K. Price and consumption of tobacco. *Lung India* **29**, 212–216 (2012).
412. Sly, D. F., Heald, G. R. & Ray, S. The Florida 'truth' anti-tobacco media evaluation: design, first year results, and implications for planning future state media evaluations. *Tob. Control* **10**, 9–15 (2001).
413. Sly, D. F., Hopkins, R. S., Trapido, E. & Ray, S. Influence of a counteradvertising media campaign on initiation of smoking: the Florida 'truth' campaign. *Am. J. Public Health* **91**, 233–238 (2001).
414. Sly, D. F., Trapido, E. & Ray, S. Evidence of the dose effects of an antitobacco counteradvertising campaign. *Prev. Med.* **35**, 511–518 (2002).
415. Søgaard, A. J. & Fønnebø, V. Self-reported change in health behaviour after a mass media-based health education campaign. *Scand. J. Psychol.* **33**, 125–134 (1992).
416. Song, A. V., Dutra, L. M., Neilands, T. B. & Glantz, S. A. Association of smoke-free laws with lower percentages of new and current smokers among adolescents and young adults: an 11-year longitudinal study. *JAMA Pediatr.* **169**, e152285 (2015).
417. Staff, M. et al. Can non-prosecutory enforcement of public health legislation reduce smoking among high school students? *Aust. N. Z. J. Public Health* **22**, 332–335 (1998).
418. Stehr, M. The effect of cigarette taxes on smoking among men and women. *Health Econ.* **16**, 1333–1343 (2007).
419. Stephens, T., Pederson, L. L., Koval, J. J. & Macnab, J. Comprehensive tobacco control policies and the smoking behaviour of Canadian adults. *Tob. Control* **10**, 317–322 (2001).
420. Stevens, V. L. et al. A prospective cohort study of cigarette prices and smoking cessation in older smokers. *Cancer Epidemiol. Biomark. Prev.* **26**, 1071–1077 (2017).
421. Stillman, F. A. et al. Evaluation of the American Stop Smoking Intervention Study (ASSIST): a report of outcomes. *J. Natl Cancer Inst.* **95**, 1681–1691 (2003).
422. Suliankatchi Abdulkader, R. et al. Trends in tobacco consumption in India 1987–2016: impact of the World Health Organization Framework Convention on Tobacco Control. *Int. J. Public Health* **64**, 841–851 (2019).
423. Szklo, A. S. et al. Do more graphic and aversive cigarette health warning labels affect Brazilian smokers' likelihood of quitting? *Addict. Behav.* **60**, 209–212 (2016).
424. Tabuchi, T., Fujiwara, T. & Shinozaki, T. Tobacco price increase and smoking behaviour changes in various subgroups: a nationwide longitudinal 7-year follow-up study among a middle-aged Japanese population. *Tob. Control* **26**, 69–77 (2017).
425. Tabuchi, T. et al. Complete workplace indoor smoking ban and smoking behavior among male workers and female nonsmoking workers' husbands: a pseudo cohort study of Japanese public workers. *BioMed. Res. Int.* **2014**, 303917 (2014).
426. Tabuchi, T. et al. Tobacco price increase and smoking cessation in Japan, a developed country with affordable tobacco: a national population-based observational study. *J. Epidemiol.* **26**, 14–21 (2016).
427. Tanihara, S. & Momose, Y. Reasons for smoking cessation attempts among Japanese male smokers vary by nicotine dependence level: a cross-sectional study after the 2010 tobacco tax increase. *BMJ Open* **5**, e006658 (2015).
428. Tattan-Birch, H., Jackson, S. E., Ide, C., Bauld, L. & Shahab, L. Evaluation of the impact of a regional educational advertising campaign on harm perceptions of e-cigarettes, prevalence of e-cigarette use, and quit attempts among smokers. *Nicotine Tob. Res.* **22**, 1148–1154 (2020).
429. Tauras, J. Public policy and some-day smoking among adults. *J. Appl. Econ.* **7**, 137–162 (2004).
430. Tauras, J. A. Public policy and smoking cessation among young adults in the United States. *Health Policy* **68**, 321–332 (2004).
431. Tauras, J. A. Can public policy deter smoking escalation among young adults? *J. Policy Anal. Manage.* **24**, 771–784 (2005).
432. Tchicaya, A., Lorentz, N. & Demarest, S. Socioeconomic inequalities in smoking and smoking cessation due to a smoking ban: general population-based cross-sectional study in Luxembourg. *PLoS ONE* **11**, e0153966 (2016).
433. Terry-McElrath, Y. M. et al. Effects of tobacco-related media campaigns on smoking among 20–30-year-old adults: longitudinal data from the USA. *Tob. Control* **22**, 38–45 (2013).
434. Terry-McElrath, Y. M. et al. State anti-tobacco advertising and smoking outcomes by gender and race/ethnicity. *Ethn. Health* **12**, 339–362 (2007).
435. Thomas, D. P., Ferguson, M., Johnston, V. & Brimblecombe, J. Impact and perceptions of tobacco tax increase in remote Australian Aboriginal communities. *Nicotine Tob. Res.* **15**, 1099–1106 (2013).
436. Thomas, D. P., McMahon, E., Wang, Z., Scollo, M. M. & Durkin, S. J. Impact of three annual tobacco tax rises on tobacco sales in remote Australian Aboriginal community stores. *Tob. Control* **30**, e122–e127 (2021).

437. Thorpe, L. E. et al. Evaluation of secondhand smoke exposure in New York City public housing after implementation of the 2018 federal smoke-free housing policy. *JAMA Netw. Open* **3**, e2024385 (2020).
438. Thrasher, J. F. et al. Linking mass media campaigns to pictorial warning labels on cigarette packages: a cross-sectional study to evaluate effects among Mexican smokers. *Tob. Control* **22**, e57–e65 (2013).
439. Thrasher, J. F. et al. The use of cigarette package inserts to supplement pictorial health warnings: an evaluation of the Canadian policy. *Nicotine Tob. Res.* **17**, 870–875 (2015).
440. Thrasher, J. F. et al. Cigarette package inserts can promote efficacy beliefs and sustained smoking cessation attempts: a longitudinal assessment of an innovative policy in Canada. *Prev. Med.* **88**, 59–65 (2016).
441. Tingum, E. N., Mukong, A. K. & Mdege, N. The effects of price and non-price policies on cigarette consumption in South Africa. *Tob. Induc. Dis.* **18**, 62 (2020).
442. Trapl, E. et al. Evaluation of restrictions on tobacco sales to youth younger than 21 years in Cleveland, Ohio, area. *JAMA Netw. Open* **5**, e2222987 (2022).
443. Tripathy, J. P. & Verma, M. Impact of health warning labels on cigarette packs in India: findings from the Global Adult Tobacco Survey 2016–17. *Behav. Med.* **48**, 171–180 (2022).
444. Troelstra, S. A., Harting, J. & Kunst, A. E. Effectiveness of a large, nation-wide smoking abstinence campaign in the Netherlands: a longitudinal study. *Int. J. Environ. Res. Public Health* **16**, 378 (2019).
445. Tseng, T. S. et al. Using a health informatics system to assess effect of a federal cigarette tax increase on readiness to quit among low-income smokers, Louisiana, 2009. *Prev. Chronic Dis.* **11**, E52 (2014).
446. Turk, T. et al. Using a smokeless tobacco control mass media campaign and other synergistic elements to address social inequalities in India. *Cancer Causes Control* **23**, 81–90 (2012).
447. Turk, T., Newton, F., Choudhury, S. & Islam, M. S. Predictors of quitting attempts among tobacco users in Bangladesh after a communication campaign to launch graphic warning labels on packaging. *Health Educ. Behav.* **45**, 879–887 (2018).
448. Tworek, C. et al. State-level tobacco control policies and youth smoking cessation measures. *Health Policy* **97**, 136–144 (2010).
449. Vallone, D. et al. The effect of branding to promote healthy behavior: reducing tobacco use among youth and young adults. *Int. J. Environ. Res. Public Health* **14**, 1517 (2017).
450. Vallone, D. M., Duke, J. C., Cullen, J., McCausland, K. L. & Allen, J. A. Evaluation of EX: a national mass media smoking cessation campaign. *Am. J. Public Health* **101**, 302–309 (2011).
451. Vallone, D. M. et al. The impact of EX: results from a pilot smoking-cessation media campaign. *Am. J. Prev. Med.* **38**, S312–S318 (2010).
452. Vallone, D. M. et al. A national mass media smoking cessation campaign: effects by race/ethnicity and education. *Am. J. Health Promot.* **25**, S38–S50 (2011).
453. van Hasselt, M. et al. The relation between tobacco taxes and youth and young adult smoking: what happened following the 2009 U.S. federal tax increase on cigarettes? *Addict. Behav.* **45**, 104–109 (2015).
454. Van Hurck, M. M., Nuyts, P. A. W., Monshouwer, K., Kunst, A. E. & Kuipers, M. A. G. Impact of removing point-of-sale tobacco displays on smoking behaviour among adolescents in Europe: a quasi-experimental study. *Tob. Control* **28**, 401–408 (2019).
455. van Mourik, D. A. et al. Quasi-experimentally examining the impact of introducing tobacco pictorial health warnings: findings from the International Tobacco Control (ITC) 4C and Netherlands surveys in the Netherlands, Australia, Canada, United Kingdom, and the United States. *Drug Alcohol Depend.* **207**, 107818 (2020).
456. van Reek, J., Knibbe, R. & van Iwaarden, T. Policy relevance of a survey on smoking and drinking behaviour among Dutch school children. *Health Policy* **18**, 261–268 (1991).
457. van Reek, J., Knibbe, R. & van Iwaarden, T. Policy elements as predictors of smoking and drinking behaviour: the Dutch Cohort Study of secondary schoolchildren. *Health Policy* **26**, 5–18 (1993).
458. Vanishree, N. et al. Impact of pictorial warning labels on tobacco products among patients attending outpatient department of a dental college in Bangalore city: a cross-sectional study. *Indian J. Cancer* **54**, 461–466 (2017).
459. Vartiainen, E. The North Karelia Project: cardiovascular disease prevention in Finland. *Glob. Cardiol. Sci. Pract.* **2018**, 13 (2018).
460. Vartiainen, E., Fallonen, U., McAlister, A. L. & Puska, P. Eight-year follow-up results of an adolescent smoking prevention program: the North Karelia Youth Project. *Am. J. Public Health* **80**, 78–79 (1990).
461. Verdonk-Kleinjan, W. M., Candel, M. J., Knibbe, R. A., Willemsen, M. C. & de Vries, H. Effects of a workplace-smoking ban in combination with tax increases on smoking in the Dutch population. *Nicotine Tob. Res.* **13**, 412–418 (2011).
462. Vickerman, K. A., Zhang, L., Malarcher, A., Mowery, P. & Nash, C. Cessation outcomes among quitline callers in three states during a national tobacco education campaign. *Prev. Chronic Dis.* **12**, E110 (2015).
463. Villanti, A. C., Cullen, J., Vallone, D. M. & Stuart, E. A. Use of propensity score matching to evaluate a national smoking cessation media campaign. *Eval. Rev.* **35**, 571–591 (2011).
464. Villanti, A. C., Curry, L. E., Richardson, A., Vallone, D. M. & Holtgrave, D. R. Analysis of media campaign promoting smoking cessation suggests it was cost-effective in prompting quit attempts. *Health Aff. (Millwood)* **31**, 2708–2716 (2012).
465. Villanti, A. C., Pearson, J. L., Cantrell, J., Vallone, D. M. & Rath, J. M. Patterns of combustible tobacco use in U.S. young adults and potential response to graphic cigarette health warning labels. *Addict. Behav.* **42**, 119–125 (2015).
466. Vuolo, M., Kelly, B. C. & Kadowaki, J. Independent and interactive effects of smoking bans and tobacco taxes on a cohort of US young adults. *Am. J. Public Health* **106**, 374–380 (2016).
467. Wakefield, M. et al. Effect of televised, tobacco company-funded smoking prevention advertising on youth smoking-related beliefs, intentions, and behavior. *Am. J. Public Health* **96**, 2154–2160 (2006).
468. Wakefield, M. A. et al. Does tobacco-control mass media campaign exposure prevent relapse among recent quitters? *Nicotine Tob. Res.* **15**, 385–392 (2013).
469. Wakefield, M. A. et al. Impact of tobacco control policies and mass media campaigns on monthly adult smoking prevalence. *Am. J. Public Health* **98**, 1443–1450 (2008).
470. Wakefield, M. A., Spittal, M. J., Yong, H. H., Durkin, S. J. & Borland, R. Effects of mass media campaign exposure intensity and durability on quit attempts in a population-based cohort study. *Health Educ. Res.* **26**, 988–997 (2011).
471. Wamamili, B. M. & Garrow, A. P. Have higher cigarette taxes in the United States discouraged smoking? A review of data from 1999–2013. *Tob. Prev. Cessat.* **3**, 15 (2017).
472. Wang, Q. The relation between cigarette taxes and older adult smoking in Zhejiang and Gansu: what happened following the 2009 Chinese Tax adjustments? *Environ. Health Prev. Med.* **22**, 21 (2017).
473. Wang, R. et al. The estimated effect of graphic warning labels on smoker's intention to quit in Shanghai, China: a cross-sectional study. *BMC Public Health* **21**, 2170 (2021).
474. Wang, Y. et al. Intentions and attempts to quit smoking among sexual minoritized adult smokers after exposure to the Tips from Former Smokers campaign. *JAMA Netw. Open* **5**, e2211060 (2022).

475. Wang, Y. et al. Characteristics of patients seeking outpatient smoking cessation treatment before and after the implementation of a smoke-free law in Valencia (Spain): a cross-sectional study. *BMJ Open* **10**, e035319 (2020).
476. Warnecke, R. B., Langenberg, P., Wong, S. C., Flay, B. R. & Cook, T. D. The second Chicago televised smoking cessation program: a 24-month follow-up. *Am. J. Public Health* **82**, 835–840 (1992).
477. Weintraub, J. M. & Hamilton, W. L. Trends in prevalence of current smoking, Massachusetts and states without tobacco control programmes, 1990 to 1999. *Tob. Control* **11**, ii8–ii13 (2002).
478. Welding, K. The effectiveness of cigarette taxes on older adult smokers: evidence from recent state tax increases https://api.semanticscholar.org/CorpusID:17498524 (2014).
479. White, V., Tan, N., Wakefield, M. & Hill, D. Do adult focused anti-smoking campaigns have an impact on adolescents? The case of the Australian National Tobacco Campaign. *Tob. Control* **12**, ii23–ii29 (2003).
480. White, V. M., Durkin, S. J., Coomber, K. & Wakefield, M. A. What is the role of tobacco control advertising intensity and duration in reducing adolescent smoking prevalence? Findings from 16 years of tobacco control mass media advertising in Australia. *Tob. Control* **24**, 198–204 (2015).
481. White, V. M. et al. What impact have tobacco control policies, cigarette price and tobacco control programme funding had on Australian adolescents' smoking? Findings over a 15-year period. *Addiction* **106**, 1493–1502 (2011).
482. Widianawati, E., Agiwahyuanto, F., Wulan, W. R., Khoironi, A. & Ahsan, A. Cigarette display regulation at point of sales (POS) and its impact on cigarette sales. *Asian Pac. J. Cancer Prev.* **23**, 3431–3435 (2022).
483. Wilhelm, A. K. et al. Local Tobacco 21 policies are associated with lower odds of tobacco use among adolescents. *Nicotine Tob. Res.* **24**, 478–483 (2022).
484. Wilkinson, A. L. et al. Smoking prevalence following tobacco tax increases in Australia between 2001 and 2017: an interrupted time-series analysis. *Lancet Public Health* **4**, e618–e627 (2019).
485. Wilson, N. et al. A new national smokefree law increased calls to a national quitline. *BMC Public Health* **7**, 75 (2007).
486. Worden, J. K. et al. Using mass media to prevent cigarette smoking among adolescent girls. *Health Educ. Q.* **23**, 453–468 (1996).
487. Wu, D. C., Essue, B. M. & Jha, P. Impact of vaping introduction on cigarette smoking in six jurisdictions with varied regulatory approaches to vaping: an interrupted time series analysis. *BMJ Open* **12**, e058324 (2022).
488. Xiao, D., Wang, C., Chen, H. & Hajek, P. Making hospitals in China smoke-free: a prospective study of implementing the new standard. *Nicotine Tob. Res.* **15**, 2076–2080 (2013).
489. Xu, X., Zhang, X., Hu, T. W., Miller, L. S. & Xu, M. Effects of global and domestic tobacco control policies on cigarette consumption per capita: an evaluation using monthly data in China. *BMJ Open* **9**, e025092 (2019).
490. Xu, Y. et al. Environmental secondhand smoke exposure and policy assessment at five venues in Zhejiang Province, China. *Asia Pac. J. Public Health* **26**, 622–630 (2014).
491. Xue, Z. et al. Association between cigarette sales in the USA and FDA's announcement of its intention to prohibit menthol as a characterising flavour in cigarettes. *Tob. Control* **0**, 1–7 (2023).
492. Yang, T., Zhu, Z., Barnett, R., Zhang, W. & Jiang, S. Tobacco advertising, anti-tobacco information exposure, environmental smoking restrictions, and unassisted smoking cessation among Chinese male smokers: a population-based study. *Am. J. Men's Health* **13**, 1557988319856152 (2019).
493. Yang, Y., Lindblom, E. N., Salloum, R. G. & Ward, K. D. The impact of a comprehensive tobacco product flavor ban in San Francisco among young adults. *Addict. Behav. Rep.* **11**, 100273 (2020).
494. Ye, X. et al. Smoking behaviors before and after implementation of a smoke-free legislation in Guangzhou, China. *BMC Public Health* **15**, 982 (2015).
495. Yong, H. H. et al. Does the regulatory environment for e-cigarettes influence the effectiveness of e-cigarettes for smoking cessation? Longitudinal findings from the ITC Four Country Survey. *Nicotine Tob. Res.* **19**, 1268–1276 (2017).
496. Yu, L., Cohen, J. E., Hoe, C., Yang, T. & Wu, D. Male smoking reduction behaviour in response to China's 2015 cigarette tax increase. *Tob. Control* **29**, 405–411 (2020).
497. Yu, S. et al. The effects of antismoking messages from family, school, and mass media on smoking behavior and smoking intention among Chinese adolescents. *J. Health Commun.* **20**, 1255–1263 (2015).
498. Zacher, M. et al. Personal tobacco pack display before and after the introduction of plain packaging with larger pictorial health warnings in Australia: an observational study of outdoor café strips. *Addiction* **109**, 653–662 (2014).
499. Zatonski, M. 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.* **16**, A4 (2018).
500. Zavala-Arciniega, L. et al. Smoking trends in Mexico, 2002–2016: before and after the ratification of the WHO's Framework Convention on Tobacco Control. *Tob. Control* **29**, 687–691 (2020).
501. Zhang, B., Cohen, J., Ferrence, R. & Rehm, J. The impact of tobacco tax cuts on smoking initiation among Canadian young adults. *Am. J. Prev. Med.* **30**, 474–479 (2006).
502. Zhang, L., Vickerman, K., Malarcher, A. & Mowery, P. Intermediate cessation outcomes among quitline callers during a national tobacco education campaign. *Nicotine Tob. Res.* **16**, 1478–1486 (2014).
503. Zucker, D. et al. Florida's 'truth' campaign: a counter-marketing, anti-tobacco media campaign. *J. Public Health Manage. Pract.* **6**, 1–6 (2000).
504. Bader, P., Boisclair, D. & Ferrence, R. Effects of tobacco taxation and pricing on smoking behavior in high risk populations: a knowledge synthesis. *Int. J. Environ. Res. Public Health* **8**, 4118–4139 (2011).
505. Chaloupka, F. J., Powell, L. M. & Warner, K. E. The use of excise taxes to reduce tobacco, alcohol, and sugary beverage consumption. *Annu. Rev. Public Health* **40**, 187–201 (2019).
506. Blecher, E. H. & van Walbeek, C. P. An international analysis of cigarette affordability. *Tob. Control* **13**, 339–346 (2004).
507. Bobak, M., Jha, P., Nguyen, S. & Jarvis, M. in *Tobacco Control in Developing Countries* (eds Jha, P. & Chaloupka, F. J.) 41–61 (Oxford Univ. Press, 2000).
508. Hoffman, S. J. & Tan, C. Overview of systematic reviews on the health-related effects of government tobacco control policies. *BMC Public Health* **15**, 744 (2015).
509. Chollat-Traquet, C. M. & World Health Organization *Evaluating Tobacco Control Activities: Experiences and Guiding Principles* (World Health Organization, 1996).
510. Flay, B. R. et al. The television, school, and family smoking prevention and cessation project. VIII. Student outcomes and mediating variables. *Prev. Med.* **24**, 29–40 (1995).
511. Lemmens, V., Oenema, A., Knut, I. K. & Brug, J. Effectiveness of smoking cessation interventions among adults: a systematic review of reviews. *Eur. J. Cancer Prev.* **17**, 535–544 (2008).
512. Mackay, J. L. & Eriksen, M. P. *The Tobacco Atlas* (World Health Organization, 2002).
513. Crawford, M. A., Balch, G. I. & Mermelstein, R. Responses to tobacco control policies among youth. *Tob. Control* **11**, 14–19 (2002).

514. Blecher, E. The impact of tobacco advertising bans on consumption in developing countries. *J. Health Econ.* **27**, 930–942 (2008).
515. Hammond, D. Health warning messages on tobacco products: a review. *Tob. Control* **20**, 327–337 (2011).
516. Strahan, E. J. et al. Enhancing the effectiveness of tobacco package warning labels: a social psychological perspective. *Tob. Control* **11**, 183–190 (2002).
517. Ranson, M. K., Jha, P., Chaloupka, F. J. & Nguyen, S. N. Global and regional estimates of the effectiveness and cost-effectiveness of price increases and other tobacco control policies. *Nicotine Tob. Res.* **4**, 311–319 (2002).
518. Woolacott, N. F. et al. The clinical effectiveness and cost-effectiveness of bupropion and nicotine replacement therapy for smoking cessation: a systematic review and economic evaluation. *Health Technol. Assess.* **6**, 1–245 (2002).
519. Rogers, T. et al. A comprehensive qualitative review of studies evaluating the impact of local US laws restricting the sale of flavored and menthol tobacco products. *Nicotine Tob. Res.* **24**, 433–443 (2022).
520. Cadham, C. J. et al. The actual and anticipated effects of a menthol cigarette ban: a scoping review. *BMC Public Health* **20**, 1055 (2020).
521. Faber, T. et al. Effect of tobacco control policies on perinatal and child health: a systematic review and meta-analysis. *Lancet Public Health* **2**, e420–e437 (2017).
522. Evans, W. N., Farrelly, M. C. & Montgomery, E. Do workplace smoking bans reduce smoking? *Am. Econ. Rev.* **89**, 728–747 (1999).
523. Coughlin, S. S., Anderson, J. & Smith, S. A. Legislative smoking bans for reducing exposure to secondhand smoke and smoking prevalence: opportunities for Georgians. *J. Ga. Public Health Assoc.* **5**, 2–7 (2015).
524. Skivington, K. et al. A new framework for developing and evaluating complex interventions: update of Medical Research Council guidance. *Br. Med. J.* **374**, n2061 (2021).
525. Wells, G. A. et al. The Newcastle–Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. https://api.semanticscholar.org/CorpusID:79550924 (2014).
526. *EPOC Resources for Review Authors* (Cochrane Effective Practice and Organisation of Care, 2017).
527. Rücker, G. & Schwarzer, G. Ranking treatments in frequentist network meta-analysis works without resampling methods. *BMC Med. Res. Methodol.* **15**, 58 (2015).
528. Grant, R. L. Converting an odds ratio to a range of plausible relative risks for better communication of research findings. *Br. Med. J.* **348**, f7450 (2014).
529. Borenstein, M., Higgins, J. P., Hedges, L. V. & Rothstein, H. R. Basics of meta-analysis: $I^2$ is not an absolute measure of heterogeneity. *Res. Synth. Methods* **8**, 5–18 (2017).
530. Higgins, J. P. & Thompson, S. G. Quantifying heterogeneity in a meta-analysis. *Stat. Med.* **21**, 1539–1558 (2002).
531. Higgins, J. P., Thompson, S. G., Deeks, J. J. & Altman, D. G. Measuring inconsistency in meta-analyses. *Br. Med. J.* **327**, 557–560 (2003).
532. Peters, J. L., Sutton, A. J., Jones, D. R., Abrams, K. R. & Rushton, L. Contour-enhanced meta-analysis funnel plots help distinguish publication bias from other causes of asymmetry. *J. Clin. Epidemiol.* **61**, 991–996 (2008).
533. Begg, C. B. & Mazumdar, M. Operating characteristics of a rank correlation test for publication bias. *Biometrics* **50**, 1088–1101 (1994).
534. Egger, M., Smith, G. D., Schneider, M. & Minder, C. Bias in meta-analysis detected by a simple, graphical test. *Br. Med. J.* **315**, 629–634 (1997).
535. Duval, S. & Tweedie, R. Trim and fill: a simple funnel-plot–based method of testing and adjusting for publication bias in meta-analysis. *Biometrics* **56**, 455–463 (2000).
536. Stata Statistical Software: Release 17 (StataCorp, 2021).
537. R Core Team *R: A Language and Environment for Statistical Computing* (R Foundation for Statistical Computing, 2020); https://www.R-project.org/

## Acknowledgements

We thank S. Sultana, N. Parcell, M. R. Islam and M. M. Rahman for their assistance in performing hand searches, paper screening and data extraction. This study was funded by the Ministry of Health, Labour and Welfare of Japan (Health and Labour Sciences Research Grant No. 20FA1022). The funder had no role in study design, data collection and analysis, decision to publish or preparation of the manuscript. The corresponding and first authors had full access to all study data and final responsibility for the decision to submit for publication.

## Author contributions

S. Akter, M.M.R. and R.N. designed the study. S. Akter and M.M.R. wrote the protocol. S. Akter, S. Aktar and R.S.N. did the study search, study selection and quality assessment. S. Akter, M.M.R. and R.N. supervised all the steps in the review process. M.M.R. did the data analysis and created the figures with S. Akter. S. Akter drafted the paper with M.M.R. and R.S.N. T.R. and R.N. edited the paper and provided critical comments. All authors were involved in the interpretation of the results and revision of the paper and read and approved the final paper. R.N. is the guarantor.

## Competing interests

The authors declare no competing interests.

## Additional information

**Supplementary information** The online version contains supplementary material available at https://doi.org/10.1038/s41562-024-02002-7.

**Correspondence and requests for materials** should be addressed to Ryota Nakamura.

**Peer review information** *Nature Human Behaviour* thanks Michael Chaiton and Trevor Thompson for their contribution to the peer review of this work. Peer reviewer reports are available.

**Reprints and permissions information** is available at www.nature.com/reprints.

**Publisher's note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by-nc-nd/4.0/.

© The Author(s) 2024

nature portfolio

Corresponding author(s): Ryota Nakamura

Last updated by author(s): Jul 17, 2024

# Reporting Summary

Nature Portfolio wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Portfolio policies, see our Editorial Policies and the Editorial Policy Checklist.

## Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

| n/a | Confirmed |
|---|---|
| ☐ | ☒ The exact sample size (*n*) for each experimental group/condition, given as a discrete number and unit of measurement |
| ☒ | ☐ A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly |
| ☐ | ☒ The statistical test(s) used AND whether they are one- or two-sided<br>*Only common tests should be described solely by name; describe more complex techniques in the Methods section.* |
| ☒ | ☐ A description of all covariates tested |
| ☐ | ☒ A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons |
| ☐ | ☒ A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals) |
| ☒ | ☐ For null hypothesis testing, the test statistic (e.g. *F*, *t*, *r*) with confidence intervals, effect sizes, degrees of freedom and *P* value noted<br>*Give P values as exact values whenever suitable.* |
| ☒ | ☐ For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings |
| ☐ | ☒ For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes |
| ☐ | ☒ Estimates of effect sizes (e.g. Cohen's *d*, Pearson's *r*), indicating how they were calculated |

*Our web collection on statistics for biologists contains articles on many of the points above.*

## Software and code

Policy information about availability of computer code

| | |
|---|---|
| Data collection | No software was used |
| Data analysis | Data analysis was performed using Stata (version 17.1 MP) and R (version 3.6.4) software |

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio guidelines for submitting code & software for further information.

## Data

Policy information about availability of data

All manuscripts must include a data availability statement. This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our policy

Data extracted for this study can be found in the data repository system. In the main text, the data availability section provides a web link to these publicly available datasets (https://github.com/ryotanakamura1/smoking).

## Research involving human participants, their data, or biological material

Policy information about studies with human participants or human data. See also policy information about sex, gender (identity/presentation), and sexual orientation and race, ethnicity and racism.

| | |
|---|---|
| Reporting on sex and gender | Because our study is a systematic review and meta-analysis based on data from original studies, we mentioned the gender of each included paper in the supplemental file. No gender specific analysis was done due to the lack of sufficient data. |
| Reporting on race, ethnicity, or other socially relevant groupings | We did not include any race or ethnicity specific analysis in our meta-analysis due to lack of sufficient data. |
| Population characteristics | Population characteristics such as gender for each included study are presented in Supplementary Table 2. |
| Recruitment | We considered all quantitative studies using individual/ community/ facility/country level data which report policy impacts on tobacco behaviour. The review focused on population-level public policies, and hence research-based interventions in controlled settings were excluded. |
| Ethics oversight | As this is a systematic review and meta-analysis, no ethical approval was required. |

Note that full information on the approval of the study protocol must also be provided in the manuscript.

# Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☐ Life sciences ☒ Behavioural & social sciences ☐ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see nature.com/documents/nr-reporting-summary-flat.pdf

# Behavioural & social sciences study design

All studies must disclose on these points even when the disclosure is negative.

| | |
|---|---|
| Study description | The inclusion criteria for this systematic review and meta-analysis are quantitative studies using individual/ community/ facility/ country level data which report policy impacts on tobacco behaviour. |
| Research sample | We considered all the published studies and gray literature focused on population-level tobacco control policies to improve smoking behavior. We extracted data from each relevant paper and created a data set. As our study involved studies published from all regions of the world including males and females, it is representative. |
| Sampling strategy | We tried to include all the relevant studies focused on population-level tobacco control policies to improve smoking behavior and extracted data from each individual study. As a result, no sampling strategy is needed in this case. |
| Data collection | We searched five electronic databases (PubMed, Embase, CINAHL, Web of Science, and EconLit).<br>Two teams of paired reviewers independently used Rayyan QCRI (http://www.rayyan.ai/) to screen the identified records by title, abstract, and full text. Any disagreement between reviewers was resolved through discussions with the project leader (SA). A preconceived and standardized data extraction form was used to collect information (supplementary material, Appendix 1). Data were extracted from the primary studies and cross-checked by two independent reviewers, with disagreements resolved through consensus.<br>Our study is a systematic review and meta-analysis of real world evidence and not a randomized control trial and thus it is not required that the researcher be blinded to experimental conditions and/or the study hypothesis. |
| Timing | We considered all studies published from their inception to August 3 2023 and extracted data from those studies. |
| Data exclusions | We included all study designs for policy impact evaluation in a real-world setting. Studies predominantly using simulation or model-based analyses were excluded. Evaluations of research-based interventions, such as lab or field experiments implemented as part of the research, were excluded to focus on public policies. Finally, letters, case series,reviews, commentaries, and editorials (without primary data) were excluded. |
| Non-participation | Since no participants were involved in the study, non-participation is not applicable here. |
| Randomization | Since this is a systematic review and meta-analysis of real world evidence, rather than a randomized control trial, randomization is not required. |

# Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

## Materials & experimental systems

| n/a | Involved in the study |
|---|---|
| ☒ | ☐ Antibodies |
| ☒ | ☐ Eukaryotic cell lines |
| ☒ | ☐ Palaeontology and archaeology |
| ☒ | ☐ Animals and other organisms |
| ☒ | ☐ Clinical data |
| ☒ | ☐ Dual use research of concern |
| ☒ | ☐ Plants |

## Methods

| n/a | Involved in the study |
|---|---|
| ☒ | ☐ ChIP-seq |
| ☒ | ☐ Flow cytometry |
| ☒ | ☐ MRI-based neuroimaging |

# Plants

| | |
|---|---|
| Seed stocks | Not applicable |
| Novel plant genotypes | Not applicable |
| Authentication | Not applicable |