TCP-Model

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Tobacco Control Policy model

Yale School of Public Health

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Version Table

Version	Release Date	Notes	Publications
2.1	2024-11-01	State-specific version of Tobacco Control Policy population model	Tam et al, 2024
2.0	2021-09-24	Tobacco Control Policy population model	Tam et al., 2021
1.0	2017-12-13	Tobacco Control Policy microsimulation model	Tam et al., 2018

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Readers Guide

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Reader's Guide

Core Profile Documentation

These topics will provide an overview of the model without the burden of detail. Each can be read in about 5-10 minutes. Each contains links to more detailed information if required.

Model Purpose
This document describes the primary purpose of the model.

Model Overview
This document describes the primary aims and general purposes of this modeling effort.

Assumption Overview
An overview of the basic assumptions inherent in this model.

Parameter Overview
Describes the basic parameter set used to inform the model, more detailed information is available for each specific parameter.

Component Overview
A description of the basic computational building blocks (components) of the model.

Output Overview
Definitons and methodologies for the basic model outputs.

Results Overview
A guide to the results obtained from the model.

Key References
A list of references used in the development of the model.

Further Reading

These topics will provide a intermediate level view of the model. Consider these documents if you are interested gaining in a working knowledge of the model, its inputs and outputs.

Advanced Reading

These topics denote more detailed documentation about specific and important aspects of the model structure

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Model Purpose

Model Purpose

Summary

This document provides an overview of the Tobacco Control Policy (TCP) model, formerly known as the CISNET Smoking History Generator Population Model. The TCP model is a deterministic, compartmental Markov model that simulates the impact of various tobacco control policies on smoking prevalence and smoking-attributable mortality for US populations. The TCP model uses state-specific inputs and can generate results for each of the 50 states and Washington DC.

Purpose

Tobacco control policy efforts have led to over 8 million fewer deaths and 157 million life-years gained since 1964. [1] Despite this progress, cigarette smoking remains the leading cause of preventable death in the U.S., with approximately 480,000 smoking-related deaths each year.

The TCP model was developed to estimate the potential impact of tobacco control policies on smoking and all-cause mortality. Each of the 50 U.S. states and the District of Columbia are modeled individually, using state-specific inputs for population sizes, tobacco control policy coverage, patterns of smoking initiation and cessation, mortality, and life expectancy.

The model currently includes modules for five key tobacco control policies: cigarette taxes, smoke-free air laws, tobacco control expenditures, Tobacco 21 (formerly the minimum age of legal access), and graphic health warnings. It estimates the potential effects of these policies on smoking prevalence, smoking-attributable deaths avoided, and life-years gained. These results are publicly available to decision-makers, health professionals, and the public health organizations through the TCP tool, an interactive web-based interface for TCP model estimates.

References

1. Theodore R. Holford, Rafael Meza, Kenneth E. Warner, Clare Meernik, Jihyoun Jeon, Suresh H. Moolgavkar, et al. Tobacco control and the reduction in smoking-related premature deaths in the United States, 1964-2012. JAMA. American Medical Association; 2014 Jan;311(2):164–171. PMID: 24399555

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Model Overview

Model Overview

Summary

This document describes the Tobacco Control Policy (TCP) model, which estimates the potential impacts of various tobacco control measures on smoking prevalence and mortality outcomes. It outlines the model's purpose, background, and key features, including differences from its predecessor, the CISNET Smoking History Generator Population Model. [1]

Further details on data sources and policy effect estimates are provided in the Parameter Overview section, while information on policy-specific modules is available in the Component Overview section.

Purpose

The TCP model estimates the impact of various tobacco control measures on smoking prevalence and smoking-related mortality outcomes. The model simulates cigarette smoking patterns for each of the 50 U.S. states and the District of Columbia individually, using state-specific inputs such as population, policy coverage, smoking patterns, mortality rates, and life expectancy. The results are shared with decision-makers, health professionals, and the public through an interactive website: the Tobacco Control Policy tool.

Background

Tobacco use remains the leading preventable cause of death in the United States, accounting for approximately one-third of all cancer deaths.[2] An estimated 85% of lung cancer cases are attributed to smoking, with additional cases linked to secondhand smoke exposure.[2] Efforts to curb tobacco use began with the pivotal Surgeon General's report in 1964, which marked the start of formal tobacco control policies. Since then, these policies have prevented more than 8 million premature deaths and resulted in 157 million life-years gained [3].

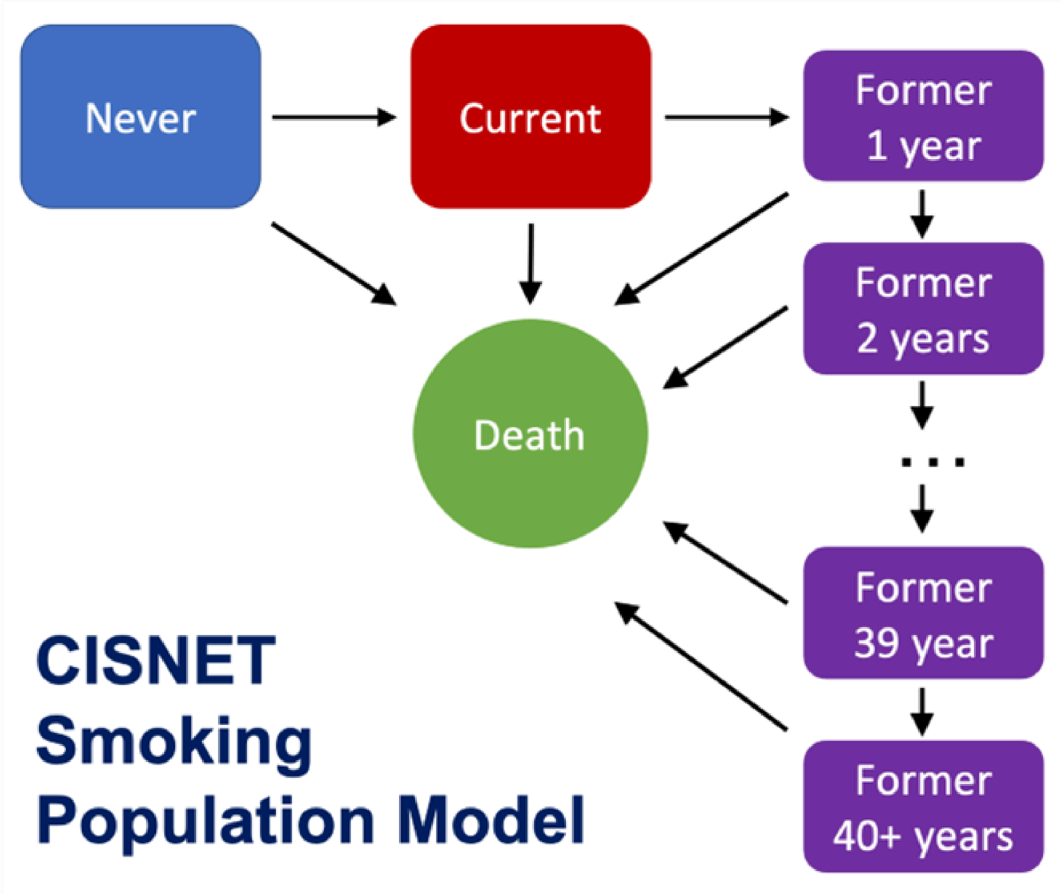
Despite this progress, tobacco use still claims approximately 480,000 lives annually in the U.S., underscoring the ongoing need for strengthened tobacco control measures.[4] Continued action is essential to further reduce smoking rates and related health burdens.

The Tobacco Control Policy (TCP) model is designed to simulate the effects of various tobacco control measures on smoking behaviors and health outcomes. By incorporating state-specific data and modifying smoking initiation and cessation probabilities, the model evaluates the impact of five tobacco control policies: cigarette taxes, smoke-free air laws, tobacco control expenditures, Tobacco 21 laws (which raised the minimum legal age for tobacco purchase to 21), and graphic health warnings.

Model Description

The TCP model is a deterministic, compartmental Markov model, previously known as the CISNET Smoking History Generator Population Model. In this updated version (Version 2.1), state-specific inputs are used to model each of the 50 U.S. states and the District of Columbia individually, instead of modeling the U.S. as a single population. For more details about changes from earlier versions, see the Model Version Updates subsection.

The model projects the annual distribution of people who never smoked, currently smoke, and formerly smoked in each state. These smoking status compartments are stratified by age (0-99 years), gender (male, female), birth cohort (1908-2100), and calendar year (1908-2100). People who formerly smoked are further subdivided based on the number of years since quitting, from 1 to 40+ years. Each time step in the model represents one year. Individuals are born having never smoked, with annual transition probabilities allowing progression to current smoking. Those who currently smoke transition to former smoking according to annual cessation probabilities.



Smoking initiation and cessation probabilities for each state are specific to age, period, birth cohort, and gender. [5]. These probabilities were derived from the 1965–2018 National Health Interview Surveys (NHIS) and state-specific data from the 1992–2019 Tobacco Use Supplement to the Current Population Surveys (TUS-CPS) using an age period cohort (APC) statistical modeling framework. Current smoking is defined as having smoked at least 100 cigarettes in one's lifetime and having smoked at all within the last two years. Defining current smoking status to include those who recently quit produces higher prevalence estimates compared to traditional definitions used by the NHIS, but this approach avoids the need to account for relapse in the TCP model and ensures that the resulting cessation probabilities reflect permanent quitting.

Exit from the population model is based on mortality probabilities according to smoking status and years since quitting (for former smokers) or upon reaching age 99. Mortality estimates rely on data from the 1969–2020 National Center for Health Statistics, detailing annual deaths by gender, state, and age. Further information on smoking and mortality parameters is available in the Parameter Overview section.

Policy effect estimates are translated into adjustments to smoking initiation and cessation probabilities based on available evidence and expert estimates. These adjustments are applied from the policy's effective date (using either observed data or a hypothetical start date) and scaled according to the population affected by the policy.

Smoking-attributable deaths (SADs) are calculated by measuring the difference in mortality between those who currently smoke ($\mu_{cs,a,g}$) and never smoked ($\mu_{ns,a,g}$) at a given age (a), gender (g), and year. This mortality difference is then applied to the size of the population ($P_{a,g}$) multiplied by the prevalence of current smoking ($\text{prev}_{cs,a,g}$) to reflect the number of currently smoking people within that age-gender-year group. The same approach is used to estimate SADs associated with former smoking, with totals summed across the population. For each death attributed to current or former smoking, the smoking-attributable years of life lost (YLL) are calculated by estimating the remaining life expectancy if the individual had never smoked ($e_{ns,a,g}$).

$$\text{SAD} = \sum_a \sum_g \left[P_{a,g} \times \left(\text{prev}_{cs,a,g} \times (\mu_{cs,a,g} - \mu_{ns,a,g}) + \text{prev}_{fs,a,g} \times (\mu_{fs,a,g} - \mu_{ns,a,g})\right)\right]$$

$$\text{YLL} = \sum_a \sum_g \left[e_{ns,a,g} \times \text{SAD}_{a,g}\right]$$

Model outcomes are based on comparisons between a baseline (no policy) scenario and the policy scenarios for each state. These outcomes include reductions in smoking prevalence, smoking-attributable deaths averted, and life-years gained (LYG).

Model Version Updates

TCP model v1.0

Version 1.0 of the TCP model was a policy-specific extension of the CISNET Smoking History Generator (SHG) Microsimulation Model.[6] The SHG microsimulation model simulates detailed individual-level life trajectories from birth, smoking initiation, cessation, and death. US parameters for annual smoking initiation, cessation, and mortality by age, gender, and birth cohort were derived from the 1964-2015 National Health Interview Surveys (NHIS) using a similar APC statistical modeling framework. Unlike more recent versions of the TCP model, the microsimulation model used former smoking mortality probabilities that did not vary by years since quitting. That is, all individuals who formerly smoked in the model had identical age, gender, and birth-cohort-specific mortality probabilities regardless of how long ago they quit.

The SHG microsimulation model was extended to include four policy modules for cigarette taxes, smoke-free air laws, tobacco control program expenditures, and the minimum legal age (MLA) of access to tobacco products. For each of these modeled policies, policy effects were applied to modify underlying smoking initiation and cessation probabilities and thereby simulate the long-term impacts on smoking prevalence and mortality outcomes. This version of the model was developed using US parameters and did not account for geographic differences by state. State-specific results from the microsimulation model were generated by scaling down US-level estimates according to state population sizes and smoking prevalence estimates.

TCP model v2.0

Version 2.0 of the TCP model was known as the CISNET Smoking History Generator (SHG) Population Model[1]—a deterministic compartmental Markov model adapted from the SHG Microsimulation Model (Version 1.0).[6] While this population model shared the same statistical framework as the current TCP model (Version 2.1), it was not state-specific and used only national-level inputs. This version projected the annual distribution of never, current and former smoking within the U.S. population, stratified by age (0-99 years), gender (male, female), birth cohort (1864-2100), and calendar year (1964-2100). In Version 2.0, former smoking mortality varied by years since quitting such that those who quit more recently had mortality rates similar to those who currently smoke. Mortality risk would then decrease with additional years since quitting, gradually approaching the mortality risk of never smokers after 40 years without smoking. Smoking initiation and cessation probabilities were derived using the APC statistical modeling framework and 1964-2018 NHIS data.

TCP model v2.1

Version 2.1 of the TCP model accounts for state heterogeneity. Each of the 50 states and Washington DC are modeled separately using updated smoking initiation, cessation, and mortality parameters as they vary by age, gender, and birth cohort. [5]. See Tam et al. (2024) for details.

Policy Modules

Tobacco 21

The Tobacco 21 (T21) policy module investigates the potential health benefits of laws raising the minimum age of legal access to tobacco products to 21. The T21 policy module uses a comprehensive dataset of real local, state, and federal Tobacco 21 laws from 2005-2024.[7-9] Effects of T21 laws were based on state-level findings from quasi-experimental studies and were translated into individual-level impacts on smoking initiation probabilities.[10] Policy effects are applied in the year following enactment and are scaled based on the percent of the population already covered by T21 laws. Further details about the assumptions made in this policy module can be found in the Assumption Overview Section. A detailed explanation of the application of policy effects can be found in the Parameter Overview section. See Tam et al. (2024) for details.

TCP model version 2.1 results for Tobacco 21 policies can be viewed using the TCP tool at tobaccopolicyeffects.org.

Graphic health warnings

The effects of graphic health warnings on cigarette packages on smoking behaviors were modeled as a combined 10% decrease to smoking initiation and 50% increase to smoking cessation based on expert estimates. While the effects of the policy on initiation were assumed constant over time, the effects on cessation decreased over time using a 20% decay rate. See Tam et al. (2021) for details. [1]

TCP model version 2.0 results for graphic health warnings can be viewed using the TCP tool at tobaccopolicyeffects.org.

Smoke-free air laws, Tobacco control program expenditures, and Cigarette taxes

TCP model version 1.0 results for cigarette taxes, tobacco control program expenditures, and smoke-free air laws can be viewed using the TCP tool at tobaccopolicyeffects.org. See Tam et al. (2018) for details. [6]

References

1. Jamie Tam, Jihyoun Jeon, James F. Thrasher, David Hammond, Theodore R. Holford, David T. Levy, et al. Estimated Prevalence of Smoking and Smoking-Attributable Mortality Associated With Graphic Health Warnings on Cigarette Packages in the US From 2022 to 2100. JAMA Health Forum. 2021 Sep;2(9):e212852.
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Assumption Overview

Assumption Overview

Summary

This section provides an overview of the general assumptions underlying the Tobacco Control Policy (TCP) model. These assumptions are primarily about our model parameters, which are detailed in the Parameter Overview section. These assumptions are for the TCP model in general, and any policy-specific assumptions can be found in the specific policy's subsection of the Parameter Overview. The information below is specific to Version 2.1 of the TCP model.

Assumption Listing

Model Design

The TCP model currently makes the following assumptions:

1. All people who quit smoking, quit permanently with no relapse back to smoking.

2. We do not consider the use of non-cigarette tobacco products such as e-cigarettes.

3. We do not account for the effects of Covid-19 pandemic on smoking or mortality.

Population Estimates

State populations are based US Census Bureau estimates. [1,2]Population sizes are from 2010-2021 and was fixed backwards to 1908 (at the 2010 levels) and forward to 2100 (at the 2021 levels). As the US Census combines individuals aged 85 and older, the Surveillance, Epidemiology, and End Results (SEER) standard US population distribution was used to distribute the 85+ population by single year of age from 85-99.

Smoking Parameters

1. Smoking initiation probabilities are held constant after the 2011 birth cohort for future projections.

2. Cessation probabilities are held constant from the 2003 birth cohort for future projections.

Mortality Parameters

1. Mortality probabilities are held constant from the 1990 birth cohort for future projections.

2. We vary mortality risk among people who formerly smoked by the number of years since quitting using relative risk estimates reported by Thun et al. [3] Mortality risk begins at current smoking levels immediately upon quitting, and then gradually decreases with each year until 40 years since quitting, when mortality risk eventually reaches the level of people who never smoked. See details in the Supplement of Tam et al (2021). [4]

References

1. United States Census Bureau. State Population by Characteristics: 2010-2019. 2021.
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3. Michael J. Thun, Brian D. Carter, Diane Feskanich, Neal D. Freedman, Ross Prentice, Alan D. Lopez, et al. 50-Year Trends in Smoking-Related Mortality in the United States. New England Journal of Medicine. 2013 Jan;368(4):351–364.

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Parameter Overview

Parameter Overview

Parameter Overview

Summary

This document outlines the Tobacco Control Policy Model parameters. It also outlines the policy effects parameters for each policy module. The information below is specific to TCP Model Version 2.1.

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Parameter Listing Overview

Smoking Parameters

Smoking histories for each state were generated using an age-period-cohort statistical modeling framework.[1] This framework produced state-specific smoking initiation and cessation probabilities using data from the 1992-2019 Tobacco Use Supplement to the Current Population Survey (TUS-CPS) for states and the 1965-2018 National Health Interview Survey (NHIS). NHIS data were used to estimate the nationwide relationship between age and ever-smoking prevalence, accounting for factors such as differential mortality by smoking status and recall bias. These age-based parameters served as offsets in each state's model for ever-smoking prevalence, thus standardizing the impact of mortality and recall bias across states. Cohort parameters in the age-period-cohort model were fixed starting from the 1989 birth cohort, thereby anchoring the final cohort year with available data at age 30 (individuals from the 1989 cohort were 30 in 2019, the last year covered by TUS-CPS data).

The smoking initiation probabilities estimated for each state were calibrated so that cumulative initiation probabilities matched the ever-smoking prevalence at age 30. A logistic regression model with constrained natural splines was applied to capture the effects of age, period, and cohort, incorporating sample weights. For future projections, age and cohort parameters were held constant, effectively fixing smoking initiation estimates beyond the 2011 cohort for model projections up to the year 2100.

A similar approach using constrained natural splines for age, period, and cohort effects within a logistic regression model was applied to estimate smoking cessation probabilities. These parameters were held constant for future years, with a net effect being that cessation probabilities were held constant from the 2003 birth cohort. The cessation parameters represent permanent quitting without relapse, where an individual is considered to have quit if they have not smoked for two years, aligning with our prior models. [2-5]Due to this inclusion of those who recently quit, current smoking prevalence estimates in the model are higher than those reported using typical survey definitions of current smoking (which excludes all individuals who do not currently smoke every day or some days regardless of the length of time since they quit). Further information about the baseline smoking prevalence estimates produced by the TCP model using these parameters can be found in the Results Overview section.

State-specific parameters can be viewed at https://apps.cisnetsmokingparameters.org.

Mortality Parameters

An age-cohort model framework was used to generate state-specific mortality rates based on sex, age, cohort, and smoking status. This model utilized midyear population data obtained from the Surveillance, Epidemiology, and End Results (SEER) Program. [6] Additionally, data from the National Center for Health Statistics spanning 1969 to 2020 provided a comprehensive record of annual deaths categorized by state, sex, and age.[7] The age-cohort model was fitted to the deaths data using constrained natural splines to account for age and cohort effects. Knots were employed to improve model fitting, with the final knot for age set to 35, forcing the age trend to continue linearly. This age constraint aligned with the available data and is consistent with the Gompertz mortality model. [8] The Rosenberg method was then used to combine our estimates of mortality with our smoking history parameters to obtain mortality rate estimates by smoking status. [9]

State Population Estimates

Annual state population estimates from 2010-2023 were obtained from the United States Census Bureau. [10,11]These estimates were used to calculate the number of smoking-attributable deaths for each state.

Tobacco 21 Module Policy Parameters

T21 Policy Effects

We obtained estimates of the effects of Tobacco 21 (T21) policies on smoking participation from Hansen et al. (2022) and converted their estimates for individuals aged 18-20 to individual-level changes in smoking initiation probabilities, estimating a 33.91% reduction (95% CI: 55.66%, 15.17%). [12,13]We reviewed the methods used by Hansen et al., conducted additional assumption checks, and compared the results with similar studies. [14,15]The authors found no significant impact of T21 policies on smoking for individuals aged 16-17 or 21+, so we assume no effects of the policy at those ages.

Policy effects are applied in the model by reducing smoking initiation probabilities, $I_{m,t}$, by the effects estimate of raising the smoking from 18 to 21, $E_{T18toT21}$, which is scaled according to the percent of the population covered by T21 policies, $M_{21s,t}$):

$$I_{m,t} = 1 - (E_{T18to21} \times M_{21s,t})$$

A detailed explanation of the literature review conducted, and the derivation of the policy effects estimates can be found in the supplemental file of our publication regarding the effects of T21 policies. [16]

T21 Policy Coverage

Policy coverage data are based on the University of Michigan Tobacco 21 Population Coverage Database [17], the University of Missouri Tobacco Control Research Center’s Tobacco 21 Database [18], and Tobacco21.org. [19] The University of Michigan Database was updated to include localities with T21 policies from 2005 to 2022.

T21 Policy Parameter Assumptions

1. Policy effects estimates in the main model assume no decay over time. An additional scenario in which T21 policies become less effective over time is presented in the supplemental file of our publication regarding the effects of T21 policies [16]. This scenario uses policy effects that decrease with a 20% exponential decay rate beginning in 2030.

2. T21 policy effects are applied in the year following enactment and are assumed to have full enforcement. We also assume that local, state, and federal T21 policies have the same level of effectiveness and enforcement. We evaluated policy effects at the upper and lower bounds of the confidence interval (55.66% and 15.17%) as a sensitivity analysis.

3. Policy effects were estimated based on an age range of 18-20 rather than single year of age. For states where the prior minimum age of tobacco sales was 19 (Alabama, Alaska, New Jersey, Utah), initiation reductions were only applied to ages 19-20.

4. We assume T21 policies have no impact on cessation.

5. We assume T21 policies do not affect those aged less than 18 or older than 20, consistent with Hansen et al findings.

References

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Component Overview

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Component Overview

Component Overview

Summary

This document describes components of the Tobacco Control Policy (TCP) model. The components themselves are available as R script files on Github.

Overview

The TCP model generates baseline smoking prevalence estimates and associated mortality outcomes for each of the 50 US states and the District of Columbia. Individuals in the model are born as never smoking and may transition to current smoking based on the initiation and cessation probabilities specific to each state, age, gender, birth cohort, and year. Smoking-attributable deaths (SADs) are calculated by determining the difference in mortality probabilities between individuals who have never smoked and those who currently smoke, broken down by age, gender, and year. This difference is applied to the population of people who currently smoke in each category, determining by multiplying model-generated prevalence estimates with U.S. Census Bureau data on annual state populations. A similar approach estimates SADs for former smoking. Total SADs are the sum of deaths associated with both current and former smoking across the population. For each death associated with current and former smoking at a specific age, smoking-attributable life-years lost (YLL) are calculated by applying the remaining life expectancy of someone of the same age, gender, and birth cohort who had never smoked, with life-years lost then summed across the population.

The model applies estimated policy effects to underlying smoking initiation and cessation probabilities for policy scenarios. Smoking prevalence, SADs, and YLL are then recalculated using these revised smoking parameters. The model then determines changes to smoking prevalence, number of smoking attributable deaths averted and life-years-gained under the policy scenario.

Component Listing

00_state_process.R

- Performs all initial raw data cleaning and preprocessing for the TCP model. This includes state-specific smoking initiation and cessation probabilities, mortality probabilities, life expectancies, census population data, and policy coverage data.

01_model_inputs.R

- Loads necessary packages, global datasets, and model inputs. The beginning of the file contains options to change model characteristics such as the policy modeled, policy effects, and whether to generate additional output files to be used by the TCP tool website.

02_model_functions.R

- Contains all TCP model functions: generate_prevs(), calculate_mort(), runstates(), and generate_TCPoutput(). A brief description of each function is as follows:

1. generate_prevs() determines the current smoking prevalence for each state by age, cohort, and year.

2. calculate_mort() determines the number of smoking-attributable deaths (SADs) and life years lost (YLL) for each age, cohort, and year.

3. runstates() generates baseline results for each state, applies policy effects, generates results for each policy scenario, including mortality outcomes.

4. generate_TCPoutput() is not a component of the model itself, but rather reformats results for use on the TCP tool website.

03_main_analysis.R

- Runs the TCP model for every state, saving the prevalence and mortality outputs. If specified by the user in ‘01_model_inputs.R’, this will generate the TCP tool data files.

04_visualization.R

- Contains the functions to visualize model outputs.

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Output Overview

Output Overview

Summary

This document describes the output generated by the Tobacco Control Policy (TCP) model. Details about the underlying model can be found in Model Overview.

Overview

The TCP model is used to make long term projections about the effects of various tobacco regulatory policies on smoking prevalence and smoking-attributable mortality at the U.S. level. The model outputs these projections for baseline and policy scenarios. The model results are shared with decision-makers, health professionals, and the public through the Tobacco Control Policy tool.

Output Listing

1. Baseline scenario smoking prevalence for each U.S. state by age, gender, cohort, and year.

2. Baseline scenario number of smoking-attributable deaths (SADs) and associated years of life lost (YLL) for each state by age, gender, cohort, and year.

3. Policy scenario smoking prevalence for each U.S. state by age, gender, cohort, and year.
   - Ex. Smoking prevalence estimates under local Tobacco 21 policies

4. Policy scenario SADs, YLL, SADs averted, and life-years gained (LYG) for each U.S. state age, gender, cohort, and year. If multiple policy scenarios are evaluated, such as different degrees of policy coverage, all results are combined into a single output file.
   - Ex. Tobacco 21 policies only at the local level, Tobacco 21 policies at the state and local levels only, and all Tobacco 21 policies at the local, state, and federal levels.

5. The baseline and policy prevalence and mortality results are output in a format compatible with the TCP tool. These files are generated for each U.S. state and subsequently aggregated to create a comprehensive file for the entire country.

6. Note: Baseline and policy scenario estimates for the US as a whole, and not by each state, are generated by aggregating data from across all 50 states and Washington DC.

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Results Overview

Results Overview

Summary

This document provides an overview of results generated by the Tobacco Control Policy (TCP) model under a baseline scenario, any specific policy scenario results can be found in their respective subsections.

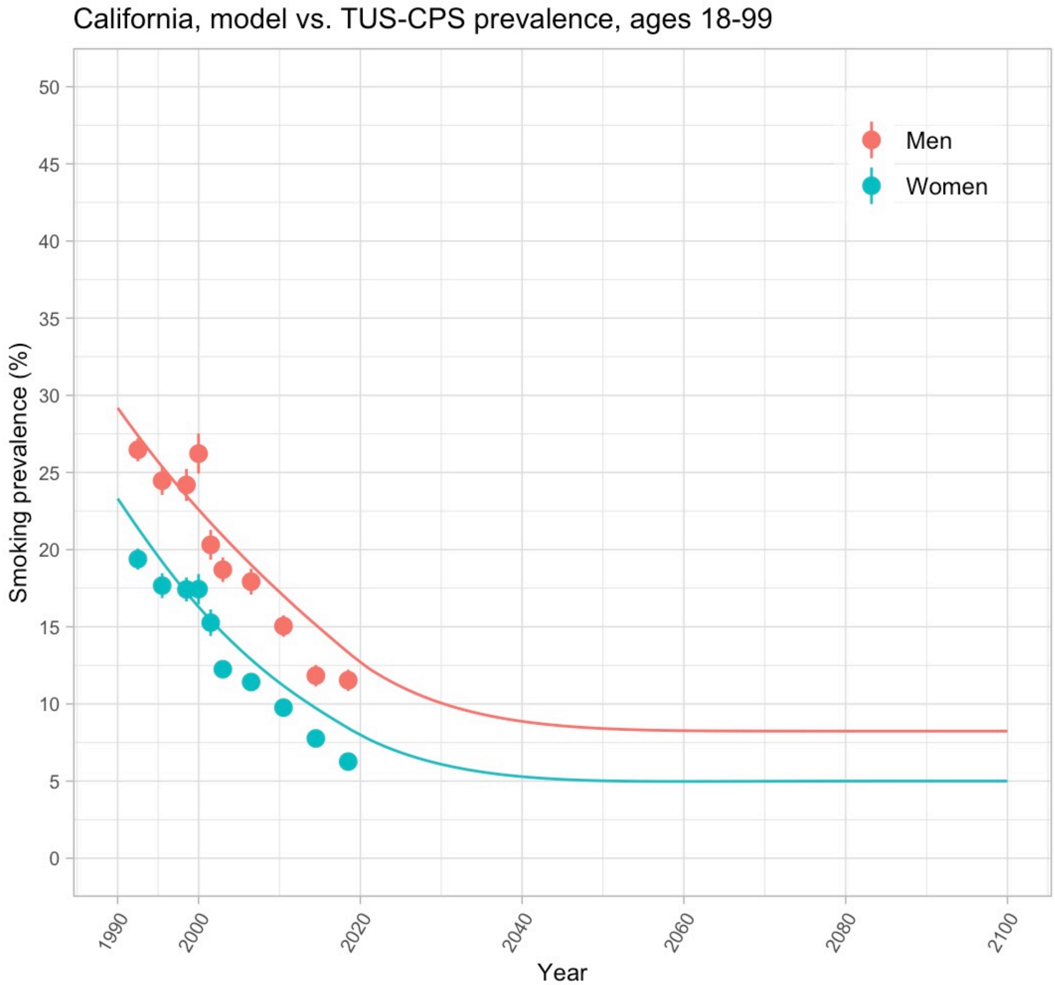
Overview

The primary results of the TCP model include state-specific smoking prevalence reductions, smoking attributable deaths averted, and life years gained under tobacco control policy scenarios. A description of how these results are generated can be found in the Component Overview section.

Results List

Baseline Smoking Prevalence

Baseline smoking prevalence is calculated for each state and compared with 1992-2019 Tobacco Use Supplement to the Current Population Survey (TUS-CPS) data. For some states, the model overestimates smoking prevalence, particularly in more recent years. Our systematic modeling approach for each state facilitates direct comparison between states, but may lead to overestimation in smaller states. The results presented below show smoking prevalence estimates for two example states, California and Wisconsin, as generated by the TCP model, and compares them with data from the Tobacco Use Supplement to the Current Population Survey (TUS-CPS). Under the baseline scenario, smoking prevalence is projected to decrease by 47.2% in California by the year 2100, and by 44.1% in Wisconsin.


California, model vs. TUS-CPS prevalence, ages 18-99
Smoking prevalence (%)
50
45
40
35
30
25
20
15
10
5
0
Men
Women
1990
2000
2020
2040
2060
2080
2100
Year

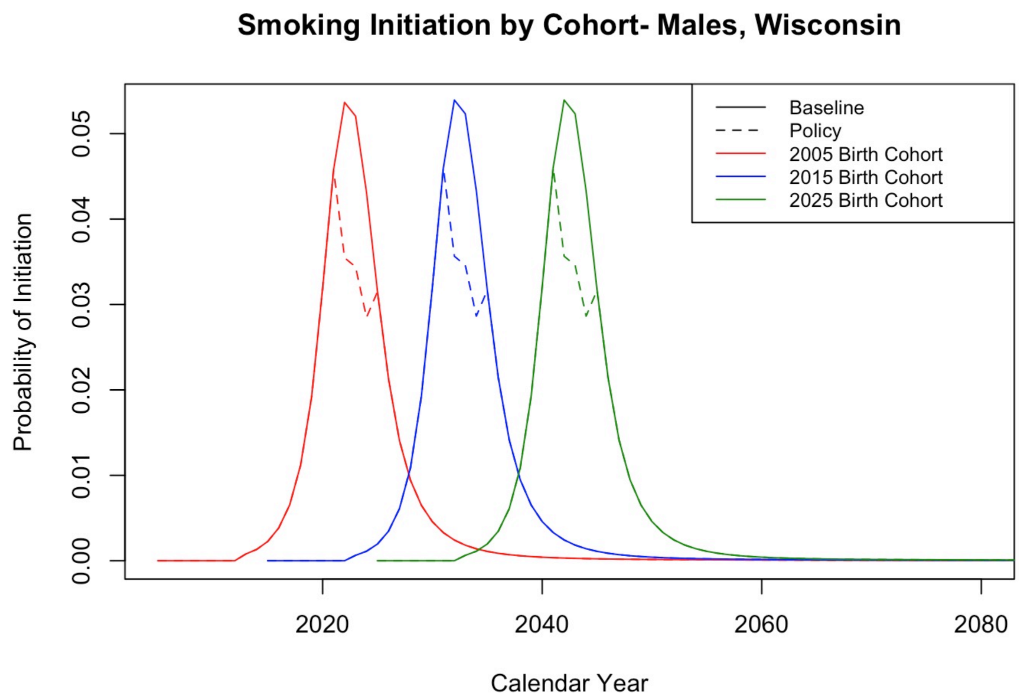
Tobacco 21 (T21) Module Results

Below is an overview of the results for the T21 module of the TCP model. For more detailed results, please see Tam et al. (2024). [1]

Policy Effects on Smoking Initiation

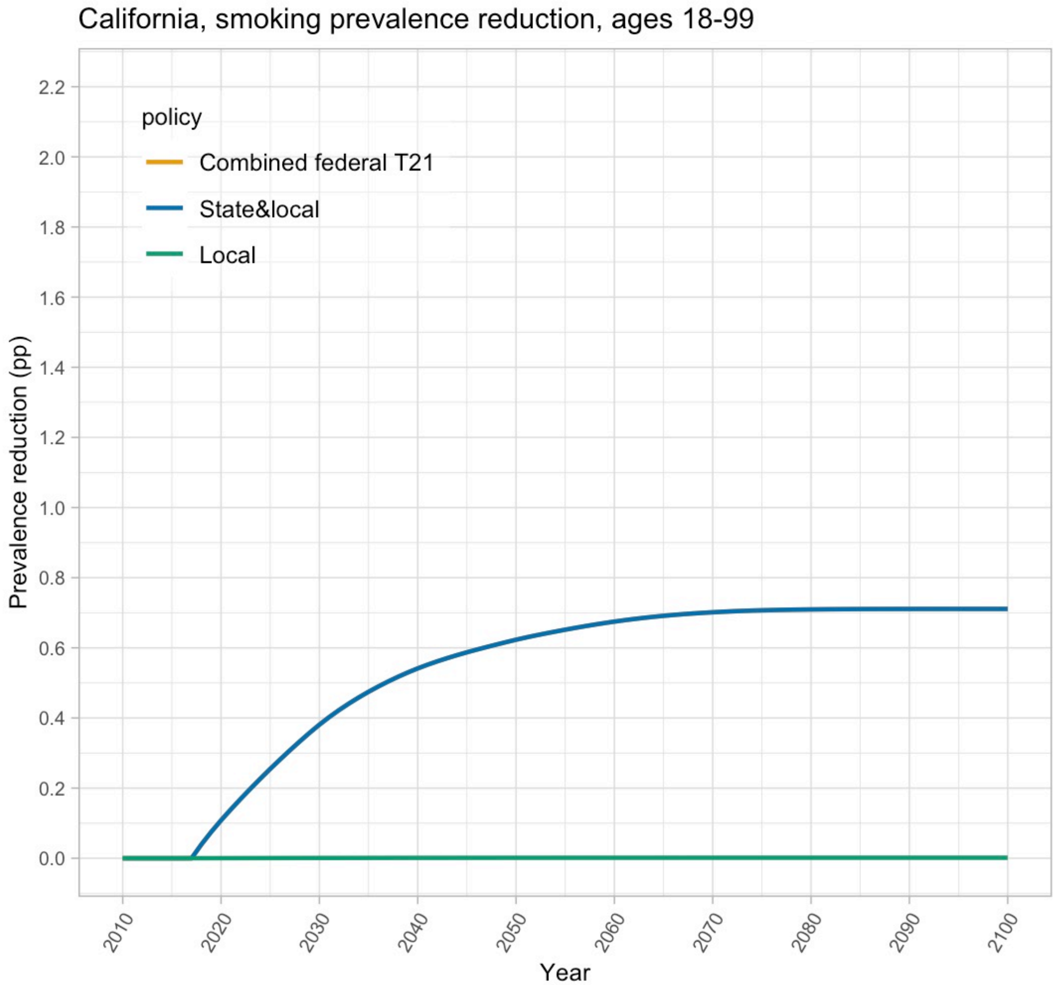
Policy effects are applied in the T21 module by reducing smoking initiation probabilities for ages 18-20. These effects are applied to each state, gender, cohort, and year following policy enactment. For details about how these policy effects are derived and applied, see the Parameter Overview section.

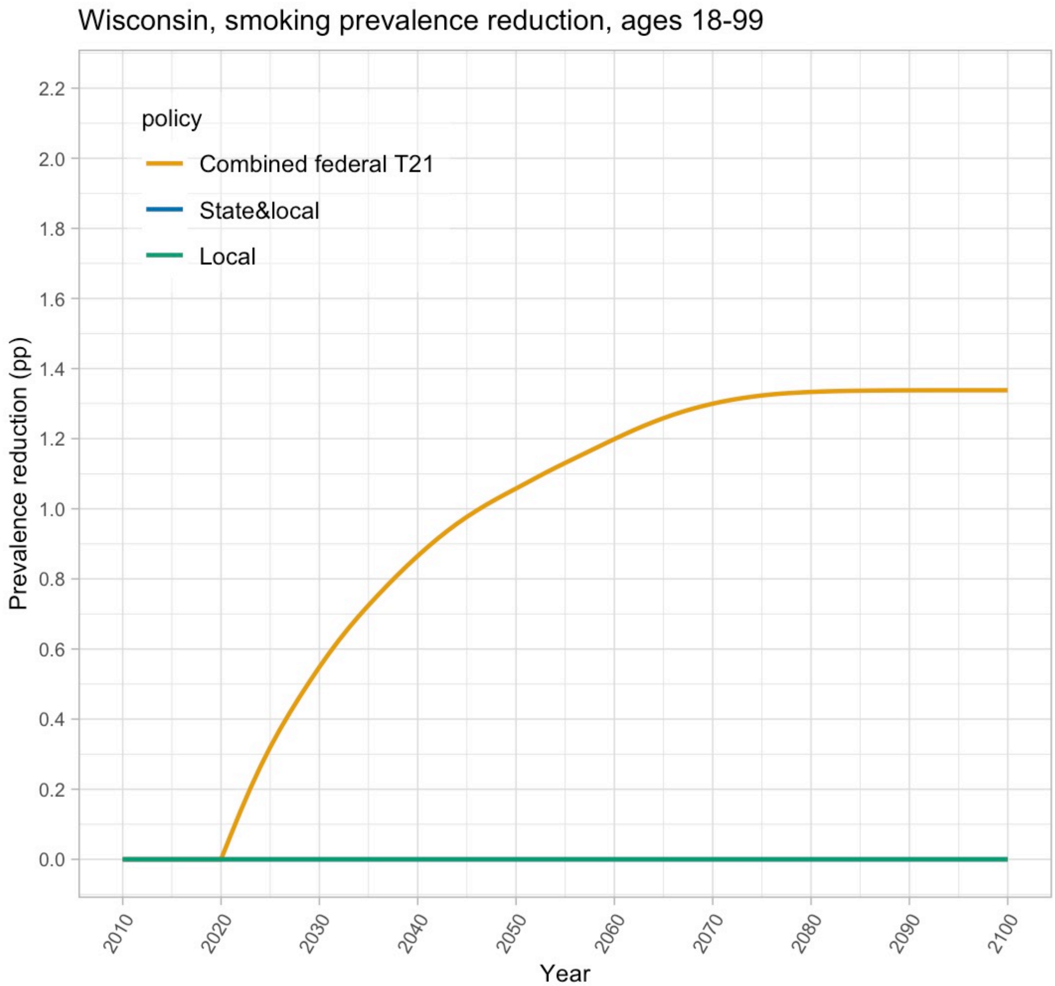
Below are results depicting how smoking initiation probabilities are reduced by cohort for men in the state of Wisconsin under a policy scenario in which all T21 laws (local, state, and federal) are considered.



Smoking Prevalence Reduction

Smoking prevalence reductions relative to the baseline are projected for each state and policy scenario. The policy scenarios modeled are based on the degree of policy coverage: local laws only, state and local laws, and combined local, state, and federal T21 laws. Below are smoking prevalence reductions for two example states, California and Wisconsin, by policy scenario. Results shown are combined values for men and women.


California, smoking prevalence reduction, ages 18-99
policy
Combined federal T21
State&local
Local
Prevalence reduction (pp)
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
Year



Mortality Reduction

Mortality outcomes such as smoking attributable deaths (SADs) averted and life-years gained (LYG) are evaluated for each state, gender, cohort, year, and policy scenario. These results are summed cumulatively through the year 2100 for each state, and then for the whole country.

Mortality results are broken down by policy scenario according to policy coverage tier: 1) local T21 policies, 2) state and local T21 policies, and 3) combined federal, state, and local T21 policies. For each scenario, results are generated using our main policy effects estimate of a 34% reduction in smoking initiation, as well as the lower and upper bounds of the 95% confidence interval of T21 policy effects (55.66%, 15.17%). For the entire United States, local T21 policies are associated with 54,000 (range: 24,000-84,000) premature deaths averted through 2100 and 1.46M (range: 650,000-2.3M) LYG. State and local T21 policies are associated with 435,000 (range: 193,000-681,000) SADs averted and 11.1M (range: 4.9M-17.4M) LYG by 2100. The combined federal T21 policy scenario estimates 526,000 (range: 233,000-824,000) SADs averted and 13.3M (range: 5.9M-20.9M) LYG by 2100.

For more details about the T21 policy module and results by state, see Tam et al. (2024).[1]

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