Annex to "How New Tobacco Control Laws Could Help Close the Racial Gap on U.S. Cancer"

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1. Introduction

The objective of this research is to evaluate the potential health effects of a proposed ban on menthol cigarettes by the Food and Drug Administration (FDA). We seek to quantitatively determine if the proposed ban would reduce disparities in U.S. lung cancer deaths attributable to smoking by race/ethnicity. We calculate the age-standardized lung cancer death rate due to smoking from 2000 to 2060 among adults ages 20+ for two racial groups: non-Hispanic Black ("NH Black") and all other races/ethnicities ("Other").

2. Data

2.1 Lung Cancer Mortality Rates

Historical death rates of lung cancer by race/ethnicity and age group (20–24, 25–29, … 80–84, 85+) for the years 2000 through 2019 are from the Institute for Health Metrics and Evaluation.[1] In order to construct the death rates for "Other" we transformed the rates of each of the included groups into total individuals by multiplying by the corresponding population estimate, also from the Institute for Health Metrics and Evaluation. The group-specific totals for all race/ethnicity groups other than non-Hispanic Black were aggregated and divided by the sum of the populations. We then age-standardized the rates by multiplying the crude death rates by age group-specific weights normalized to the 2000 U.S. adult population (ages 20+) so that the weights add up to 1. Further details on the methodology used by the Institute for Health Metrics and Evaluation to estimate death rates and population by race/ethnicity are available in the main text and supplementary material of the publication cited above.

We were unable to locate estimates of age-standardized lung cancer death rates projected through 2060. As a result, we held the 2019 age-standardized death rates constant for 2020 to 2060. While we recognize age-standardized lung cancer death rates have been decreasing since 2000, this is a limitation of our analysis and suggests that any age-standardized death rates we estimate for 2020 to 2060 are likely overestimates and the true rates could be even lower.

2.2 Prevalence of Smoking

We extracted the prevalence of current, former, and never smokers for the years 2000–2018 and 2020 from the National Health Interview Survey.[2] As defined by the National Health Interview Survey, current smokers have smoked at least one hundred cigarettes in their lifetime and still currently smoke; former smokers have smoked at least one hundred cigarettes in their lifetime but currently do not smoke at all; and never smokers have smoked fewer than one

hundred cigarettes in their lifetime. Smoking data is available for the total U.S. population and NH Black; thus, we were able to calculate out smoking rates for "Other" assuming the population-weighted average of NH Black and "Other" equals the total population. Population weights are from the Institute for Health Metrics and Evaluation.

Forecasted estimates of smoking prevalence with and without the FDA ban on menthol cigarettes come from Levy et al. (2021) for the total population and Issabakhsh et al. (2022) for NH Black. Those two studies use the menthol Smoking and Vaping Model from the Center for the Assessment of Tobacco Regulations to estimate the public health impact of cigarette use over time with and without the ban in place.[3] Their models assume the ban took place in 2021 and they provide smoking rates for the years 2021, 2026, and 2060, which are provided in Table 1 for ease of access.

Table 1: Estimates of Adult Smoking Prevalence With and Without the FDA Ban

		Total population			NH Black		
		2021	**2026**	**2060**	**2021**	**2026**	**2060**
Status quo	**Current**	12.6%	10.2%	5.1%	14.4%	11.5%	5.0%
	Former	19.4%	18.4%	9.2%	10.5%	10.5%	5.5%
Menthol ban	**Current**	12.6%	8.7%	4.3%	14.4%	7.4%	3.7%
	Former	19.4%	19.1%	9.2%	10.5%	12.8%	5.5%

We assumed a constant relative rate of change between the available years and imputed smoking rates for 2022 to 2025 and 2027 to 2059. Additionally, we presumed the prevalence of never smokers is equal to 1 minus the sum of current and former smokers. We followed the same population-weighted method used above for the historical rates to back calculate the rates for "Other," using population forecasts available from the U.S. Census Bureau.[4]

2.3 Relative Risks

We extracted adjusted relative risks of smoking as a risk factor for developing lung cancer from a meta-analysis of cohort studies.[5] Those relative risks do not incorporate the additional risk of death from lung cancer, smoking intensity, or years since quitting. Consequently, we apply a scalar to our estimates to align our estimates with a more methodologically rigorous study estimating attributable mortality described in Section 3.2 below. We additionally assume the relative risks do not change over time or vary by R/E.

3. Methods

3.1 Attributable Burden

The population attributable fraction (PAF) of lung cancer mortality due to smoking was calculated using the following formula as proposed by Levin:[6]

$$PAF = \frac{(prev_{never\ smoker} + (prev_{current\ smoker} * RR_{current\ smoker}) + (prev_{former\ smoker} * RR_{former\ smoker})) - 1}{prev_{never\ smoker} + (prev_{current\ smoker} * RR_{current\ smoker}) + (prev_{former\ smoker} * RR_{former\ smoker})}$$

We calculated the PAF for the total population, NH Black, and "Other" for all available years. We then multiplied each PAF by the age-standardized lung cancer death rate to obtain the lung cancer death rate attributable to smoking.

3.2 The Adjustment Scalar

The PAF formula above fails to account for aspects of smoking habits that can influence mortality risk, such as smoking intensity for current smokers and years since quitting for former smokers. The Global Burden of Disease Study (GBD) 2019 incorporated those elements into their estimates of the attributable burden of lung cancer due to smoking for the total U.S. population.[7] To account for the fact that our analysis does not go into as much depth, we scaled our total U.S. population age-standardized attributable death rate estimates to match those produced by the GBD 2019. We applied the same scalars used for the total population to the NH Black and "Other" subgroups as well; the scalars ranged from 1.2 to 1.4. GBD 2019 estimates do not extend beyond 2019, so we held the scalar from 2019 constant for all following years.

References

1. Dwyer-Lindgren, L. et al., "Life Expectancy by County, Race, and Ethnicity in the USA, 2000–19: a Systematic Analysis of Health Disparities," *The Lancet* 400, 25–38 (2022).
2. National Center for Health Statistics, "Crude Percentages of Current Cigarette Smoking for Adults Aged 18 and Over, United States, 2000-2018, 2020," National Health Interview Survey.
3. Levy, D. T. et al., "Public Health Impact of a US Ban on Menthol in Cigarettes and Cigars: a Simulation Study," *Tobacco Control* tobaccocontrol-2021-056604 (2021) doi:10.1136/tobaccocontrol-2021-056604; Issabakhsh, M. *et al.* "Public Health Impact of a US Menthol Cigarette Ban on the Non-Hispanic Black Population: a Simulation Study," *Tobacco Control* tobaccocontrol-2022-057298 (2022) doi:10.1136/tobaccocontrol-2022-057298.
4. U.S. Census Bureau, "U. C. 2017 National Population Projections Datasets," https://www.census.gov/data/datasets/2017/demo/popproj/2017-popproj.html.
5. O'Keeffe, L. M. et al., "Smoking as a Risk Factor for Lung Cancer in Women and Men: a Systematic Review and Meta-Analysis," *BMJ Open* 8, e021611 (2018).
6. Levin, M. L., "The Occurrence of Lung Cancer in Man," *Acta—Unio Int. Contra Cancrum* 9, 531–541 (1953).
7. Reitsma, M. B. et al., "Spatial, Temporal, and Demographic Patterns in Prevalence of Smoking, Tobacco Use and Attributable Disease Burden in 204 Countries and Territories, 1990–2019: a Systematic Analysis From the Global Burden of Disease Study 2019, " *The Lancet* 397, 2337–2360 (2021).