From: Mark Gottlieb <mark@phaionline.org>
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Date: 10/24/2024 2:22:34 PM
Subject: [EXTERNAL] - Written Testimony for Tonight's Hearing regarding tobacco Regulations
Attachments: NFG Testimony - Manchester.pdf

Hello Wendy and Ellen -

I am unfortunately unable to offer testimony in person or on Zoom this evening. I am attaching my written testimony as well as two relevant medical journal articles in the attachment. I hope you will make this available to the Board members.

I also wanted to point out an error in the workplace smoking regulation. At the end of Section A, the test says:

Now, therefore it is the intention of the Town of Manchester-by-the-Sea Board of Health to regulate the sale of tobacco products.

I think it should instead say the use of tobacco products.

Thanks and good luck with all of these hearings tonight!
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Publications

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Public Health Advocacy Institute
Big Ideas for Public Health and Social Justice

October 24, 2024

Manchester-by-the-Sea Board of Health
10 Central St
Manchester-by-the-Sea, MA 01944

Written Testimony of Mark A. Gottlieb
In Support of Nicotine Free Generation
Amendment to Tobacco Regulation

I regret that I could not attend tonight's hearing. I am the executive director of the non-profit Public Health Advocacy Institute at Northeastern University School of Law in Boston where I also teach public health advocacy to upper-level law students. While I am a faculty member and author or co-author of dozens of peer-reviewed articles about tobacco products and policy, I am also a practicing attorney

I represented the Town of Brookline (along with my colleagues) pro bono in successfully defending the policy proposed in the tobacco regulations from a legal challenge from the retail sector of the tobacco industry. The case went to the SJC and established Nicotine Free Generation as a valid exercise of local public health power in Massachusetts.

My organization offered our legal help to Brookline and any other town adopting this policy in Massachusetts (including yours) because we believe that it creates healthier communities by gradually ending the sale of tobacco products without affecting a single existing retail customer who can be sold tobacco products today. If widely adopted, it will make a huge difference. Someday, like smoke-free workplaces, Tobacco-21, bans on tobacco sales in pharmacies, and the flavor ban, it could become a statewide law.

Importantly, by making the health choice to phase out the addiction and illness caused by nicotine and tobacco products starting with the next generation of future customers, it puts a town on a path toward improving health outcomes and reducing the town's burden of chronic disease.

In the October, 2024 issue of the journal "Lancet Public Health," there is a study that estimates the impact of a generational tobacco sales ban on lung cancer in 185 countries. It finds that, based on current trends, this policy would prevent nearly 2 million lung cancer deaths just among those born between 2006 and 2010.[1] (it is attached, along with an article about this policy published this year in the New England Journal of Medicine)

While Nicotine Free Generation is designed to eventually end all tobacco product sales in jurisdictions that adopt it, I expect it to have some very positive near to mid-term effects as well that build on what we learned from Tobacco 21.

Older peers with access to tobacco products are a significant source of these products for youth.[2] It is expected that such access will be reduced with the progressive increase of the minimum sales age under this policy. This is because, while a 21-year-old may still be an older peer or sibling to a high school student, it becomes less likely that someone in their mid-to late twenties, after this policy has been in effect for a few years, would still be in a teen's social circle. This is the same effect that was forecast by the Institute of Medicine's model used to predict the impact of raising the minimum sales age for tobacco to 21 or 25.[3] The IOM's modeling was important evidence supporting the policy to adopt Tobacco-21. As you know, Tobacco-21 started as a local Massachusetts policy and, in less than 15 years, became national policy.

Likewise, peers who model the use of tobacco products have been a predictor of youth initiation.[4] With fewer older peers modeling tobacco product use as a result of the proposed policy, it can be expected to contribute to a reduction in tobacco initiation by middle and high school populations.

This policy is about prevention by targeting those who have yet to access tobacco sales. It does not help those among us who are now nicotine-dependent, the vast majority of whom want to quit and wish they never had started.[5] They need help, resources, and encouragement. This, however, is very difficult for a BoH to deliver. What can be delivered by this Board is a policy that will stop this problem from happening in the first place through the Nicotine Free Generation approach to tobacco prevention.

While for some, Nicotine Free Generation might seem radical, they may actually be in the minority. A study published by the U.S. Centers for Disease Control and Prevention in 2023 found that, in a national survey, the majority of Americans (57%) favored a policy to ban the sale of all tobacco products.[6]

I would like to address the concerns raised around contributing to black markets with this policy. There must already be strong demand for a product to create a black market. Consider the 2020 flavor ban where there was an existing demand for a product removed from retail shelves. That has resulted in out-of-state purchases and a small but not trivial black market. Contrast this with Tobacco-21. One of the reasons Tobacco-21 did not create a black market was because young people did not lose the ability to purchase tobacco. They never had it, so there wasn't an established retail demand from those under the legal age. Likewise, Nicotine Free Generation affects sales only to the next generations, for whom there is no strong existing demand for nicotine products. For this reason, concerns about this proposed policy creating a black market are unfounded.

There is no legal right to buy or sell tobacco products. These are products that, by and large, only exist as profit centers because they are designed to cause and sustain addiction in their users. Tobacco products are the deadliest consumer products sold in the United States and, in my opinion, it is strongly in the interest of public health that the next generations are spared the mental and physical costs of nicotine addiction.

Sincerely,

Mark A. Gottlieb
Executive Director

References:

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Estimated impact of a tobacco-elimination strategy on lung-cancer mortality in 185 countries: a population-based birth-cohort simulation study

Julia Rey Brandariz, Harriet Rumgay, Olalekan Ayo-Yusuf, Richard Edwards*, Farhad Islami*, Shiwei Liu, Mónica Pérez-Ríos*, Paulo César Rodrigues Pinto Corrêa*, Alberto Ruano-Ravina*, Isabelle Soerjomataram*

Summary

Background The tobacco-free generation aims to prevent the sale of tobacco to people born after a specific year. We aimed to estimate the impact of eliminating tobacco smoking on lung-cancer mortality in people born during 2006–10 in 185 countries.

Methods For this population-based birth-cohort simulation study, we proposed a scenario in which tobacco sales were banned for people born between Jan 1, 2006, and Dec 31, 2010, and in which this intervention was perfectly enforced, quantified until Dec 31, 2095. To predict future lung-cancer mortality rates, we extracted lung-cancer mortality data by sex, 5-year age group, and 5-year calendar period for countries with at least 15 years of data from the WHO Mortality Database. For countries for which mortality data were not available, we extracted data on lung-cancer incidence from the Cancer Incidence in Five Continents. To establish the number of lung-cancer deaths that could be prevented in the birth cohort if tobacco smoking was eliminated, we subtracted reported age-specific rate of deaths in people who had never smoked tobacco (hereafter referred to as never smokers) from a previous study from the expected rate of lung-cancer deaths in our birth cohort and applied this difference to the size of the population. We computed population impact fractions (PIFs), the percentage of lung-cancer deaths that could be prevented, by dividing the number of preventable lung-cancer deaths by the expected lung-cancer deaths in the birth cohort. We also aggregated expected and prevented deaths into the four World Bank income groups (ie, high-income, upper-middle-income, lower-middle-income, and low-income). The primary outcome was the impact on lung-cancer mortality of implementing a tobacco-free generation.

Findings Our birth cohort included a total population of 650 525 800 people. Globally, we predicted that 2 951 400 lung-cancer deaths could occur in the population born during 2006–10 if lung-cancer rates continue to follow trends observed during the past 15 years. Of these deaths, 1 842 900 (62·4%) were predicted to occur in male individuals and 1 108 500 (37·6%) were expected to occur in female individuals. We estimated that 1 186 500 (40·2%) of 2 951 400 lung-cancer deaths in people born during 2006–10 could be prevented if tobacco elimination (ie, a tobacco-free generation) was achieved. We estimated that more lung-cancer deaths could be prevented in male individuals (844 200 [45·8%] of 1 842 900 deaths) than in female individuals (342 400 [30·9%] of 1 108 500 deaths). In male individuals, central and eastern Europe had the highest PIF (48 900 [74·3%] of 65 800 deaths) whereas in female individuals, western Europe had the highest PIF (56 200 [77·7%] of 72 300 deaths). Middle Africa was the region with the lowest PIF in both male individuals (180 [2·1%] of 8600 deaths) and female individuals (60 [0·9%] of 6400 deaths). In both sexes combined, PIF was 17 400 (13·5%) of 128 900 deaths in low-income countries, 104 900 (15·8%) of 662 800 deaths in lower-middle-income countries, 650 100 (43·9%) of 1 482 200 deaths in upper-middle-income countries, and 414 100 (61·1%) of 677 600 deaths in high-income countries.

Interpretation The implementation of a tobacco-free generation could substantially reduce global lung-cancer mortality. However, data from low-income countries were scarce and our estimates should be interpreted with caution.

Funding Spanish Society of Pneumology and Thoracic Surgery.

Introduction

Lung cancer is the second most diagnosed cancer and the leading cause of cancer death worldwide, responsible for approximately 1·8 million deaths per year.[1] Tobacco smoking is the most important risk factor for lung cancer and, in 2019, was estimated to cause more than 67% of lung-cancer deaths globally.[2]

Tobacco control is a priority for global public health. Strategies such as the WHO MPOWER measures (ie, monitoring tobacco use; protecting people from tobacco

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For **MPOWER** see https://www.who.int/initiatives/mpower

Research in context

Evidence before this study

Tobacco smoking is the leading cause of preventable deaths worldwide. Identifying and implementing effective tobacco-prevention strategies is essential to reduce the prevalence of smoking and to increase control of poor health outcomes as a result of tobacco use. In the past 10 years, new proposals have emerged as part of comprehensive tobacco-elimination strategies, such as the tobacco-free generation, which aims for a substantial reduction in prevalence of tobacco smoking and elimination of it among younger generations. To identify studies that estimated the impact of eliminating tobacco smoking in a population by restricting the sale of tobacco to people born after a specific year, we searched PubMed for articles published between database inception and Oct 26, 2023. We used the search terms ("tobacco-free generation" OR "smoke-free generation" OR "tobacco endgame") AND "lung cancer", without language restrictions. Four simulation studies analysed the impact of a tobacco-free generation on the population of a specific country, but most focused on health gains rather than mortality.

Added value of this study

To our knowledge, our simulation study is the first to evaluate the impact of a tobacco-free generation on lung-cancer mortality in any country. We estimated the impact of a tobacco-free generation on lung-cancer mortality in a birth cohort of people from 185 countries. Globally, the implementation of a tobacco-free generation could prevent more than 1·1 million lung-cancer deaths in people born between Jan 1, 2006, and Dec 31, 2010. In sensitivity analyses, we estimated that 961 500 lung-cancer deaths could be prevented in this birth cohort if the effectiveness of smoking control was reduced by 25% and, if lung-cancer mortality rates remained stable from 2022 onwards, the estimates differ from those using the predicted rates up to 2040–44.

Implications of all the available evidence

Our results provide global and national insights into the burden of lung-cancer mortality that could be prevented by implementing a restriction on tobacco sales to people born during 2006–10. The burden of lung-cancer mortality attributable to tobacco smoking remains high in many countries and is expected to increase in others. Our findings indicate that implementation of a tobacco-free generation could reduce the impact of tobacco smoking on lung-cancer mortality in future generations. Furthermore, our methods could be used to assess the impact of tobacco-free generations on other cancers or causes of death related to tobacco smoking.

smoke; quitting smoking; warning about the dangers of tobacco; enforcing bans on tobacco advertising, promotion, and sponsorship; and increasing tobacco taxes) have been developed to control poor health outcomes as a result of tobacco use. However, few countries have the highest level of achievement in the measures.[3] In the past 10 years, a new strategy to combat poor health outcomes as a result of tobacco use, known as the tobacco endgame, has emerged. The aim of tobacco-endgame strategies is to accelerate tobacco control by rapidly, equitably, and profoundly reducing the prevalence of tobacco smoking and eliminating it among the population. One of the measures included in many proposed tobacco-endgame strategies is the tobacco-free generation, which would restrict the sale and supply of tobacco to people born after a specific year.[4] New Zealand was a pioneer in the tobacco-free generation strategy by proposing to ban the sale of tobacco to people born on or after Jan 1, 2009.[5] Although some other cities have implemented a similar strategy, such as Balanga City (Philippines)[6] and Brookline (MA, USA),[7] and countries such as the UK[8] are considering implementing one, few studies have analysed the impact of a tobacco-free generation on population health.[9–11]

For the **WHO Mortality Database** see https://www.who.int/data/data-collection-tools/who-mortality-database

For the **Cancer Incidence in Five Continents database** see https://ci5.iarc.fr/ci5plus/

See **Online** for appendix

We aimed to estimate the impact of eliminating tobacco smoking on lung-cancer mortality in people born during 2006–10 in 185 countries.

Methods

Study design

To analyse the impact of implementing a tobacco-free generation on lung-cancer mortality in this population-based birth-cohort simulation study, we proposed a scenario in which tobacco sales were banned for people born between Jan 1, 2006, and Dec 31, 2010, and in which this intervention was perfectly enforced. We quantified the number of preventable lung-cancer deaths in this birth cohort until Dec 31, 2095.

Population and procedures

To predict future lung-cancer mortality rates, we extracted lung-cancer mortality data (ICD-10 codes C33–34) by sex, 5-year age group (eg, 0–4 years, 5–9 years, 10–14 years, until age 85 years or older), and 5-year calendar period (eg, 2005–09, 2010–14, 2015–19) for countries with at least 15 years of data (ie, three 5-year calendar periods) from the WHO Mortality Database. For countries for which mortality data were not available, we extracted data on lung-cancer incidence from the Cancer Incidence in Five Continents database, which are collected via population-based cancer registries. Sufficient lung-cancer data over time were available for 82 countries (appendix pp 2–4). We obtained current and predicted population sizes from the UN World Population Prospects 2019 medium-fertility variant.[12]

We predicted sex-specific and age-specific lung-cancer rates up to 2040–44 for each of the 82 countries using the Nordpred software package in R version 4.3.0, which is based on an age-period cohort model.[13] To improve our estimation, we calculated Nordpred predictions for a period of five blocks of 5 years, the first period being 2020–24 and the fifth being 2040–44. We incorporated an attenuation effect using drift parameters of 25% in the second prediction period (2025–29), 50% in the third prediction period (2030–34), and 75% in the fourth (2035–39) and fifth (2040–44) prediction periods (appendix pp 2–4).

From the predicted age-specific lung-cancer rates, we established lung-cancer rates for the cohort born between Jan 1, 2006, and Dec 31, 2010, using a Lexis diagram (appendix pp 5–7). Although cohort-specific rates up to 2040–44 were derived from the predicted rates, we assumed the rates remained constant from this block onwards, as the predictions become more uncertain after this time period.

Although data were available for 82 countries, we decided to expand our estimates to 185 countries to evaluate potential global benefits of the implementation of a tobacco-free generation across regions with different smoking prevalences. Thus, after deriving cohort-specific mortality rates, we calculated the ratio between lung-cancer rates in the birth cohort and the baseline period (ie, 2006–10) by age and sex for each of the 82 countries for which the prediction was done, to allow us to transform period rates to cohort rates for additional countries. We then applied this period/cohort ratio to lung-cancer mortality rates from the Global Cancer Observatory 2022 database, which was modelled and adjusted for missing data, to obtain birth-cohort rates by country and sex for 185 countries. In countries where data to predict cohort-specific lung-cancer rates were not available, a regional mean period/cohort ratio was applied. We derived the regional mean period/cohort ratio from countries that were in the same geographical region or had similar lung-cancer mortality rates in 2022 (appendix pp 8–14).

To calculate the number of lung-cancer deaths expected in the birth cohort as per business as usual, we constructed the population structure of this cohort using age-specific, sex-specific, 5-year-period-specific, and country-specific population sizes from Jan 1, 2006, to Dec 31, 2095, from the UN Population Prospects 2019 medium-fertility variant.[12] At the end of the simulation, all age groups older than 85 years were included. We obtained expected lung-cancer deaths in the birth cohort by multiplying lung-cancer mortality rates by the size of the population.

To establish the number of lung-cancer deaths that could be prevented in the birth cohort if tobacco smoking was eliminated, we subtracted reported age-specific rate of deaths in people who had never smoked tobacco (hereafter referred to as never smokers) from a previous study[14] from the expected rate of lung-cancer deaths in our birth cohort and applied this difference to the size of the population. We used the Cancer Prevention Study phase II[15] for all countries and regions with a high lung-cancer rate (eg, Europe, North America, Australia, and New Zealand) and the Korean Cancer Prevention Study[16] for all countries and regions with a low lung-cancer rate (eg, Asia [excluding female individuals from China and North Korea], Africa, and Latin America). We categorised countries with more than 35 deaths per 100 000 population as having high lung-cancer mortality rates. For female individuals from China and North Korea, in whom lung-cancer rates are much higher than for female individuals in other countries, we used lung-cancer incidence rates from four cities in China during 1983–87.[14] The rates of never smokers used for each country are provided in the appendix (pp 15–17). We computed population impact fractions (PIFs), interpreted as the percentage of lung-cancer deaths that could be prevented by stopping the generation born during 2006–10 from tobacco smoking, by dividing the number of preventable lung-cancer deaths by the expected lung-cancer deaths in the birth cohort (appendix p 18).

Statistical analysis

The primary outcome was the impact on lung-cancer mortality of implementing a tobacco-free generation.

Prediction of lung-cancer mortality rates was done in R version 4.3.0 and the remaining statistical analyses were done in Stata version 17.0. Our results are presented in absolute numbers rounded to the nearest 100, proportions, and age-standardised rates (ASRs; Segi-Doll world standard)[17,18] by sex and 19 UN world regions.[19] In addition, we aggregated expected and prevented deaths into the four World Bank income groups (ie, high-income, upper-middle-income, lower-middle-income, and low-income).[20]

For the **Global Cancer Observatory** see https://gco.iarc.fr/en

We conducted two sensitivity analyses (appendix pp 19–24). In the first sensitivity analysis, we quantified a conservative reduction in lung-cancer mortality in a scenario in which the tobacco-free generation reduced lung-cancer mortality rates to 25% more than those of never smokers. We chose this scenario to assess what would happen if implementation of the tobacco-free generation was not fully achieved. We set this percentage at 25% on the basis of a study published by Ait Ouakrim and colleagues,[9] in which they assumed that implementation of a tobacco-free generation would result in a 90% (95% uncertainty interval 78·5–97·4) reduction in rates of initiating tobacco smoking. In the second sensitivity analysis, we held lung-cancer mortality rates stable from 2022 onwards to assess whether the results of the primary analysis differed depending on the evolution of rates over time. Based on reported stabilisation of lung-cancer rates in several upper-middle-income countries, such as Brazil[21,22] and South Africa,[23] we also assessed

	Male individuals					Female individuals					Total				
	Expected deaths	Prevented deaths	PIF	ASR of expected deaths	ASR of prevented deaths	Expected deaths	Prevented deaths	PIF	ASR of expected deaths	ASR of prevented deaths	Expected deaths	Prevented deaths	PIF	ASR of expected deaths	ASR of prevented deaths
Africa															
Eastern Africa	32 600	1800	5·4%	3·5	0·2	32 400	1300	4·0%	2·6	0·1	65 000	3100	4·7%	3·0	0·1
Middle Africa	8600	180	2·1%	2·8	0·1	6400	60	0·9%	1·6	0·0	15 000	240	1·6%	2·1	0·1
Northern Africa	90 400	45 000	49·8%	17·0	8·6	26 500	3300	12·6%	4·1	0·2	116 900	48 400	41·4%	10·4	4·3
Southern Africa	14 300	6500	45·8%	17·7	8·6	10 900	4600	42·1%	8·1	2·9	25 200	11 100	44·2%	12·3	5·5
Western Africa	17 200	1100	6·3%	2·7	0·2	10 000	320	3·2%	1·5	0·1	27 200	1400	5·1%	2·1	0·1
America															
Latin America and the Caribbean	115 100	17 000	14·7%	8·3	1·4	120 800	49 800	41·2%	7·4	2·8	236 000	66 800	28·3%	7·8	2·1
North America	91 200	45 000	49·3%	10·3	6·1	94 900	59 700	63·0%	9·1	5·7	186 100	104 700	56·3%	9·7	5·9
Asia															
Eastern Asia	702 800	422 000	60·0%	28·2	18·6	369 600	45 300	12·2%	13·3	0·5	1 072 400	467 200	43·6%	21·1	10·0
China*	628 300	379 500	60·4%	29·4	19·7	329 900	30 400	9·2%	14·0	0·4	958 100	409 900	42·8%	22·2	10·6
South central Asia	251 700	15 000	5·9%	7·1	0·6	122 300	9600	7·8%	3·5	0·2	374 000	24 600	6·6%	5·2	0·4
India*	153 600	3100	2·0%	6·5	0·4	81 500	1100	1·3%	3·6	0·1	235 100	4200	1·8%	5·1	0·3
Southeast Asia	161 400	49 300	30·6%	16·2	6·9	78 800	11 600	14·7%	6·6	1·5	240 200	60 900	25·4%	11·3	4·2
Western Asia	134 337	86 375	64·3%	21·4	14·0	42 702	18 372	43·0%	7·3	3·3	177 040	104 747	59·2%	14·3	8·6
Europe															
Central and eastern Europe	65 800	48 900	74·3%	22·6	18·4	34 000	19 900	58·4%	7·9	4·7	99 800	68 700	68·9%	14·9	11·2
Northern Europe	30 700	18 500	60·3%	13·1	9·0	35 600	26 400	74·2%	11·8	8·5	66 200	44 900	67·8%	12·5	8·8
Southern Europe	51 200	37 000	72·3%	18·7	14·5	40 700	29 400	72·2%	13·7	10·3	91 900	66 400	72·2%	16·2	12·4
Western Europe	64 200	44 200	68·9%	19·6	15·4	72 300	56 200	77·7%	17·2	13·8	136 400	100 400	73·6%	18·4	14·6
Oceania															
Australia and New Zealand	9900	5600	56·2%	13·0	8·8	9500	6100	63·8%	10·5	7·1	19 400	11 600	60·0%	11·7	7·9
Melanesia, Micronesia, and Polynesia	1700	940	56·7%	10·1	6·2	1200	500	42·6%	5·7	2·6	2800	1400	50·8%	7·9	4·3
World	1 842 900	844 200	45·8%	13·2	6·6	1 108 500	342 400	30·9%	6·7	1·8	2 951 400	1 186 500	40·2%	9·9	4·2

ASRs are per 100 000 population. ASR=age-standardised rate. PIF=population impact fraction. *Data from China are included in eastern Asia and data from India are included in south central Asia.

Table 1: **Numbers, PIFs, and ASRs of expected and prevented lung-cancer deaths in male individuals, female individuals, and both sexes combined, by world region**

whether the results obtained for these two countries differed if we assumed that lung-cancer mortality rates remained stable after 2022. For this purpose, instead of using lung-cancer mortality rates for the birth cohort, we used lung-cancer mortality rates for the 2022 period from GLOBOCAN 2022 to calculate both prevented lung-cancer deaths and PIFs.

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Results

Our birth cohort included all births occurring between Jan 1, 2006, and Dec 31, 2010, in 185 countries (appendix pp 3, 26–34), with a total population of 650 525 800 people. Of the 82 countries with sufficient lung-cancer data, 46 (56%) were high-income countries with mortality registries or cancer registries. In the remaining 103 (56%) of 185 countries, data to predict cohort-specific lung-cancer rates were not available.

Globally, we predicted that 2 951 400 lung-cancer deaths could occur in the population born during 2006–10 if lung-cancer rates continue to follow trends observed during the past 15 years. Of these deaths, 1 842 900 (62·4%) were predicted to occur in male individuals and 1 108 500 (37·6%) were expected to occur in female individuals (table 1). Asian regions were expected to have the highest number of lung-cancer deaths in both sexes, at 1 863 640 (63·1%) of the global total. Upper-middle-income countries were expected to have the highest number of lung-cancer deaths, at 1 482 200 (50·2%) of the global total (table 2).

We estimated that 1 186 500 (40·2%) of 2 951 400 lung-cancer deaths in people born during 2006–10 could be prevented if tobacco elimination (ie, a tobacco-free generation) was achieved. We estimated that more lung-cancer deaths could be prevented in male individuals (844 200 [45·8%] of 1 842 900 deaths) than in female individuals (342 400 [30·9%] of 1 108 500 deaths; table 1).

In both sexes, we estimated the impact of eliminating tobacco smoking measured via PIF to be greater than 50% in eight (47·1%) of 17 world regions (table 1), particularly in Europe. In male individuals, central and eastern Europe had the highest PIF (48 900 [74·3%] of 65 800 deaths) whereas in female individuals, western Europe had the highest PIF (56 200 [77·7%] of 72 300 deaths). Middle Africa was the region with the lowest PIF in both male individuals (180 [2·1%] of 8600 deaths) and female individuals (60 [0·9%] of 6400 deaths). Estimated PIFs for six regions (ie, western Africa, Latin America and the Caribbean, North America, northern Europe, western Europe, and Australia and New Zealand) were higher in female individuals than in male individuals (table 1; appendix p 25).

	Male individuals					Female individuals					Total				
	Expected deaths	Prevented deaths	PIF	ASR of expected deaths	ASR of prevented deaths	Expected deaths	Prevented deaths	PIF	ASR of expected deaths	ASR of prevented deaths	Expected deaths	Prevented deaths	PIF	ASR of expected deaths	ASR of prevented deaths
High-income	356 000	201 900	56·7%	13·4	8·4	321 600	212 300	66·0%	10·5	6·9	677 600	414 100	61·1%	11·9	7·7
Upper-middle-income	959 500	541 100	56·4%	22·5	14·1	522 700	109 000	20·9%	10·5	1·7	1 482 200	650 100	43·9%	16·6	8·0
Lower-middle-income	457 600	89 900	19·6%	8·7	2·2	205 200	15 000	7·3%	3·8	0·4	662 800	104 900	15·8%	6·2	1·3
Low-income	69 800	11 300	16·3%	4·8	0·9	59 100	6100	10·3%	3·0	0·3	128 900	17 400	13·5%	3·8	0·6
World	1 842 900	844 200	45·8%	13·2	6·6	1 108 500	342 400	30·9%	6·7	1·8	2 951 400	1 186 500	40·2%	9·9	4·2

Country-income group was derived from The World Bank. ASRs are per 100 000 population. ASR=age-standardised rate. PIF=population impact fraction.

Table 2: Numbers, PIFs, and ASRs of expected and prevented lung-cancer deaths in male individuals, female individuals, and both sexes combined, by country-income group

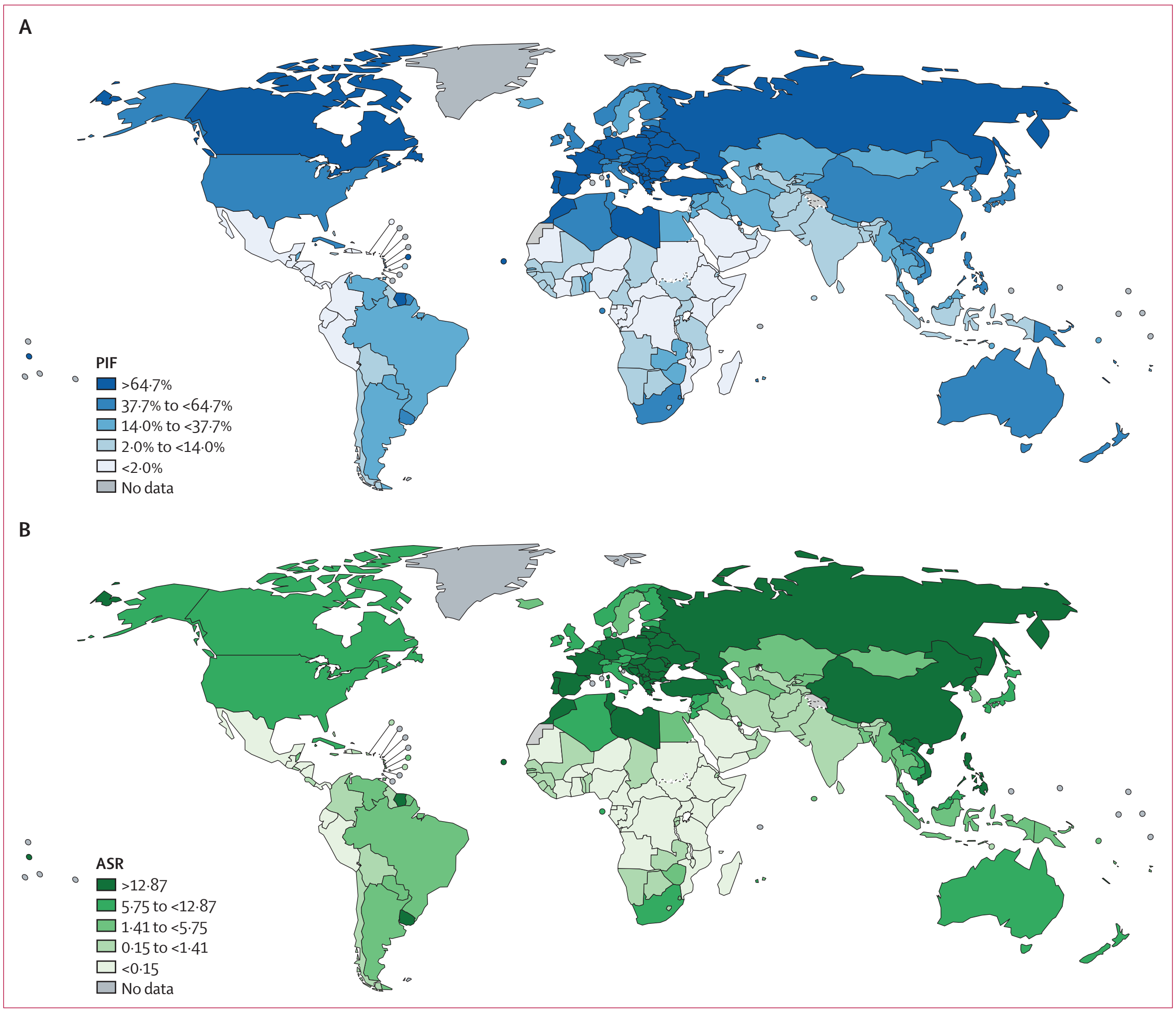

Figure 1: **Percentages and ASRs of prevented lung-cancer deaths in male individuals born 2006–10, by country**
ASRs are per 100 000 population. ASR=age-standardised rate. PIF=population impact fraction.

Eastern Asia (18·6 per 100 000 population) and central and eastern Europe (18·4 per 100 000 population) were the regions with the highest estimated ASRs of prevented lung-cancer deaths in male individuals. By contrast, eastern Africa (0·2 per 100 000 population), western Africa (0·2 per 100 000 population), and middle Africa (0·1 per 100 000 population) had the lowest ASRs in male individuals. Western Europe (13·8 per 100 000 population) and southern Europe (10·3 per 100 000 population) were the regions with the highest estimated ASRs of prevented lung-cancer deaths in female individuals. By contrast, eastern Africa (0·1 per 100 000 population), western Africa (0·1 per 100 000 population), and middle Africa (0·0 per 100 000 population) had the lowest ASRs in female individuals (table 1; appendix p 25).

Countries with the highest estimated PIFs in male individuals were Cyprus (1100 [87·3%] of 1200 deaths), Belarus (2600 [82·5%] of 3100 deaths), and Greece (4900 [83·0%] of 5900 deaths) and in female individuals were Hungary (3000 [84·0%] of 3500 deaths), the Netherlands (6400 [82·6%] of 7800 deaths), and Canada (18 300 [81·5%] of 22 400 deaths). The highest estimated ASRs of prevented lung-cancer deaths in male individuals were in Türkiye (41·4 per 100 000 population), Cyprus (37·6 per 100 000 population), and French Polynesia (32·7 per 100 000 population) and in female individuals were in Hungary (17·4 per 100 000 population), France (16·9 per 100 000 population), and Serbia (15·7 per 100 000 population; figures 1, 2; appendix pp 26–34).

In both sexes combined and each sex separately, PIF was estimated to increase by World Bank country-income group. In both sexes combined, PIF was 17 400 (13·5%) of 128 900 deaths in low-income countries, 104 900 (15·8%) of 662 800 deaths in lower-middle-income countries, 650 100 (43·9%) of 1 482 200 deaths in upper-middle-income countries, and 414 100 (61·1%) of 677 600 deaths in high-income countries. A similar gradient by country-income group was observed for the estimated ASR of

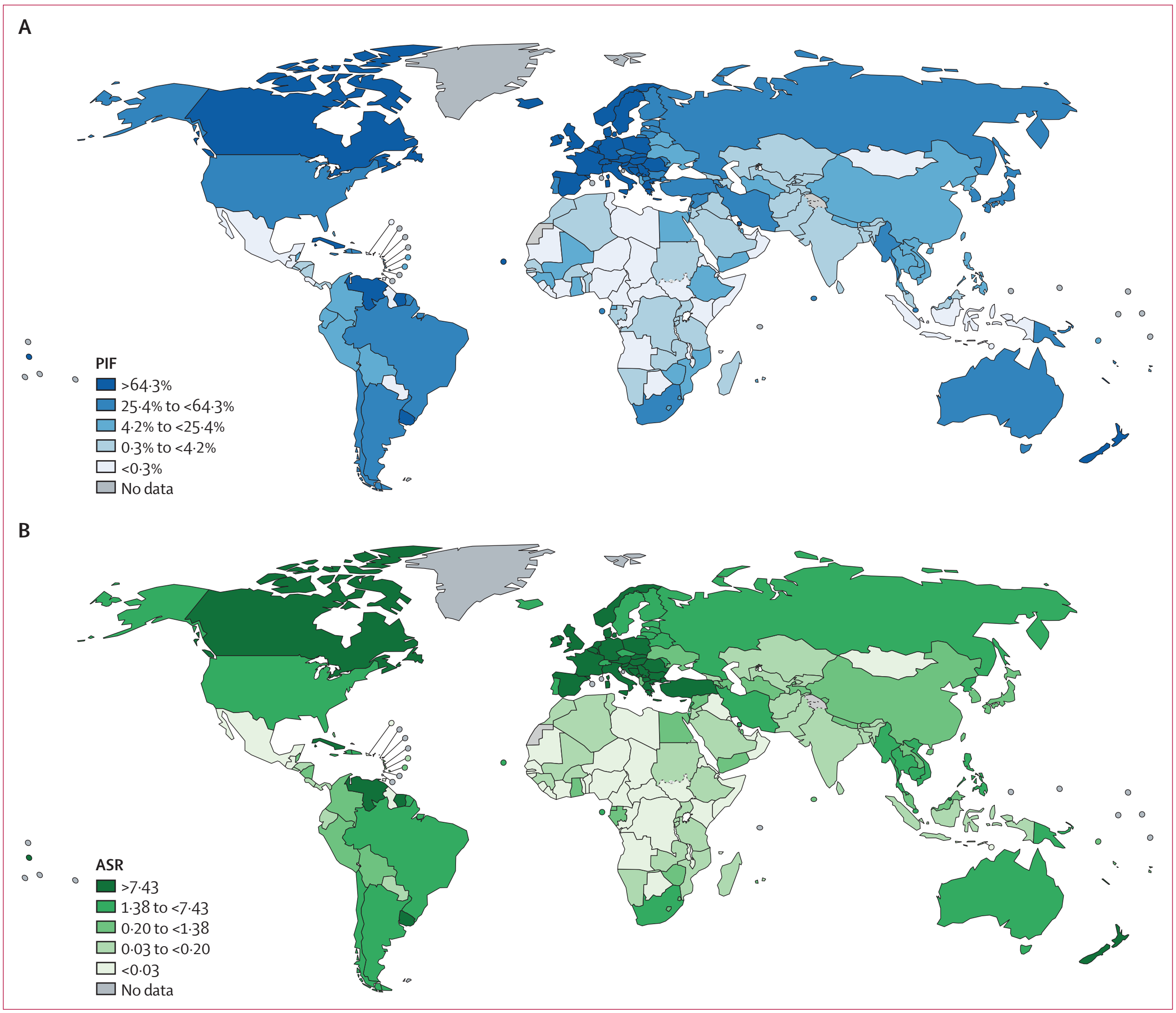

Figure 2: **Percentages and ASRs of prevented lung-cancer deaths in female individuals born 2006–10, by country**
ASRs are per 100 000 population. ASR=age-standardised rate. PIF=population impact fraction.

prevented lung-cancer deaths in female individuals, with the highest ASR in high-income countries (6·9 per 100 000 population). In male individuals, however, the highest estimated ASR of prevented lung-cancer deaths was in upper-middle-income countries (14·1 per 100 000 population; table 2). Between the four income groups, the largest proportion of prevented lung-cancer deaths in male individuals was estimated to occur in upper-middle-income countries (541 100 [64·1%] of 844 200 deaths), whereas in female individuals it was in high-income countries (212 300 [62·0%] of 342 400 deaths; figure 3).

In sensitivity analyses, assuming that the tobacco-free generation intervention would reduce lung-cancer mortality rates to 25% more than that of never smokers, we estimated that 961 500 (32·6%) of 2 951 400 total lung-cancer deaths could be prevented. 696 800 (37·8%) of 1 842 900 lung-cancer deaths could be prevented in male individuals and 264 700 (23·9%) of 1 108 500 lung-cancer deaths could be prevented in female individuals. By world region, the smallest difference between PIFs obtained in this scenario and the main analysis was in middle Africa, with an absolute decrease of 0·5 percentage points in both sexes combined. The largest difference between PIFs was observed in southern Africa, with an absolute decrease of 12·7 percentage points in both sexes combined. When assuming that lung-cancer mortality rates remained stable after 2022, there were large differences by sex across world regions (appendix pp 19–24).

Discussion

We estimated that 1 186 500 (40·2%) of 2 951 400 lung-cancer deaths in people born during 2006–10 could be prevented globally if tobacco smoking was eliminated in this cohort. The estimated impact of a tobacco-free generation on lung-cancer deaths varied by sex, country, world region, and country-income group.

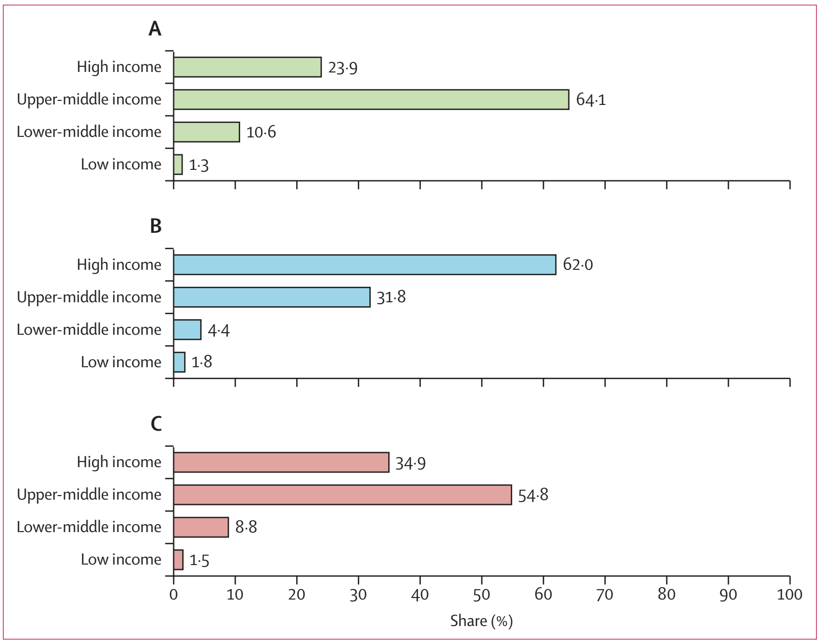

Figure 3: **Percentage of prevented lung-cancer deaths as a proportion of total prevented deaths in the 2006–10 birth cohort, by country-income group**
(A) Male individuals. (B) Female individuals. (C) Total.

Globally, we estimated that elimination of tobacco smoking in the evaluated birth cohort could prevent a greater number and proportion of lung-cancer deaths in male individuals than in female individuals, likely related to higher prevalence and earlier onset of smoking in male individuals.[24] The disparities in our results by sex were particularly important in southern Africa, northern Africa, eastern Asia, southeast Asia, and western Asia, where the proportion of prevented lung-cancer deaths in male individuals was estimated to be 20 percentage points higher than in female individuals. In countries in these regions, smoking prevalence was more than 30–40% in male individuals in 1970 and around 20–40% in 2020, compared with smoking prevalence far less than 10% in female individuals during the same period.[24] However, lobbying from the tobacco industry in several countries in these regions is strong[25] and smoking prevalence could increase in the near future. Therefore, our estimated impact of a tobacco-free generation could be an underestimate.[25] By contrast, in North America, Australia and New Zealand, northern Europe, and western Europe, we estimated that a larger number of lung-cancer deaths could be prevented in female individuals than in male individuals. In these regions, recognition of poor health outcomes as a result of tobacco use started earlier than in other regions.[24,26–28]

A previous study estimated that 80% of lung-cancer deaths are caused by tobacco smoking in high-income countries,[29] although this percentage reduced to 64% globally.[30] The percentage of lung-cancer deaths attributed to tobacco use in high-income countries has declined during 2010–19, whereas this percentage increased in different regions of Africa during 2010–19.[30,31] The decline in high-income countries is likely to continue in the coming years due to declining smoking prevalence[2] and improved lung-cancer diagnostic techniques and survival after diagnosis.[32]

The deaths that we estimated could not be prevented could be due to other risk factors associated with lung cancer. For example, the GBD 2019 Respiratory Tract Cancers Collaborators[30] found that lung-cancer mortality attributed to air pollution and exposure to second-hand smoke decreased during 2010–19 in countries with high sociodemographic index and increased in countries with low sociodemographic index. These diverging trends could have influenced our estimated lung-cancer deaths.

Although we estimated that high-income countries had a larger proportion of prevented lung-cancer deaths, our study also showed that, in terms of number of prevented lung-cancer deaths, the largest contribution came from low-income or middle-income countries (LMICs). LMICs generally have younger populations than high-income countries, so the relative size of our 2006–10 cohort was larger. Furthermore, although youth smoking prevalence has decreased in many high-income countries, it remains high in many LMICs.[3] Therefore, measures, such as the tobacco-free generation, that aim to eliminate smoking uptake could have the greatest impact in LMICs.[3,33] Although there has been progress in the implementation of tobacco-control measures since 2020 in LMICs, implementation remains higher in high-income countries.[3] Therefore, the long delay in implementation of tobacco-control measures and increasing smoking prevalence in many LMICs[24] suggest that LMICs should remain an important focus for global tobacco-control efforts.

The implementation of a tobacco-free generation could be more successful in countries with strong tobacco-control policies, where smoking prevalence is less than 15%, or where there has been a rapid decline in prevalence.[34] The implementation of a tobacco-free generation needs to occur alongside other tobacco-control measures, such as setting a nicotine cap, increasing taxes, or reducing the number of retail outlets that sell tobacco products.[9,35,36] However, the introduction of a tobacco-free generation alone would take many years to have an effect on smoking prevalence[9,36] and, consequently, on lung-cancer mortality rates. Moreover, it is a measure that focuses on preventing initiation of smoking and would not affect current smokers. Therefore, a tobacco-free generation and other measures proposed in the tobacco-endgame strategy should be implemented in conjunction with policies that are effective, such as increased taxes, smoke-free environments, and smoking-cessation support.[37,38] There is still a need to focus on current smokers and smoking cessation.

Our study has multiple strengths, including being, to our knowledge, the first to provide estimates of the impact of a tobacco-free generation on global lung-cancer mortality. Furthermore, we used lung-cancer mortality data from population-based registries, where available.

Our study has multiple limitations. We did not formally consider the multitude of factors that can influence the implementation of tobacco-control programmes, such as the black market or compliance. Other measures based on early smoking bans, such as increasing the minimum legal age of tobacco use, showed variation in compliance between 62% and 94%.[39,40] In our sensitivity analysis, we estimated that if the effectiveness of smoking-control activities was reduced by 25%, the impact of the tobacco-free generation would decrease by between 1 percentage point and 13 percentage points, depending on the region. Furthermore, we mainly studied impacts on the younger generation, for whom the effects of a tobacco-free generation on lung-cancer mortality would only materialise in five or six decades, when rates of lung cancer increase. As such, multiple interventions targeting different cohorts and subsets of populations are key to reducing lung-cancer mortality in the near future. Trends in tobacco smoking and therefore lung cancer might also change due to evolving tobacco and nicotine products, such as the use of non-combustible devices (eg, electronic cigarettes), which has increased in the young population. This development was not captured in our study as the product was introduced to the market only 20 years ago and its impact on lung-cancer mortality is unclear.

We could only estimate lung-cancer prevalence and mortality with local data in 82 countries. For the remaining 103, we extrapolated predictions on the basis of geographical location and lung-cancer burden, which might have led to overestimation or underestimation. Most recorded data came from high-income countries with good health-information systems. Data from low-income countries were scarce and our estimates should be interpreted with caution. We used an established method to estimate long-term cancer trends, but changes in rates during 2010–19 might not be captured in our prediction. One of our sensitivity analyses, with an alternative assumption in which lung-cancer mortality rates remained constant in all regions, showed the importance of including recent data. Furthermore, we assumed that lung-cancer rates would remain constant from 2044 onwards as prediction became increasingly uncertain beyond this period.[13] Thus, we could have underestimated expected lung-cancer deaths in countries where the lung-cancer mortality rate could have an upward trend and overestimated them in countries that could have a downward trend.

Another limitation is the scarce data on lung-cancer rates among never smokers, which were only available for the USA, South Korea, and China. The use of lung-cancer mortality rates in never smokers from before the 2000s could influence our estimates, as rates might have changed by 2022—the year in which much of the data used in our calculations was obtained—due to improvements in lung-cancer tumour-detection techniques or changes in exposure to other lung-cancer risk factors. Furthermore, by using lung-cancer mortality rates in never smokers, we did not consider deaths linked to second-hand smoke. If we had included these deaths, the number of preventable lung-cancer deaths due to the tobacco-free generation could be higher.

In summary, we estimated that more than 1·1 million lung-cancer deaths in 185 countries could be prevented in one 5-year birth cohort if smoking uptake was eliminated. Europe, North America, and Australia and New Zealand were the regions where more lung-cancer deaths could be prevented by strengthening tobacco-control measures to achieve a tobacco-free generation. However, the impact of tobacco smoking on lung-cancer mortality remains high in many countries and will increase in others. Therefore, the implementation of tobacco-control measures to help reduce the prevalence of tobacco smoking, and its impact, is imperative. Tobacco-control measures, including a tobacco-free generation, should be used in conjunction to achieve the tobacco endgame.

Contributors

HR and IS conceptualised the study. JRB, HR, and IS designed the study and analysis and interpreted the results. JRB and HR collected, accessed, and verified the data. JRB wrote the first draft of the manuscript. All authors reviewed the manuscript, had full access to all the data in the study, and had final responsibility for the decision to submit for publication.

Declaration of interests

JRB received funding from the Ministry of Universities of Spain for university professorship training (FPU20/00926 and EST23/00725). RE received payments for contribution to the International Tobacco Control Project and the CENIC study (funded by the US National Institutes of Health); received support for conference attendance from the Centre of Research Excellence on Achieving the Tobacco Endgame (funded by the Australian National Health and Medical Research Council) and Hapai te Hauora; received payments for invited presentations at international scientific meetings from the Ontario Public Health Association, the Korean Society for Research on Nicotine and Tobacco, the Malaysian Public Health Physicians' Association, and the Kedah State Health Department; received payments for Deputy Editor services from *Society of Research on Nicotine and Tobacco*; received payments for a paper published in Tobacco Control Anniversary Edition 2022 from BMJ Publishing; received payments for writing an Editorial from *The Lancet*; and has been awarded research funding (payment made to his institution) from the Health Research Council New Zealand, the University of Otago, and the Cancer Society of New Zealand. PCRPC received payments for developing a report on heated tobacco products from Aliança de Promoção da Saúde and received payments for a lecture at a meeting from Boehringer Ingelheim Brazil. MP-R received funding from a competitive grant from the Spanish Society of Pneumology and Thoracic Surgery. All other authors declare no competing interests.

Data sharing

All cancer incidence, mortality, and population estimates are available from the Global Cancer Observatory (https://gco.iarc.fr/en).

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Editorial note: The Lancet Group takes a neutral position with respect to territorial claims in published maps.

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Perspective

MAY 30, 2024

Toward a Tobacco-free Generation — A Birth Date–Based Phaseout Approach

Katharine Silbaugh, J.D., Lis Del Valle, B.A., and Christopher Robertson, J.D., Ph.D.

Despite decades of public health efforts and advances in cessation treatments, smoking is still the leading cause of preventable disease, disability, and death in the United States.

Smoking kills more people in this country than HIV, drug overdoses, alcohol use, motor vehicle crashes, and firearm-related injuries combined. Governments worldwide have tried to reduce tobacco use. In a development that could signal a new direction for tobacco regulation, one U.S. town's policy aimed at creating a tobacco-free generation has successfully withstood legal challenge.

The bylaw, passed by Brookline, Massachusetts, gradually phases out commercial tobacco by banning the sale of nicotine products to anyone born on or after January 1, 2000 (one of us cosponsored the bylaw). Eventually, no one will be old enough to purchase nicotine products. Tobacco retailers sued Brookline over the bylaw. A unanimous March 2024 Massachusetts Supreme Judicial Court decision upholding the tobacco-free generation (TFG) bylaw may now boost its viability as a model for other local and state governments. In response to the ruling, health boards in three other Massachusetts towns (Melrose, Stoneham, and Wakefield) voted to implement birth date–based phaseouts, and other municipalities have taken initial steps toward adopting this policy.

The concept of a birth date–based phaseout of commercial tobacco has drawn attention worldwide. New Zealand passed a similar law in 2022, though a subsequent change in government led to its repeal. The concept is under discussion in the European Union, the Philippines, Singapore, Malaysia, Australia, and Norway. In April 2024, a TFG bill in the United Kingdom cleared a major hurdle in Parliament when a first reading secured strong support. Whereas the Brookline bylaw applies to all nicotine products, including combustible products and e-cigarettes (vapes), New Zealand's repealed law and the U.K. bill cover combustible tobacco products only. This variation reflects ongoing public health discussion about the relative harm of vapes as compared with cigarettes. By including vapes in its TFG bylaw, Brookline targets a key driver of initiation of nicotine use among adolescents.

The World Health Organization considers tobacco use, which kills more than 8 million people per year, one of the largest global public health threats.[1] In 2022, one fifth of U.S. adults still regularly consumed tobacco products. Use often starts at an early age:

that same year, 22.2% of U.S. middle and high school students reported ever having used tobacco products, according to the Centers for Disease Control and Prevention (CDC). Adolescents are particularly affected by the smoking behaviors of young adults — people just above the minimum age for purchasing tobacco products, who may serve as role models or buyers for younger users.[2] Reducing the availability of nicotine to this young-adult group may reduce its attractiveness to teenagers.

Smoking increases the risk of heart disease, stroke, lung cancer, and diabetes, among other conditions. Secondhand smoke contributes to 41,000 deaths per year in the United States among people who don't smoke. A reduction in smoking has long been among the most important goals for public health leaders.

Nicotine is thought to be more addictive than other widely available products, such as alcohol and cannabis. Nicotine binds to acetylcholine receptors in the central nervous system that stimulate the release of neuromodulators such as dopamine, which gives the user a feeling of pleasure.[3] There are several pharmacologic approaches to helping people stop using nicotine. But withdrawal symptoms — such as sleep problems, nausea, nicotine cravings, fatigue, irritability, and depression — cause more than 75% of people who try to quit smoking without medical support to relapse within the first week.[4] Nicotine dependency is so strong that people who stop using nicotine for 1 year still have a 35% chance of relapse at some point in their lives.[4] Exposure to nicotine can therefore be associated with lifelong harm.

Over the past six decades, the United States has seen many efforts to reduce tobacco-related harm. The U.S. Surgeon General's report in 1964 linked smoking to lung cancer and heart disease, and in 1966 Congress required manufacturers to add a warning label to cigarette packs. In 1970, Congress banned the advertising of cigarettes on television and radio. Beginning in 1992, stores were prohibited from selling tobacco products to people under 18 years of age. By 1998, a total of 46 states, the District of Columbia, and five U.S. territories had sued the four largest U.S. tobacco companies. This lawsuit resulted in the Master Settlement Agreement, which required companies to pay the states billions of dollars each year to compensate for taxpayer money used to fund health care for people who smoke.

In 2009, Congress banned flavored cigarettes (not including menthol-flavored cigarettes) and gave the Food and Drug Administration (FDA) the authority to regulate the manufacturing, distribution, and marketing of tobacco products. In 2019, Congress passed legislation that tobacco products could be sold only to people 21 years of age or older, and in 2022, it gave the FDA the authority to regulate products containing nicotine from any source, including so-called synthetic nicotine.[5] State excise taxes on cigarette purchases are as high as $5.35 per pack in New York, with an additional $1.01 federal tax, but U.S. taxes remain substantially lower than taxes in other high-income countries. Notwithstanding these efforts, tobacco use kills about 480,000 people each year in the United States, according to the CDC.

Brookline's TFG bylaw, passed in 2020 when it applied to people who were too young to purchase tobacco products under state and federal law, represents a new approach to tobacco regulation. This approach doesn't affect people who currently smoke, a feature designed to humanely recognize access concerns generated by nicotine addiction. Instead, the bylaw could eventually establish a generational firebreak against nicotine addiction, preventing tobacco purchases even as the current generation of young people ages. This approach could result in a steadily increasing proportion of the population that cannot legally be sold tobacco products, thereby phasing out tobacco sales.

Several tobacco retailers in Brookline filed a lawsuit against the town, arguing that the bylaw is preempted by state law and that it violates the guarantee of equal protection under the Massachusetts constitution by discriminating against people born on or after January 1, 2000. In March 2024, the Massachusetts Supreme Judicial Court unanimously rejected these challenges, thereby paving the way for action by other Massachusetts municipalities.

Retailers had argued that Brookline's tobacco bylaw is preempted by the Massachusetts Tobacco Act, which makes it illegal to sell tobacco products to anyone under 21 years of age. The Massachusetts high court recognized that the Brookline bylaw leaves that sales restriction "untouched" and that the Tobacco Act expressly preserves a role for cities and towns in regulating tobacco.

The court also rejected the suggestion that the Brookline bylaw requires a heightened level of scrutiny under the state's equal-protection provision. Because the bylaw doesn't burden a fundamental right, such as religious freedom, or discriminate on the basis of a suspect classification, such as race or gender, it needs only to be "rationally related to the furtherance of a legitimate state interest." The bylaw clearly meets this standard; it was drafted to prevent health-related harms associated with tobacco use. Line drawing is routine and necessary in any legislation.

As other U.S. jurisdictions consider this approach, the Supreme Judicial Court's decision could be an important precedent. The equal-protection standard in Massachusetts is similar to provisions in the U.S. Constitution and other state constitutions. Unlike the Massachusetts legislature, however, some state legislatures have aggressively limited their local governments' authority to enact public health measures. In these states, the power to consider a TFG law rests with the state legislature. Other states, including California, have permitted local innovation in tobacco control; cities in those states could now choose to follow Brookline's lead.

An audio interview with Katharine Silbaugh is available at NEJM.org

Brookline's bylaw will have only a modest effect on public health as long as neighboring towns continue to permit tobacco sales to people who have turned 21. We believe the bylaw, and the court's decision, offer a proof of concept for birth date–based phaseout laws. Other Massachusetts towns have already shown an inclination to follow Brookline's lead. As more towns implement this policy, the Massachusetts legislature and other states could be motivated to adopt a birth date–based phaseout of commercial tobacco.

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Fair Allocation of GLP-1 and Dual GLP-1–GIP Receptor Agonists

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The percentage of U.S. adults with overweight or obesity now exceeds 70%, and more than 10% of adults have type 2 diabetes. These people are at increased risk for heart disease, stroke, cancer, and premature death. Glucagon-like peptide-1 (GLP-1) receptor agonists, such as semaglutide, and dual GLP-1 and glucose-dependent insulinotropic polypeptide (GIP) receptor agonists, such as tirzepatide, have been found to be effective for treating obesity and diabetes, significantly reducing weight and the risk or predicted risk of adverse cardiovascular events. There is a global shortage of these medications that could last several years and raises questions about how limited supplies should be allocated.

Belgium, Britain, and other countries have banned or discouraged use of GLP-1 receptor agonists for weight loss to prioritize use for diabetes. No U.S. state or federal agency has released similar guidance, although some health plans have restricted use for obesity, and Medicare doesn't cover these or other drugs for weight loss. Consequently, in the United States, allocation of these drugs has been largely on a first-come, first-served basis and has often depended on people's ability to pay, which has produced racial, ethnic, and socioeconomic inequities.[1]

We propose a fair-allocation framework that enables evaluation of the ethics of current practices and could guide governments, professional societies, and physicians in allocation decisions. This framework focuses on allocation within countries, although fair allocation among countries also requires ethical analysis.[2]

Fair allocation of scarce medi-