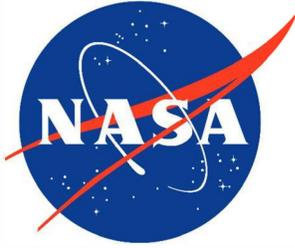NASA/TP-20250006549

Updated Background Incidence, Mortality, and Survival Rates for the NASA Cancer Risk Model: 2018, 2019, 2021 Combined Data

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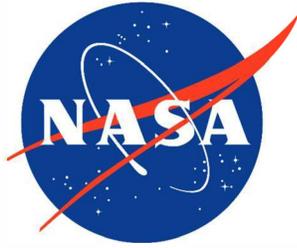For more information about the NASA STI program, see the following:

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Abbreviations

AML   Acute Myeloid Leukemia
BFO   Blood Forming Organs
BRFSS   Behavioral Risk Factor Surveillance System
CDC   Centers for Disease Control and Prevention
CHD   Coronary Heart Disease
CS   Current Smoker
ICD   International Classification of Diseases
FS   Former Smoker
GCR   Galactic Cosmic Rays
LEO   Low Earth Orbit
LSS   Life Span Study
NASA   National Aeronautics and Space Administration
NCHS   National Center for Health Statistics
NCI   National Cancer Institute
NHIS   National Health Interview System
NPCR   National Program of Cancer Registries
NS   Never Smoker
NSAF   Never Smoker Attributable Fraction
NSCR   NASA Space Cancer Risk model
NVSS   National Vital Statistics System
NVSR   National Vital Statistics Reports
REIC   Risk of Exposure Induced Cancer
REID   Risk of Exposure Induced Death
RR   Relative Risk
SAF   Smoking Attributable Fraction
SAM   Smoking Attributable Mortality
SAMMEC Smoking-Attributable Mortality, Morbidity, And Economic Costs
SEER   Surveillance, Epidemiology, and End Results
SRAG   Space Radiation Analysis Group
WEAT   Web Enabled Analysis Tool
WONDER Wide-ranging ONline Data for Epidemiologic Research

I. Abstract

The NASA space cancer risk model requires cancer incidence and mortality rates, along with overall survival data, for male and female U.S. average and never-smoker populations. These data are obtained from U.S. national cancer and health databases and are regularly updated to reflect the current health status relevant to the astronaut population. This report outlines the methods used to acquire and analyze the most recent U.S. background population data and compares the results to previous background data used in the risk model. Cancer incidence and mortality rates were obtained from national cancer databases by combining data from 2018, 2019, and 2021. The 2020 data were excluded due to Covid complications. The survival data were obtained from the 2019 National Vital Statistics Reports U.S. life tables for males and females. Data were interpolated to single ages using cubic spline interpolation with B-spline smoothing and extrapolated beyond available data where needed. Never-smoker rates for smoking sensitive cancers and overall survival were calculated using relative risk data from the 2014 Surgeon General's Report and smoking prevalence data for former, current, and never smokers from the Behavioral Risk Factor Surveillance System web analysis tool. Risk calculations were performed using the updated background data for galactic cosmic ray exposure during a nominal mission duration of 365 days, at ages 35 and 55 for both males and females and compared to risk calculations using previous background data.

II. Introduction

Space radiation is one of the five primary hazards of human spaceflight and poses significant long-term health risks, including cancer, cardiovascular disease, and damage to the central nervous system [1]. The National Aeronautics and Space Administration (NASA) has developed a risk modeling framework—the NASA Space Cancer Risk (NSCR) model—to assess and project the excess lifetime risk of radiation-induced cancer mortality and incidence for astronauts. This model calculates the Risk of Exposure-Induced Death (REID) and the Risk of Exposure-Induced Cancer (REIC), which serve as key metrics for setting career radiation exposure limits [2], [3], [4]. While the NSCR model is primarily used for the assessment of cancer risk for space radiation exposures, it also has the capability to evaluate risks for stroke and coronary heart disease (CHD) [5]. The model relies on epidemiological data from the Japanese atomic bomb survivor cohort, known as the Life Span Study (LSS) [6]. The LSS data are used to derive models capable of estimating excess risks from acute gamma-ray exposures, which must then be adjusted to account for the low dose rates and complex mixed-particle radiation environments encountered in space [3]. Adjustments must also be made to transfer excess risks derived from the LSS cohort, a Japanese population exposed to the atomic bomb during World War II, to a target population more representative of U.S. astronauts and modern-day space travelers.

The transfer of excess risks from the LSS cohort to a population more representative of astronauts requires obtaining cancer incidence and mortality rates, as well as all-cause survival rates for an unirradiated U.S. population (referred to herein as background rates). These background rates must be obtained for males and females across all age groups to facilitate sex- and age-dependent risk projections. Additionally, adjustments are made to account for smoking prevalence and associated risks, ensuring the data reflects a never-smoker population, which better represents astronauts [3].

Given that population health data are periodically updated, the underlying background rates require regular revisions. This ensures the data remains accurate and relevant while allowing for better trend tracking and integration of new epidemiological observations. Since the implementation of the 2012 version of the NSCR [3], cancer incidence and mortality rates have been updated in three-year intervals based on the latest available data from the Centers for Disease Control and Prevention (CDC), Surveillance, Epidemiology, and End Results (SEER) and National Cancer Institute (NCI), as reported by the Space Radiation Analysis Group (SRAG) [7], [8], [9]. Combining data over three-year intervals helps improve statistics for site-specific cancers with low rates. The most recent operational implementation, referred to as the NSCR 2020 version, utilizes data from 2014–2016. The dataset used as input to the NSCR model consists of cancer incidence, mortality, and overall survival rates for males and females, differentiated between the average U.S. population and never-smokers. The data spans all integer ages between 0–101. This report outlines the methods used to acquire and analyze the most recent U.S. background population data and compares the results to previous background data used in the NSCR model.

III. Materials and Methods

III.I U.S. Average Background Cancer Incidence and Mortality Rates

III.I.I Data Sources

This section describes the data sources and analysis methods used to obtain background cancer incidence and mortality rates for the average U.S. male and female populations. Two data sources were used in tandem to obtain the raw cancer incidence and mortality data: the Wide-ranging ONline Data for Epidemiologic Research (WONDER) database provided by the CDC and the NCI's DevCan software. WONDER is the more comprehensive source and includes all cancer site definitions used in the NSCR model. DevCan complemented the WONDER data by providing additional information at older ages, as it includes rates for ages up to 90+, whereas WONDER is limited to 85+. Additionally, the WONDER database was used to obtain background mortality rates for coronary heart disease and stroke for the cardiovascular risk projection capabilities of the NSCR model. The following subsections describe the data sources and selection criteria in detail, as well as the methods used to interpolate the raw data from five-year to one-year age intervals and to extrapolate the rates across the full range of integer ages from 0 to 101 years.

<u>WONDER Databases for Cancer Incidence and Mortality</u>

The WONDER online databases provide access to U.S. cancer incidence and mortality data. The underlying incidence data in WONDER are provided by the National Program of Cancer Registries (NPCR) and the Surveillance, Epidemiology, and End Results (SEER) program. The mortality data in WONDER are provided by the CDC, the National Center for Health Statistics (NCHS), and the National Vital Statistics System (NVSS). U.S. incidence and mortality data for all 50 states and the District of Columbia can be requested based on various factors, including location, age group, race, sex, year of diagnosis, and cancer site. Ages are categorized into 19 groups: the first group is for those under 1 year, the second is for ages 1–4 years, and subsequent groups are in 5-year intervals (e.g., 5–9, 10–14, …), with the final group covering ages 85 and older (85+).

The most recent available data (as of April 2025) was released in 2024 and includes data for years 1999-2021. The cancer incidence was obtained from the WONDER Cancer Incidence Database [10] and the cancer mortality rates from the WONDER Cancer Mortality Database [11]. For this report, data combined by WONDER for the years 2018, 2019, and 2021 were used. Data from 2020 were excluded to align with the years available in the DevCan software, as explained later. The three-year dataset was stratified by sex and cancer subcategories corresponding to cancer sites tracked in the NSCR model [2]. Previous reports describing background cancer incidence and mortality data analysis [7], [8], [9] were used to match the WONDER cancer subcategories to the appropriate NSCR cancer sites, as shown in Table 1.

Table 1. Mapping of WONDER and DevCan cancer subcategories to NSCR cancer sites.

NSCR cancer Site	WONDER subcategories	DevCan cancer sites[*]
Bladder	Urinary Bladder	Urinary Bladder – In Situ and Mal
Brain	Brain and Other Nervous System	Brain and Other Nerv Sys – Mal only
Breast	Female Breast	Female Breast – Mal only
Colon	Colon excluding Rectum	*Excluded*[**]
Esophagus	Esophagus	Esophagus – Mal only
Gallbladder[†]	Gallbladder	Gallbladder – Mal only
Kidney[†]	Kidney and Renal Pelvis	Kidney and Renal Pelvis – Mal only
Leukemia (BFO)	Acute Lymphocytic Leukemia, Acute Myeloid Leukemia, Chronic Myeloid Leukemia, Other Leukemias	*Excluded*[**]
Liver	Liver and Intrahepatic Bile Duct	Liver and Intrahepatic Bile Duct – Mal only
Lung	Lung and Bronchus	Lung and Bronchus – Mal only
Oral Cavity	Oral Cavity and Pharynx	Oral Cavity and Pharynx – Mal only
Other[†]	Small Intestine, Anus, Anal Canal and Anorectum, Intrahepatic Bile Duct, Other Biliary, Retroperitoneum, Peritoneum, Omentum and Mesentery, Other Digestive Organs, Nose, Nasal Cavity and Middle Ear, Larynx, Pleura, Trachea, Mediastinum and Other Respiratory Organs, Bones and Joints, Soft Tissue including Heart, Male Breast, Vagina, Vulva, Other Female Genital Organs, Testis, Penis, Other Male Genital Organs, Ureter, Other Urinary Organs, Eye and Orbit, Other Endocrine including Thymus	*Excluded*[**]
Ovary	Ovary	Ovary – Mal only
Pancreas[†]	Pancreas	Pancreas – Mal only
Prostate	Prostate	Prostate – Mal only
Rectum[†]	Rectum and Rectosigmoid Junction	*Excluded*[**]
Skin[‡]	Other Non-Epithelial Skin	*Excluded*[**]
Stomach	Stomach	Stomach – Mal only
Thyroid	Thyroid	Thyroid – Mal only
Uterus	Cervix Uteri, Corpus Uteri, Uterus, Not Otherwise Specified (NOS)	Cervix – Mal only, Corpus and Uterus, NOS – Mal only

* Cancer sites are listed as they appear in DevCan. Abbreviations include the following: Mal = Malignant, Nerv Sys = Nervous System.
** DevCan data excluded as there was no one-to-one matching available with the Wonder subcategories.
† Rates for pancreas, kidney, gallbladder, rectum, and other are obtained (and available) separately, but are combined into the "remainder" site in the current NSCR code.
‡ While "skin" is a cancer site in the NSCR code, the rates have been set to 0 in the later versions due to its negligible contribution to overall REID [3].

DevCan: Probability of Developing or Dying from Cancer

DevCan is a software package developed by the National Cancer Institute (NCI) to estimate the probability of developing or dying from cancer. DevCan sources its cancer incidence data from the SEER program and mortality data from NCHS. For this report, the latest available version, DevCan 6.9.1 (released in May 2024), was used [12]. The SEER database underlying this latest version is the SEER 22 Incidence Database for 2000–2021 (2020 Excluded). The data from 2020 were excluded due to pandemic-related delays and disruptions that temporarily lowered reported cases [12]. DevCan groups data into pre-defined three-year intervals, but unlike WONDER, selection of individual years is not possible. Consequently, the latest available three-year interval—2018, 2019, and 2021—was used.

Not all the cancer sites included in the NASA cancer risk model are available in DevCan. The software provides similar sex- and age-based groupings as the CDC WONDER database. However, the main reason for incorporating DevCan rates is that the highest available age group is 90+ (compared to 85+ for WONDER), which provides key information for estimating rates up to the limiting age of 101 needed by NSCR. Despite some cancer sites being unavailable in DevCan, the inclusion of additional age groups is helpful for the sites that are available and were therefore included in this report. The mapping of cancer sites in DevCan to NSCR cancer sites and corresponding WONDER subcategories can be found in Table 1.

CDC WONDER Mortality Data for CHD and Stroke

Since NSCR includes the option to account for radiation-induced mortality due to CHD and stroke, the mortality rates for these conditions were also included in the background statistics. These mortality rates were obtained from a separate CDC mortality database for "Underlying Cause of Death" [13]. The data for this database are provided by NCHS and CDC. The International Classification of Diseases, 10th Revision (ICD-10) is used to identify cause of death. The current database covers causes of death from 1999-2023. To provide consistency with the cancer data, the rates from 2018, 2019, and 2021 were selected.

This database has similar data selection categories as the WONDER cancer database, though there are differences. For example, while single-year age groups may be selected in this database, five-year age groups were chosen for better statistics and consistency and to match the grouping used for WONDER cancer data. Table 2 shows the ICD-10 codes used for CHD and stroke in the CDC mortality database.

Table 2. ICD-10 codes to map CDC WONDER mortality rates for CHD and stroke to NSCR cause of death.

NSCR cause of death	ICD-10 Codes
CHD	Ischemic heart disease (I20-I25)
Stroke	Cerebrovascular disease (I60-I69)

III.I.II Data Processing

The NSCR model uses incidence and mortality rates for ages 0-101 years in one-year intervals. However, the raw data from DevCan and WONDER are produced with ages in five-year intervals. Therefore, the data must be interpolated from five-year intervals to one-year intervals.

Previously, the interpolation was performed with STATA using kernel-weighted local polynomial smoothing [7], [8] or restricted cubic spline [9]. In this report, cubic spline interpolation with B-spline smoothing was employed. The interpolation/smoothing was performed in Python (version 3.12.7) with the interpolate subpackage from Python's SciPy package (version 1.4). For the five-year age intervals in WONDER and DevCan, the midpoint of each age group was selected as the representative age, and the corresponding rate (incidence or mortality) was represented by the average rate within each age group. In cases where both WONDER and DevCan provided data for the same midpoint age, the rates from the two sources were averaged to produce a single representative value.

Since the final age category in WONDER is 85+ and in DevCan is 90+, the average age for individuals aged 85–101 and 90–101 was estimated, respectively, using survival data (Section *III.II*). The average age, $a_{avg}(a_1,a_2)$, within an interval $[a_1,a_2]$ can be calculated using the survival function, $S(a)$, according to

$$a_{avg}(a_1, a_2) = \frac{\int_{a_1}^{a_2} a\,S(a)\,da}{\int_{a_1}^{a_2} S(a)\,da}. \tag{1}$$

Cubic spline interpolation was performed on a logarithmic scale, and a set of default options of the Python interpolation routines was chosen for all cancer sites. The B-spline representation of the data is obtained from the splerp function of SciPy's interpolate submodule. The main adjustable option of the splerp function is the smoothness parameter, s, used for controlling the tradeoff between closeness and smoothness of fit (the larger the s, the greater the smoothing). For this work, $s = 0.1$ was chosen as default as it resulted in a smooth and accurate representation of the data for most cancer sites. However, a few cancer sites required adjustment for a better fit as shown in Table 3.

Table 3. Cancer incidence/mortality data requiring a different smoothness parameter than the default option of $s = 0.1$.

Cancer Site	Rate Type	Sex	s
Leukemia (BFO)	Incidence	Male	0.05
Other	Incidence	Male	0.3
Esophagus	Incidence	Male	0.4
Liver	Mortality	Male	0.4
Larynx	Incidence	Female	0.4
Uterus	Mortality	Female	0.4

Another modifiable option is to restrict the spline by removing data points. For the case of male leukemia incidence, the data point for the age group "1-5 years old" was removed. Inclusion of this point caused oscillations in the spline fit at later ages. Childhood rates have no direct relevance or impact for NSCR projections; removing the data point therefore improves fit robustness at older relevant ages without any adverse consequence.

Finally, extrapolation beyond the available data up to age 101 and down to age 0 needs to be addressed. In previous reports, extrapolation was achieved by setting rates constant beyond the available data [7], [8]. Here, a slightly different approach is taken. For cancer sites where DevCan rates are available, the underlying data include a distribution of ages above 90. Hence, beyond the last available DevCan age, point-slope matching was used to project rates up to age 101. For the five cancer sites excluded from DevCan data (Table 1), the last available age is lower than 90. Therefore, after the last available age, point-slope matching was used to extrapolate rates up to age 95, and then rates were set constant from age 95 up to age 101. For the cancer sites that do not have available data for lower ages (e.g. < 30), point-slope matching was used to extrapolate data to lower ages down to 0.

III.II U.S. Average Background Survival Data

In addition to background cancer incidence and mortality data, NSCR also requires overall survival data for the male and female populations. This section describes how U.S. lifetables were analyzed to obtain background survival functions for NSCR.

III.II.I Data Sources

U.S. Life Tables from National Vital Statistics Reports

U.S. life tables for both males and females were obtained from the National Vital Statistics Reports (NVSR), published by the CDC's National Center for Health Statistics (NCHS). These reports provide annual age- and period-specific estimates of all-cause mortality, survival, and life expectancy, based on data from the U.S. Census Bureau and Medicare. The life tables are available for the total population but may be delineated by sex and race as well. In this report, male and female life tables for 2018 [14], 2019 [15], and 2021 [16] were gathered and analyzed. The 2019 data were ultimately used, as discussed in the next section.

III.II.II Data Processing

The NSCR requires a survival function $S(a)$, which represents the probability of surviving to age a, for any integer age from 0 to 101. The survival function can be estimated from the life table data representing the number of individuals, l_a, from a "hypothetical cohort of 100,000 live births who survive to the beginning of each age interval" [15], with the age intervals defined as 0-1, 1-2, ..., 99-100, and 100+. The survival function can be calculated as

$$S(a) = \frac{l_a}{10^5}.$$ (2)

Equation (2) yields a survival fraction at each age that spans between 0 and 1. By definition, survival is 1.0 at age 0 (indicating all individuals are alive at birth) and gradually declines with increasing age. Since the maximum age in the NSCR model is 101, and the last age interval in the life tables is 100+, l_{100} (corresponding to ages 100+) was used for calculating $S(100)$, and $S(101)$ was set to 0.

In contrast to cancer incidence and mortality data—where data from three years are combined—survival functions were previously obtained using life tables from a single year [7], [8], [9]. This approach was taken because life table

data are already smoothed and provided in single-year age intervals, and not much variation is observed over a three-year period. Therefore, the midpoint of the three year interval was used for the life tables (for example, for cancer data from 2010–2012, the 2011 life table was used to represent the three year interval [8]).

The top panel of Figure 1 shows the trend of male and female survival data for years 2011[17] , 2015 [18], 2018 [14], 2019 [15], 2021 [16], and 2022 [19]. As can be seen from the figure, the survival functions for both males and females from 2011 – 2019 are quite similar and almost indistinguishable in the plot. However, a noticeable reduction is observed in the 2021 survival for ages between 40 and 80, which can be attributed to increased mortality from Covid. The bottom panel of Figure 1 compares the trend in survival data for 70-year-olds. It is seen that survival rates for this age group were very stable up through 2019 but were abruptly reduced in 2020 and 2021. A recovery is seen in 2022; although, rates have not yet returned to pre-Covid levels.

The 2019 survival data will be used for this update. This choice maintains consistency with prior analyses [7], [8], [9], where survival data from a single year near the midpoint of the analysis time interval were used (e.g. 2019 selected for the interval 2018-2021). It also allows Covid effects on survival data, which are irrelevant for the intended applications of the NSCR model, to be avoided.
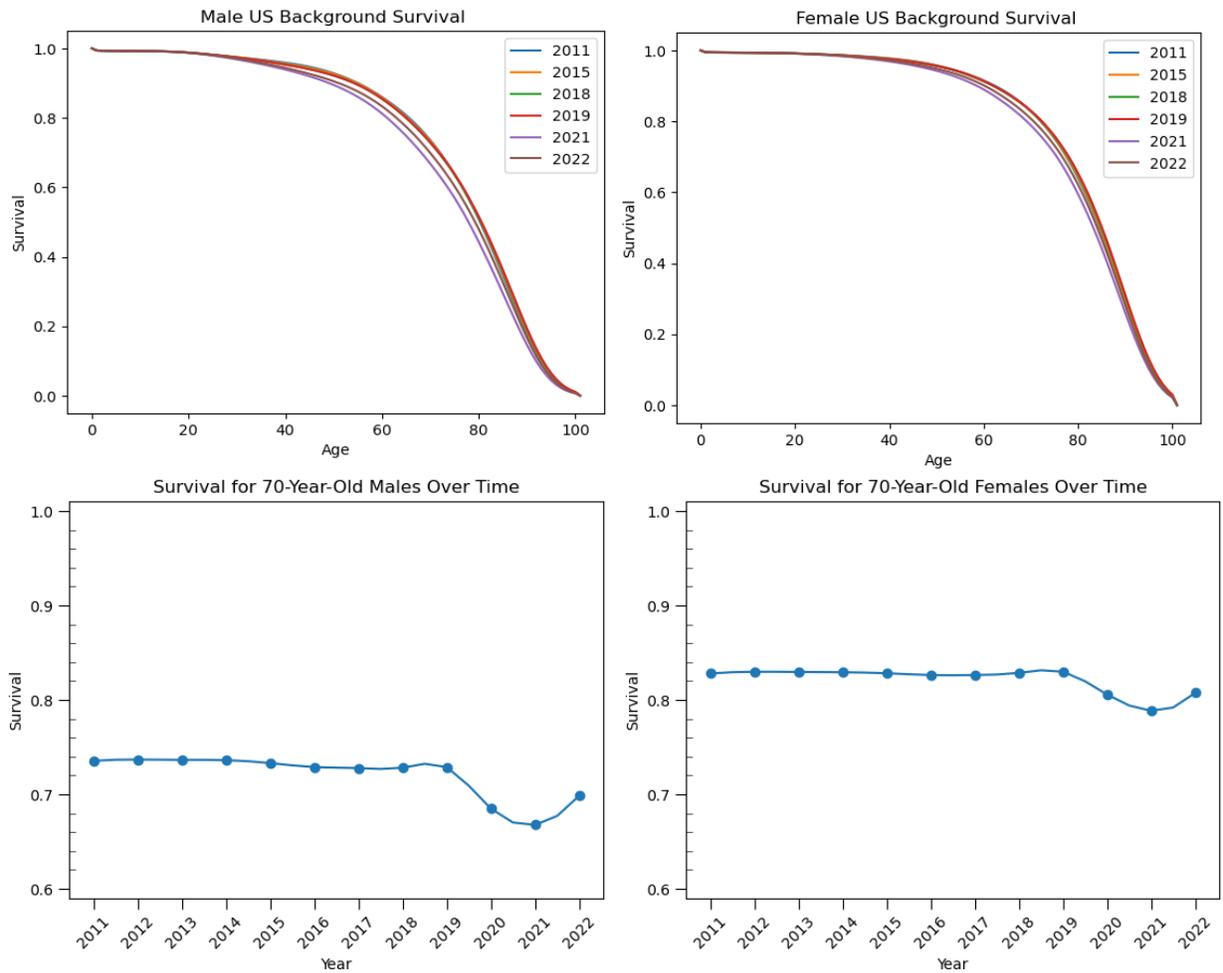
Figure 1. Top: Comparison of male (left) and female (right) survival data obtained from US life tables for years 2011, 2015, 2018, 2019 and 2021. Data for the years before 2021 are overlapping and therefore difficult to distinguish. Bottom: Survival for 70-year-old males (left) and females (right) between the years 2011 – 2022.

III.III Obtaining Background Rates for Never Smoker Population

Due to the exceptional healthy lifestyles of astronauts, the U.S. never smoker population is considered a more relevant cohort to represent astronauts than the average U.S. population [3]. Since the national background cancer databases do not contain separate rates based on smoking status, the never smoker incidence and mortality rates for smoking sensitive cancer sites and overall survival need to be estimated. The approach taken here to generate never smoker disease and survival rates relies directly on data and recommendations from the 2014 Surgeon General's report [20][1]. Additional assumptions or modifications are avoided to the extent possible.

As will be discussed, the background cancer rates for smoking sensitive tissues are estimated based on two types of statistical data: the relative risk (RR) of cancer mortality for never smokers (NS) compared to former (FS) and current smokers (CS), and smoking prevalences[2] for never, former, and current smokers [7], [8], [9]. This section explains the data sources used to obtain RRs and prevalence data for smoking along with the methodology used to calculate never smoker rates.

III.III.I Data Sources

2014 Surgeon General Report for Smoking Relative Risks

The 2014 Surgeon General's report includes three key pieces of information critical to estimate the impact of smoking on incidence, mortality, and survival rates used in NSCR. The first piece appears in Table 12.1 of the Surgeon General's report and includes site-specific RRs (risk estimates tailored to different organs or tissues) for adults 35+ (a single age-adjusted relative risk for the entire age group rather than varying by age). Data contained in the table were generated by the CDC SAMMEC (Smoking-Attributable Mortality, Morbidity, and Economic Costs) methodology, which was developed to estimate smoking attributable mortality (SAM) and relative risks for different cancers and diseases [7], [8]. The information in Table 12.1 of the report used data from 6-years of follow up of American Cancer Society's Cancer Prevention Study II (CPS-II, 1982-1988) [21] and unpublished data by the CDC. The information from Table 12.1 relevant for consideration in NSCR is provided in Table 4.

The second piece of information appears in Table 12.3 of the 2014 Surgeon General's report, which provides age-dependent RRs for certain disease sites (not the same exact list of sites as represented in Table 12.1). Data contained in Table 12.3 were generated by an updated SAMMEC methodology based on pooled studies by Thun et al. [22] (which include additional follow-up for the CPS-II study), Jha et al. [23] and Pirie et. al [24]. The information from Table 12.3 relevant for consideration in NSCR is provided in Table 5.

Updates incorporated into the SAMMEC methodology are discussed in the 2014 Surgeon General's report. The CDC updated its SAMMEC methodology as a result of an expert panel review in 2009-2010. From the 2014 Surgeon General's report: "The expert panel noted that the SAMMEC methodology had been evaluated repeatedly and was found to provide a credible indication of the mortality burden of the disease consequences of smoking." [20]. Additionally, "… the panel recommended that RRs be updated and calculated separately, to the extent possible, for individual racial/ethnic groups and older age strata." [20]. The updated SAMMEC results provided in Table 12.3 of the Surgeon General's report therefore align with the recommendation that more detailed site- and age-dependent information be provided where possible. No recommendation was made regarding the preference to use one set of results over the other (e.g. Table 12.1 vs. Table 12.3). Thus, for the purpose of this work, site-specific age-adjusted RRs are used for the sites listed in Table 4, and age-dependent RRs are used for the sites listed in Table 5. The all-cause RRs from Table 5 are used to adjust overall population survival, as will be discussed in section *III.III.II*.

The third piece of information from the 2014 Surgeon General's report addresses the impacts of smoking on the breast, colon, and liver, which are not considered in the present study. In the case of breast cancer, the Surgeon General concluded that evidence was "suggestive but not sufficient to infer a causal relationship between" [20] smoking-related hazards (tobacco smoke, active smoking, secondhand smoke) and the disease. For colon cancer, the Surgeon

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[1] The most recent Surgeon General report published in 2020 focuses on determining the benefits of quitting smoking and does not provide any new guidance or updates for obtaining relative risk estimates.

[2] Prevalence refers to portion of the population that, at a certain time period, has a health condition (such as cancer), or in this context engages in a health-related behavior such as smoking.

General concluded that sufficient evidence existed to infer causality between smoking and the disease. However, data in the 2014 Surgeon General's report were only provided as RRs for benign colorectal adenomas and adenomatous polyps. While these benign lesions can potentially develop into cancer, the RRs cannot be used directly as a measure for smoking induced cancer mortality. For liver cancer, the Surgeon General concluded that sufficient evidence existed to infer causality between smoking and the disease. Additional consideration is required to control for the effects of alcohol consumption and hepatitis on the resulting RRs. While certain studies discussed in the 2014 Surgeon General's report controlled for these additional factors, the RRs provided did not encompass the required never and former smoker categories (ever smokers were studied instead). In summary, never smoker adjustments are not applied to breast cancer due to insufficient causal evidence; never smoker adjustments are not applied to colon or liver cancer due to lack of directly compatible RRs.

Table 4. Site-specific smoking mortality RRs from Table 12.1 of the 2014 Surgeon General's report.

Risk Tissue	Age	Male		Female	
		Current Smoker	Former Smoker	Current Smoker	Former Smoker
Oral Cavity	35+	10.89	3.40	5.08	2.29
Esophagus	35+	6.76	4.46	7.75	2.79
Stomach	35+	1.96	1.47	1.36	1.32
Pancreas	35+	2.31	1.15	2.25	1.55
Larynx[*]	35+	14.60	6.34	13.02	5.16
Cervix Uteri[*]	35+	NA	NA	1.59	1.14
Kidney[†]	35+	2.72	1.73	1.29	1.05
Bladder	35+	3.27	2.09	2.22	1.89
AML[*]	35+	1.86	1.33	1.13	1.38

[*]These tissues are sub-tissues of NSCR cancer sites. Larynx is sub-tissue of "other" (and subsequently "remainder"), cervix uteri is sub-cancer of uterus, and AML a sub-cancer of leukemia (BFO).
[†] Kidney is one of the tissues that constitute the "remainder" site in NSCR.

Table 5. Age- and site-specific smoking mortality RRs from Table 12.3 of the 2014 Surgeon General's report.

Cause	Age	Male		Female	
		Current Smokers	Former Smokers	Current Smokers	Former Smokers
Lung Cancer	35-54	14.33	4.40	13.30	2.64
	55-64	19.03	4.57	18.95	5.00
	65-74	28.29	7.79	23.65	6.80
	75+	22.51	6.46	23.08	6.38
CHD	35-54	3.88	1.83	4.89	2.23
	55-64	2.99	1.52	3.25	1.21
	65-74	2.76	1.58	3.29	1.56
	75+	1.98	1.32	2.25	1.42
Stroke*	35-64	3.27	1.04	4.00	1.30
	65-74	2.17	1.23	2.27	1.24
	75+	1.48	1.12	1.70	1.10
All causes	35-54	2.55	1.33	1.79	1.22
	55-64	2.97	1.47	2.63	1.34
	65-74	3.02	1.57	2.87	1.53
	75+	2.40	1.41	2.47	1.43

*For stroke RRs, only two age categories of 65-74, and 75+ were provided in table 12.3 of the Surgeon General's report [20]. The stroke RRs for age category of 35-64 were obtained from the earlier SAMMEC RRs reported in table 12.1 of the report [20].

As will be discussed in Section *III.III.II*, age-specific smoking prevalence data for males and females—categorized as former, current, and never smokers—are needed for calculating never-smoker (NS) incidence and mortality rates. Previously [7], these data for the U.S. population were obtained from the National Health Interview Survey (NHIS), as reported in the 2014 Surgeon General's Report [20], covering selected years from 1965 through 2011. For more recent years, and for the purposes of this study, data were obtained from the Behavioral Risk Factor Surveillance System (BRFSS), administered by the CDC [25].

The BRFSS Web-Enabled Analysis Tool (WEAT) is an online platform that offers access to prevalence estimates and analysis tools for health-related behaviors —including smoking— from the largest telephone health survey system in the U.S. Users can select prevalence data for a health condition of interest based on the location and years of interest (with data currently available from 2004-2022) and further categorize the estimates based on different factors such as demographics and risk levels. Accordingly, the BRFSS WEAT platform was utilized with the "Cross Tabulation" option to obtain the age-specific smoking prevalence data for 2018, 2019 and 2021. The system allows for the classification of data into sex-specific and 14 age groups, beginning at age 18 and increasing in five-year intervals, with the final group encompassing individuals aged 80 and above. Additionally, the tobacco use was further categorized in four smoking levels including former smokers, current everyday smokers, current someday smokers and never smokers[3]. The selection criteria used for the "Cross Tabulation" option are shown in Table 6. The analysis results include the sample size for the selected variables and the weighted percentages for each category based on the specified selection criteria. In this report the appropriate weighted percentage (in this case "Column %") were used. The obtained data from the WEAT system for this study are shown in Table 7.

Table 6. Selection criteria used in BRFSS WEAT Cross Tabulation to obtain smoking prevalence data.

Year(s)	2018, 2019, 2021 (combine)
Location(s)	All (single)
Row Variable	Tobacco Use: Calculated variable for 4 level smoker status: everyday/someday/former/non-smoker (_SMOKER3)
Column Variable	Demographic Information: Respondents sex
Control Variable(s)	Demographic Information: Calculated variable for 14-level age category (_AGEG5YR)

Table 7. U.S. smoking prevalence (%) data for 2018, 2019, 2021 as obtained from the BRFSS WEAT.

	Male			Female		
Age (years)	Never Smokers (%)	Current Smokers (%)	Former Smokers (%)	Never Smokers (%)	Current Smokers (%)	Former Smokers (%)
18-24	80.9	11.1	8.0	87.2	7.8	5.0
25-29	62.2	20.1	17.7	74.8	14.1	11.1
30-34	56.5	21.4	22.1	69	15.5	15.5
35-39	52.4	22.4	25.2	66.2	16.2	17.6
40-44	52.1	21.0	26.9	66	15.6	18.4
45-49	55.7	18.8	25.5	65.9	15.5	18.6
50-54	56.7	18.5	24.8	63.7	16.6	19.7
55-59	52.7	19.0	28.3	57.7	17.4	24.9
60-64	48.0	17.5	34.5	55.9	15.4	28.7
65-69	45.0	14.4	40.6	58.8	11.7	29.5
70-74	41.8	10.3	47.9	58	9.5	32.5
75-79	39.1	7.5	53.4	57.3	6.5	36.2
80+	42.0	4.0	54.0	64.7	3.6	31.7

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[3] The four smoking categories were later grouped into CS, FS, and NS after downloading the data to match the grouping needed for the NS calculations. The CS is sum of current every-day and someday smokers.

III.III.II Data Processing

To obtain the never smoker background cancer incidence and mortality rates, a quantity referred to as the Never Smoker Attributable Fraction (NSAF) [7], [8] needs to be calculated. The NSAF is evaluated by considering the process used by the CDC to estimate Smoking Attributable Fractions (SAFs) and SAM.

The SAF for each cancer site, *T*, identified in Tables 4 and 5 is calculated according to [7], [8]

$$\text{SAF}_T = 1 - \frac{1}{\text{RR}_T}. \tag{3}$$

It should be noted that RR_T and related quantities such as SAF_T are sex and age dependent, but for simplicity, the dependencies are not shown in the equations. The quantity RR_T is the relative risk of smoking mortality for cancer *T* in the U.S. population compared to a never smoker population and can be calculated according to [7], [8]

$$\text{RR}_T = \text{P}_{\text{NS}} + \text{P}_{\text{FS}}(\text{RR}_{T,\text{FS}}) + \text{P}_{\text{CS}}(\text{RR}_{T,\text{CS}}), \tag{4}$$

where $\text{P}_{\text{NS}}, \text{P}_{\text{FS}}, \text{P}_{\text{CS}}$, are the smoking prevalences for never smokers, former smokers and current smokers, respectively. The quantities $\text{RR}_{T,\text{FS}}$ and $\text{RR}_{T,\text{CS}}$ are respectively the relative risks for FS and CS compared to NS. The NSAF is defined as [7], [8]

$$\text{NSAF}_T = 1 - \text{SAF}_T = \frac{1}{\text{RR}_T}. \tag{5}$$

Combining equations (3), (4), and (5) yields the final expression for NSAF_T [7], [8]

$$\text{NSAF}_T = \frac{1}{\text{P}_{\text{NS}} + \text{P}_{\text{FS}}(\text{RR}_{T,\text{FS}}) + \text{P}_{\text{CS}}(\text{RR}_{T,\text{CS}})}. \tag{6}$$

The NS cancer mortality and incidence rates are consequently calculated by multiplying average U.S. population rates by NSAF_T. That is if $\lambda^{(I)}_{T,Avg}(a)$ and $\lambda^{(M)}_{T,Avg}(a)$ are respectively the average incidence (*I*) and mortality (*M*) rates for cancer *T* at age *a*, then the corresponding NS incidence and mortality rates are obtained from

$$\lambda^{(I)}_{T,NS}(a) = \text{NSAF}_T(a) \times \lambda^{(I)}_{T,Avg}(a), \tag{7}$$

$$\lambda^{(M)}_{T,NS}(a) = \text{NSAF}_T(a) \times \lambda^{(M)}_{T,Avg}(a), \tag{8}$$

where the age-dependence of NSAF_T has been made explicit for clarity. Equation (7) uses the mortality-based $\text{NSAF}_T(a)$ to estimate the never-smoker incidence rate from the average U.S. population incidence rate, consistent with prior analyses [7], [8], [9].

For each of the smoking sensitive tissues identified earlier, NSAF needs to be calculated for each integer age from 0 to 101 for both males and females. To achieve this, both the smoking prevalence data and RRs must be defined at single-year intervals. For prevalence, it is justifiably assumed that 0% of the population at age 0 are classified in current or former smoker categories, providing an anchor to guide extrapolation below age 18. The values from Table 6, combined with the anchor point at age 0 were interpolated to single-year ages using the same B-spline method described in Section *III.I.II*, with the smoothing parameter *s* set to 0, resulting in all data points to be fitted. Beyond age 80, the average age of the population from 80-101 was calculated using equation (1). The smoking prevalences are extrapolated to this average age using the aforementioned spline and held constant thereafter.

For sites identified in Table 5, the age-dependence of RRs is represented only for four broad age groups starting at age 35. Extra processing is needed to translate this information into a single year format. Due to the small number of age intervals in Table 5, linear interpolation was employed using NumPy's `interp` function, which is more appropriate for sparse data than cubic spline smoothing. The representative ages for each age group were determined using equation (1). The RRs are set to 1 at age 0 (where smoking prevalence is 0) and are assumed to rise linearly until age 35. Beyond age 35, RRs were linearly interpolated between the midpoints of successive age groups. For ages greater than 75, the average age of the population from 75-101 was calculated using equation (1). The RRs were extrapolated to this average age and held constant thereafter. For sites identified in Table 4, the age-adjusted RRs were held constant for all integer ages beyond 35. For ages below 35, the same linear increase from RR = 1 at age 0 to the RR value at age 35 was applied, ensuring consistency in the treatment of younger ages across all sites.

Finally, as noted earlier and shown in Table 1, AML, larynx, and cervix uteri are subcategories within broader cancer site groupings in NSCR—specifically, AML is part of leukemia (BFO), larynx is part of other/remainder, and cervix uteri is part of uterus. For the present work, the method outlined in [7] to enable NS corrections to be applied to AML, larynx, and cervix uteri subcategories and retain integration within the broader cancer site groupings in NSCR is used. For each broader cancer site category, T, (i.e., leukemia, other/remainder, uterus), the NS rate is calculated by subtracting an estimate for the component of the smoking-sensitive subcategory, t, (i.e., AML, larynx, cervix uteri) that can be attributed to smokers. The mathematical expression can be written as

$$\lambda_{T,NS}(a) = \lambda_{T,Avg}(a) - [\lambda_{t,Avg}(a) - \lambda_{t,NS}(a)]. \tag{9}$$

Equation (9) is used for both incidence and mortality data.

Never Smoker Estimation for Background Survival Data

The NS modification of the survival function, denoted as $S_{NS}(a)$, requires a few more steps than obtaining NS cancer mortality and incidence rates. In the first step, the hazard function for the average population, $m_{ave}(a)$, was obtained for each age, a. The method for obtaining the hazard function from the life tables is detailed in **Appendix A**. In the next step, which is analogous to obtaining NS cancer rates, the hazard function for the NS population, $m_{NS}(a)$, is obtained according to

$$m_{NS}(a) = \text{NSAF}_{\text{all-cause}}(a) \times m_{ave}(a) \tag{10}$$

The quantity $\text{NSAF}_{\text{all-cause}}(a)$ is obtained according to equation (6), where T in the equation is replaced with "all-cause" mortality. The RRs for all-cause mortality are derived from Table 5 and interpolated for individual age as before. Subsequently, $S_{NS}(a)$ was calculated from $m_{NS}(a)$ according to the well-known equation for the exponential survival function

$$S_{NS}(a) = e^{-\sum_{i=0}^{a} m_{NS}(i)}. \tag{11}$$

III.IV REID Calculations

The NSCR 2020 model [2] was used to calculate REID in order to compare the updated background data (2018, 2019, 2021 cancer incidence, mortality, and survival) with previous background datasets developed for NSCR (2011 [8] and 2015 [9]). For missions beyond low Earth orbit (LEO), the primary radiation risk that cannot be fully mitigated by shielding is exposure to galactic cosmic rays (GCR) [1]. Therefore, REID was calculated for a hypothetical 365-day mission beyond LEO, subjected to GCR exposure under solar minimum conditions (when GCR flux is at maximum).

To obtain the GCR environment described, the Badhwar-O'Neill 2020 GCR model [26] was used in combination with the HZETRN2020 radiation transport code [27]. To represent the shielded tissue environment, the October 1976 solar minimum GCR flux was evaluated behind 20 g/cm² of spherical aluminum shielding [28]. REID was calculated for male and female astronauts at ages 35 and 55, using the background data for both the average and never-smoker populations. To obtain the average REID values and 95% confidence intervals, 100,000 Monte Carlo trials were used [2].

IV. Results

IV.I   U.S. Average Background Cancer Incidence and Mortality Data

Figures 2–20 show 2018, 2019, 2021 combined average U.S. interpolated incidence and mortality rates for males and females (using the method described in section III.I.II), alongside the underlying CDC WONDER and DevCan data (where available) for the cancer sites listed in Table 1. Background data from previous studies ([8], [9]) are also shown for comparison. The "Remainder" site in NSCR includes the tissue sites "Gallbladder", "Kidney", "Liver", "Other", and "Pancreas" and are shown in Figures 7, 10, 13, 15 and 17, respectively. Since these individual components were fitted separately to WONDER and DevCan data for interpolation, they were shown individually. The summed "Remainder" site used for the NSCR is shown in Figure 21. Figure 22 presents the total solid cancer rates. The updated average incidence and mortality background data as used for NSCR are provided in Appendix B (Tables 8-11).
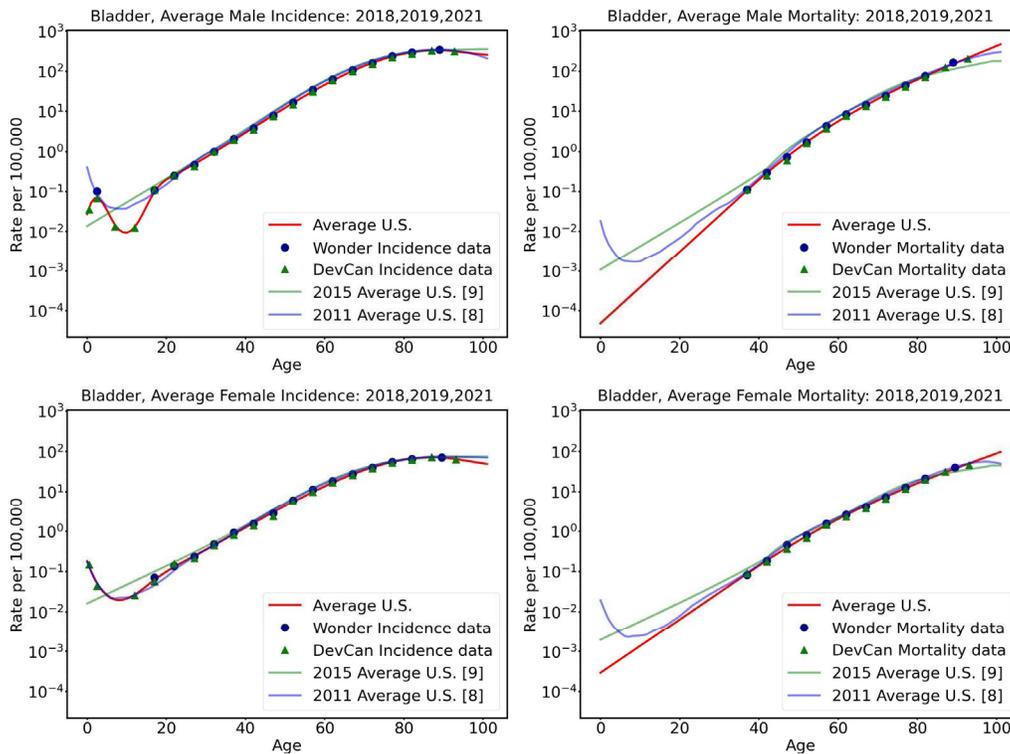
Figure 2. Bladder, 2018, 2019, 2021 average cancer incidence and mortality rates for males and females. Comparison of interpolated results to WONDER, DevCan, and prior analyses [8] [9].
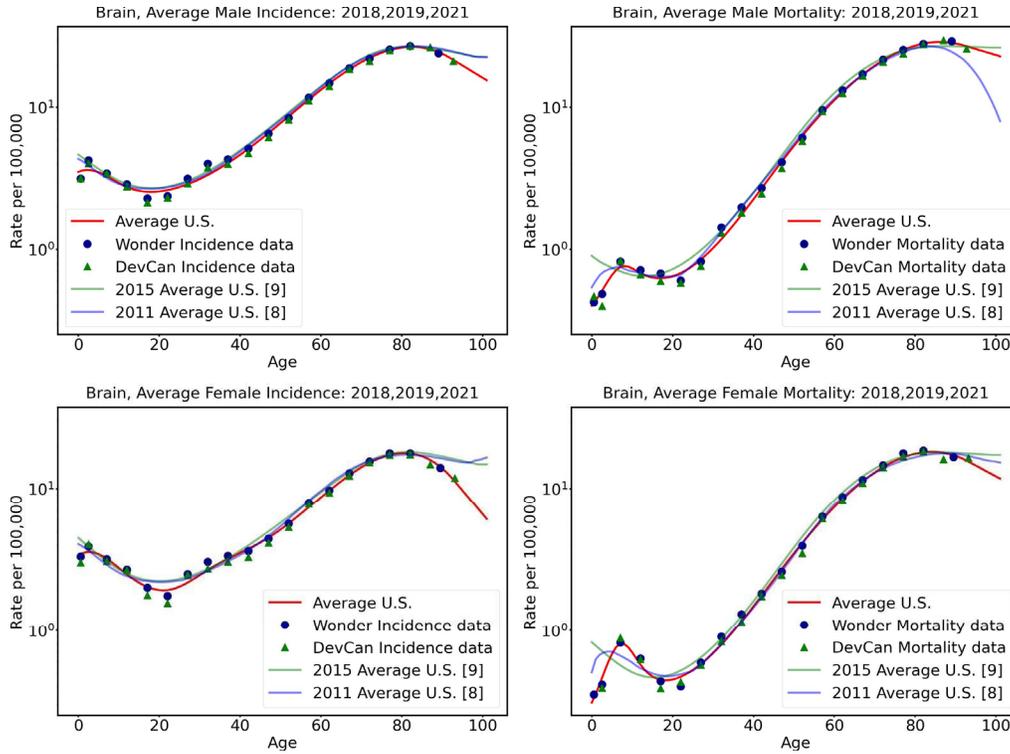
Figure 3. Brain, 2018, 2019, 2021 average cancer incidence and mortality rates for males and females. Comparison of interpolated results to WONDER, DevCan, and prior analyses [8] [9].
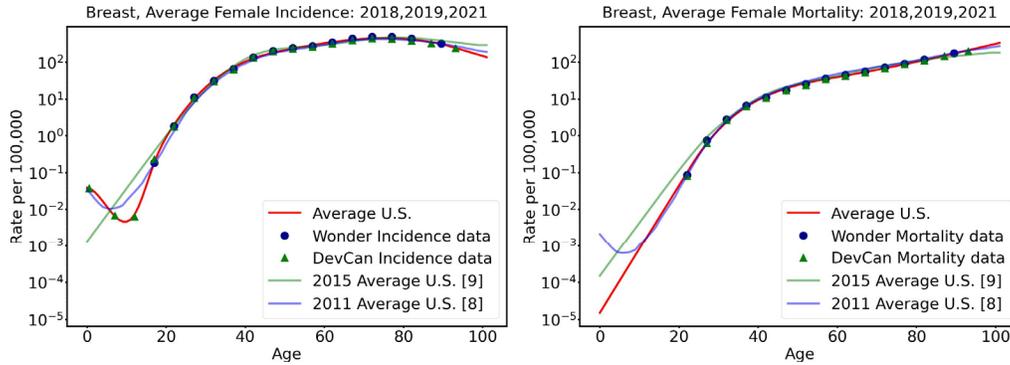
Figure 4. Breast, 2018, 2019, 2021 average cancer incidence and mortality rates for females. Comparison of interpolated results to WONDER, DevCan, and prior analyses [8] [9].
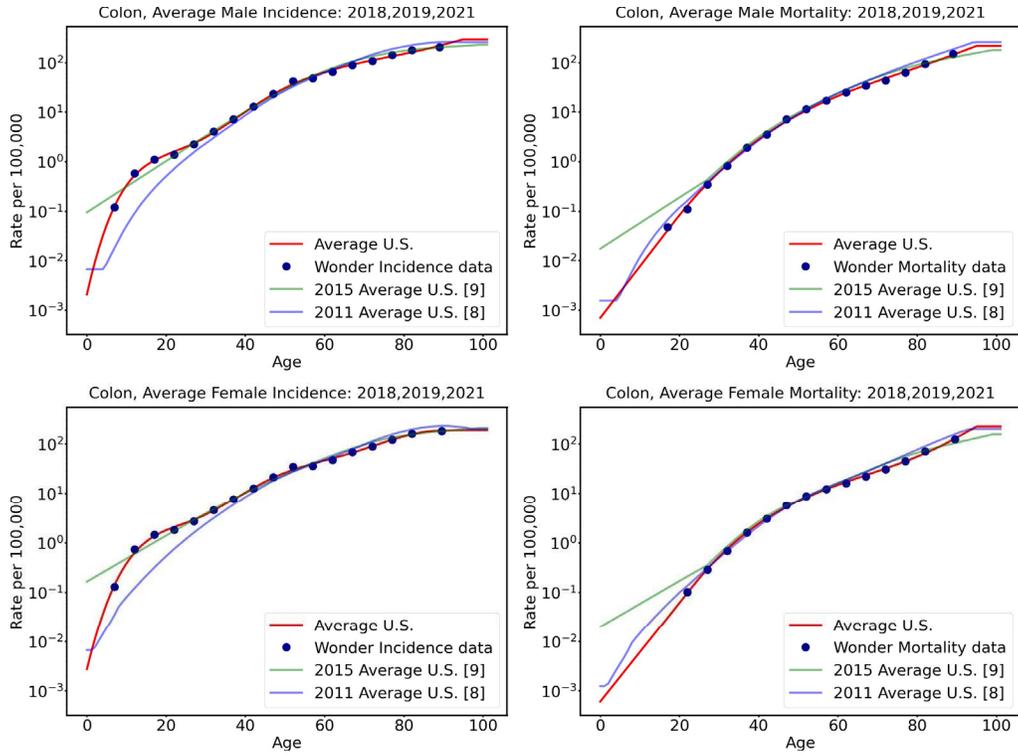
Figure 5. Colon, 2018, 2019, 2021 average cancer incidence and mortality rates for males and females. Comparison of interpolated results to WONDER, DevCan, and prior analyses [8] [9].
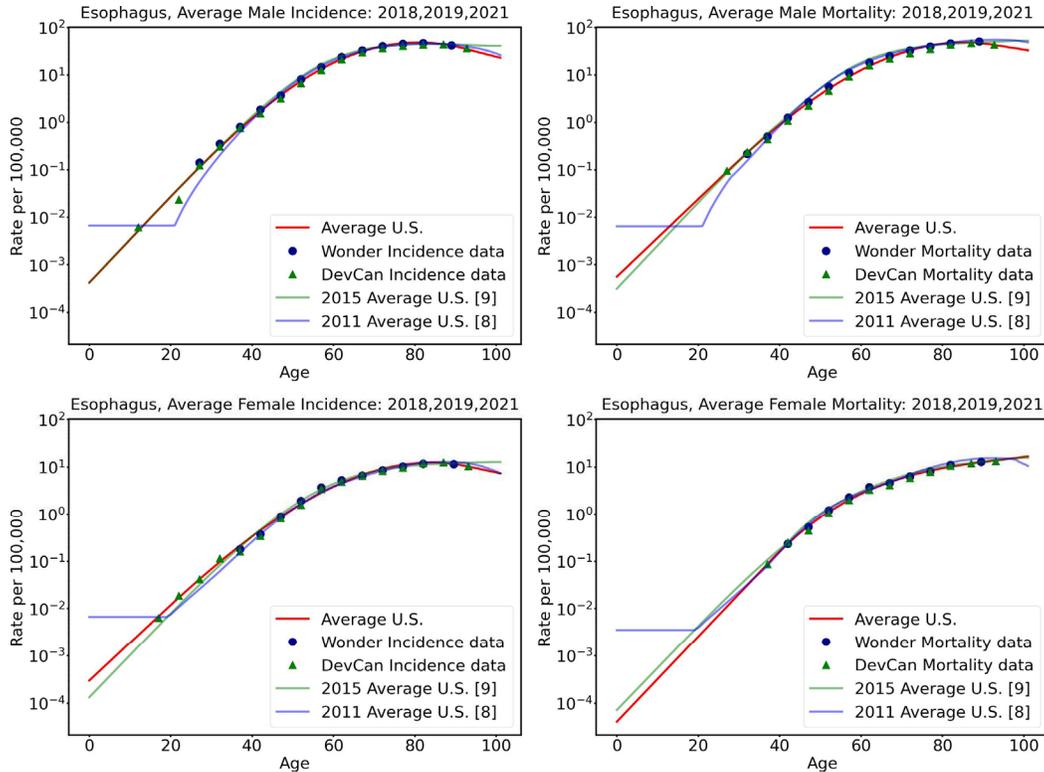
Figure 6. Esophasgus, 2018, 2019, 2021 average cancer incidence and mortality rates for males and females. Comparison of interpolated results to WONDER, DevCan, and prior analyses [8] [9].
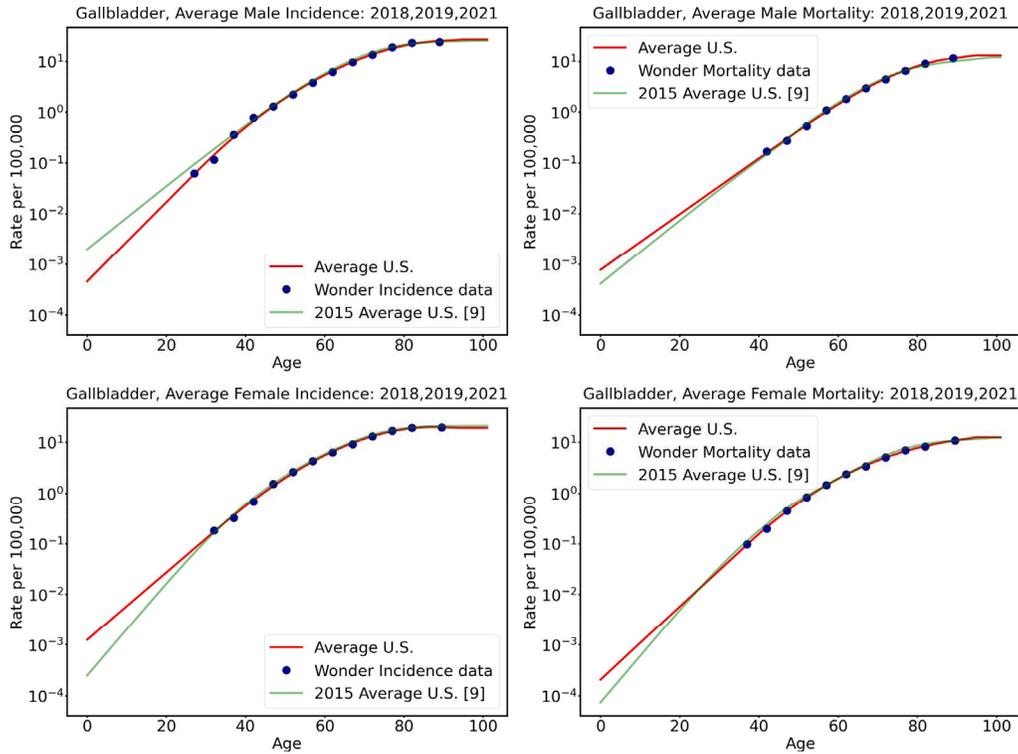
Figure 7. Gallblader, 2018, 2019, 2021 average cancer incidence and mortality rates for males and females. Comparison of interpolated results to WONDER, DevCan, and prior analyses [9].
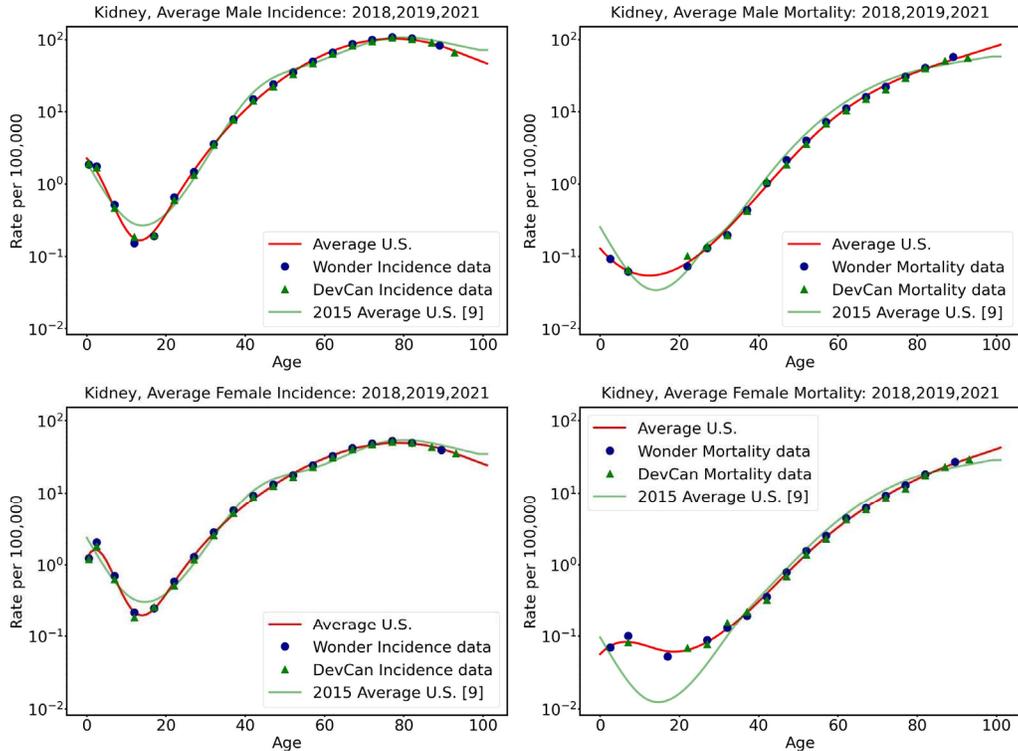
Figure 8. Kidney, 2018, 2019, 2021 average cancer incidence and mortality rates for males and females. Comparison of interpolated results to WONDER, DevCan, and prior analyses [9].
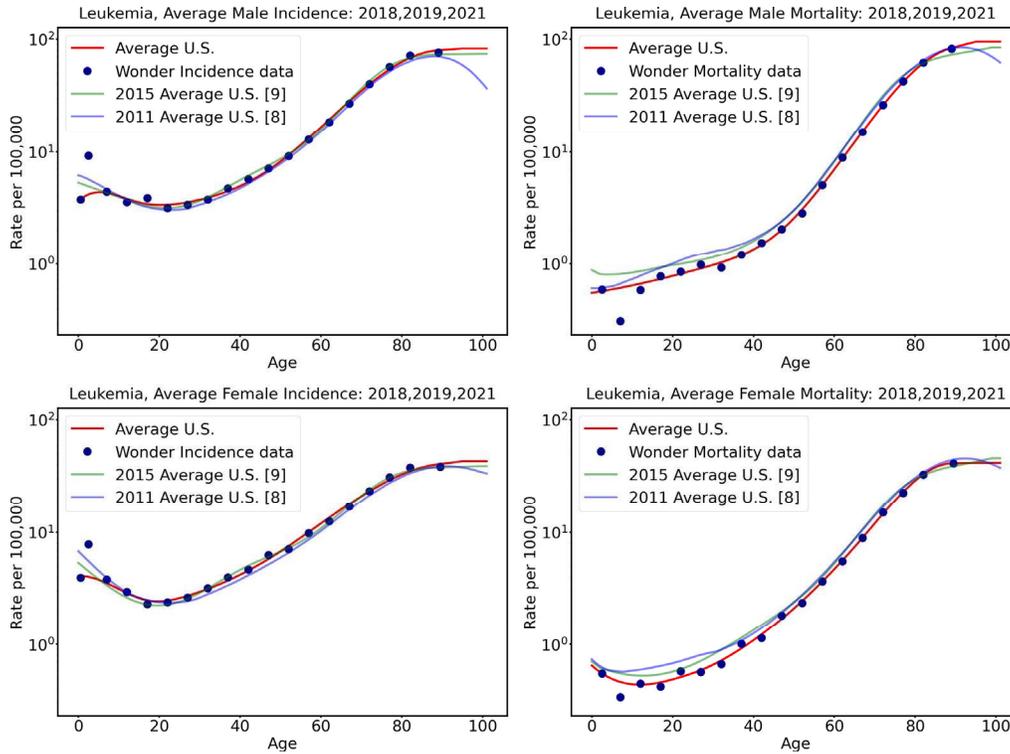
Figure 9. Leukemia, 2018, 2019, 2021 average cancer incidence and mortality rates for males and females. Comparison of interpolated results to WONDER and prior analyses [8] [9]. Note that the WONDER data point corresponding to age group "1–5 years" was omitted from the analysis for male incidence, as discussed in III.I.II.
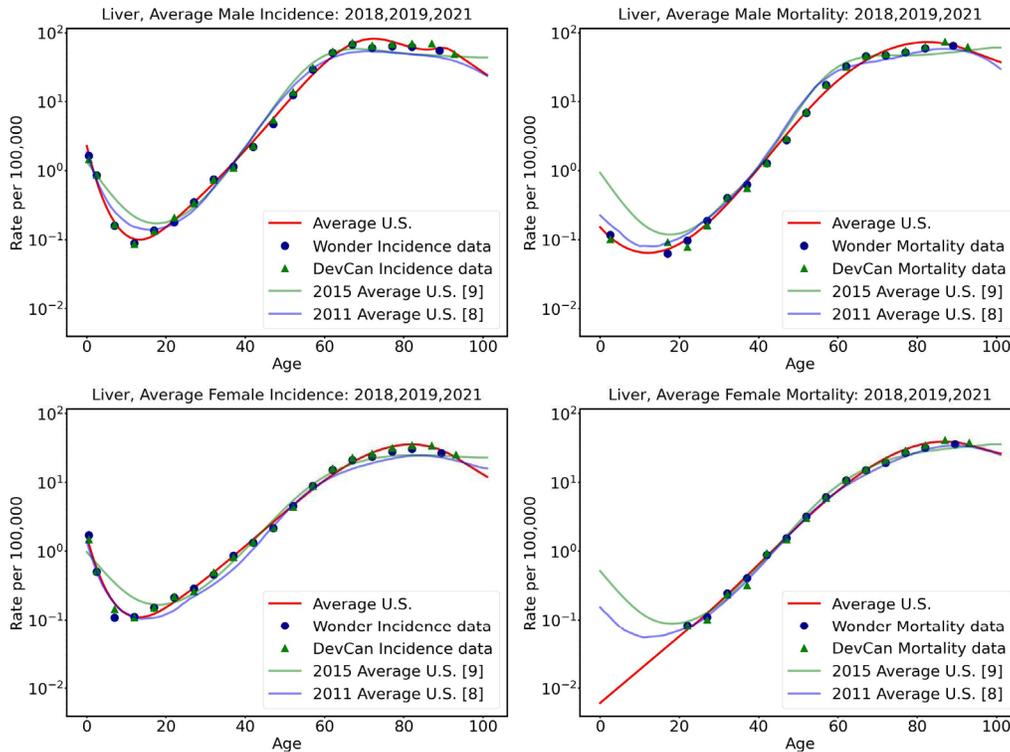
Figure 10. Liver, 2018, 2019, 2021 average cancer incidence and mortality rates for males and females. Comparison of interpolated results to WONDER, DevCan, and prior analyses [8] [9].

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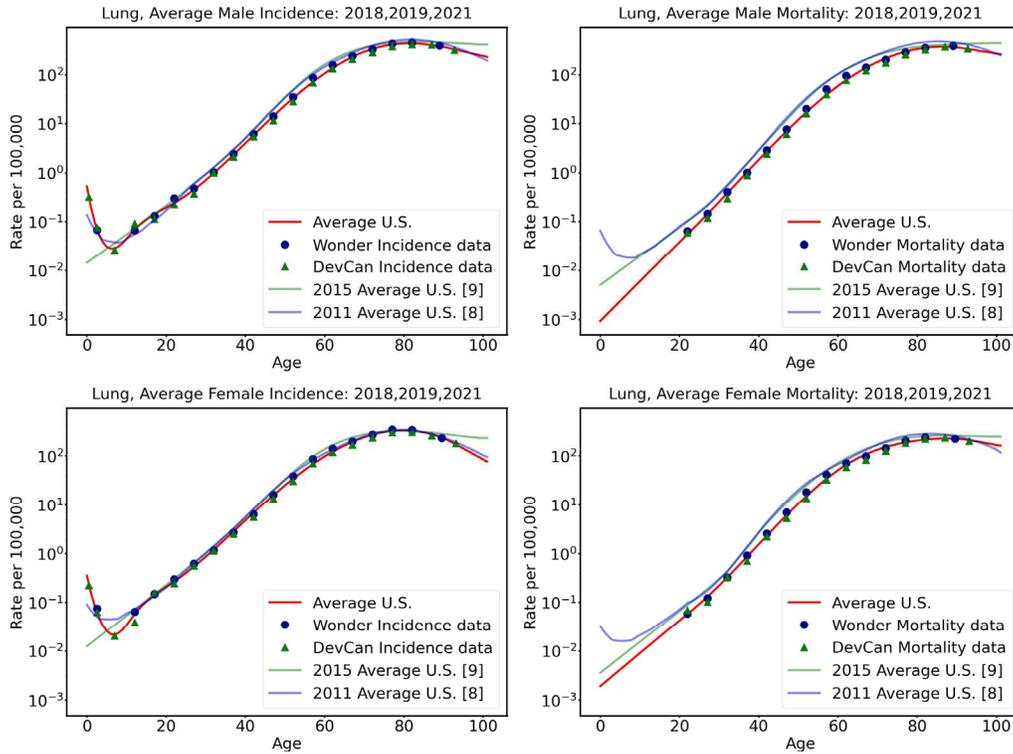
Figure 11. Lung, 2018, 2019, 2021 average cancer incidence and mortality rates for males and females. Comparison of interpolated results to WONDER, DevCan, and prior analyses [8] [9].
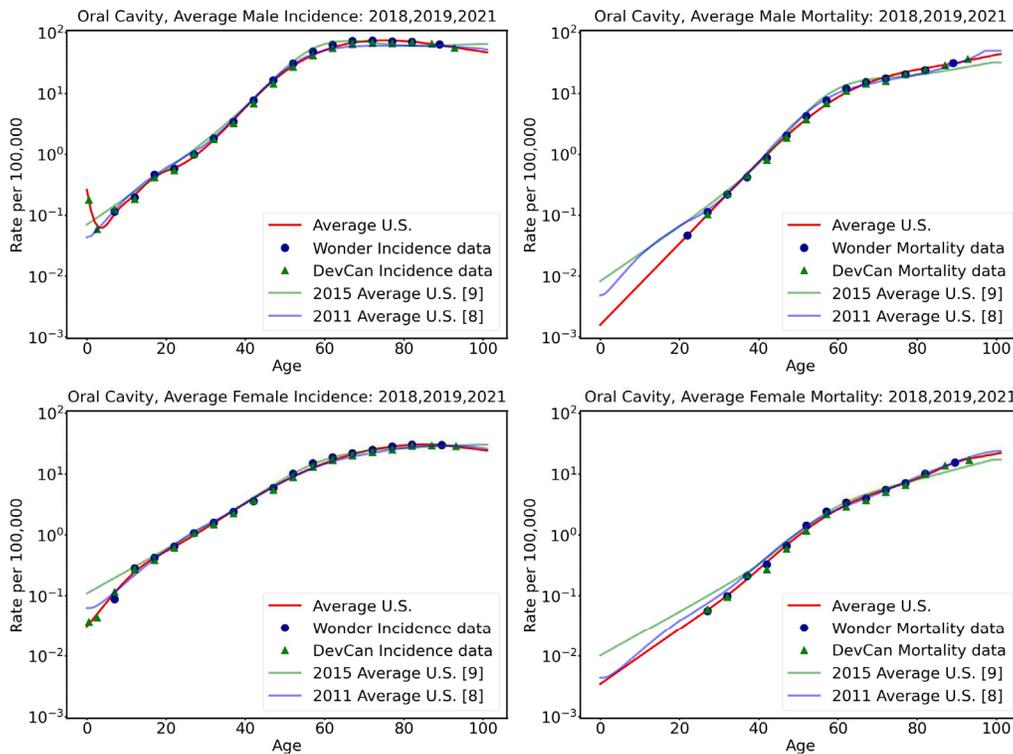
Figure 12. Oral cavity, 2018, 2019, 2021 average cancer incidence and mortality rates for males and females. Comparison of interpolated results to WONDER, DevCan, and prior analyses [8] [9].

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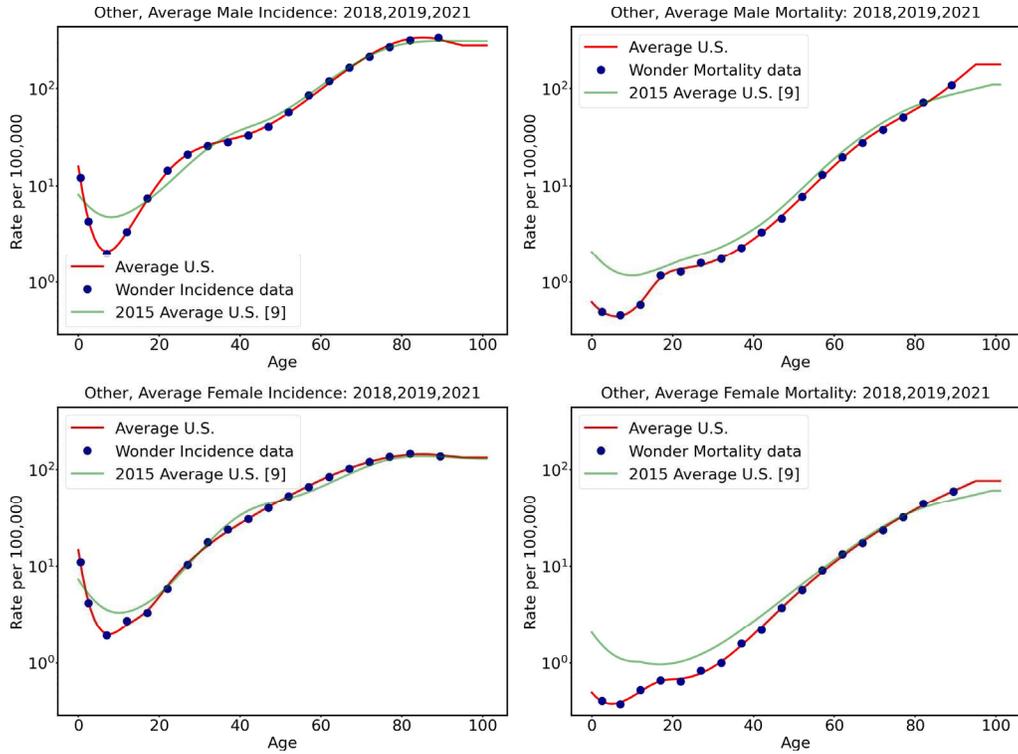
Figure 13. Other, 2018, 2019, 2021 average cancer incidence and mortality rates for males and females. Comparison of interpolated results to WONDER and prior analysis [9].
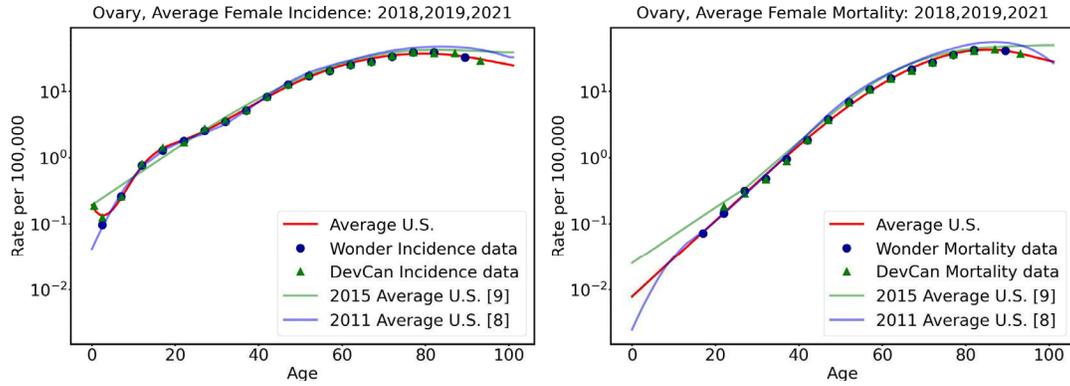
Figure 14. Ovary, 2018, 2019, 2021 average cancer incidence and mortality rates for females. Comparison of interpolated results to WONDER, DevCan, and prior analyses [8] [9].
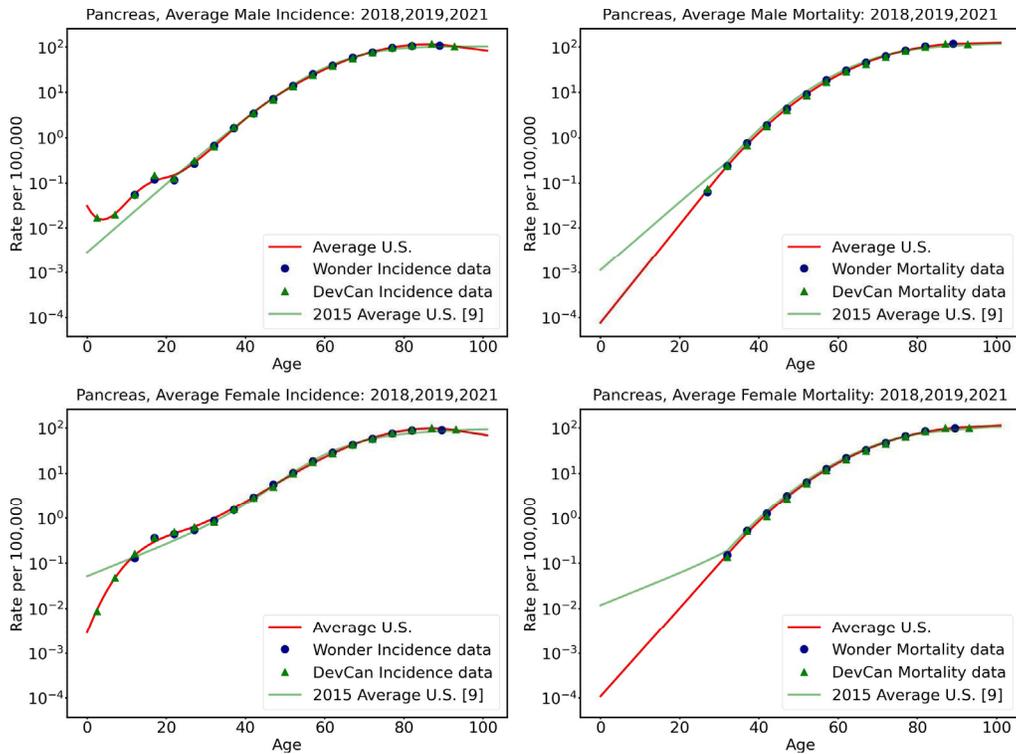
Figure 15. Pancreas, 2018, 2019, 2021 average cancer incidence and mortality rates for males and females. Comparison of interpolated results to WONDER, DevCan, and prior analysis [9].
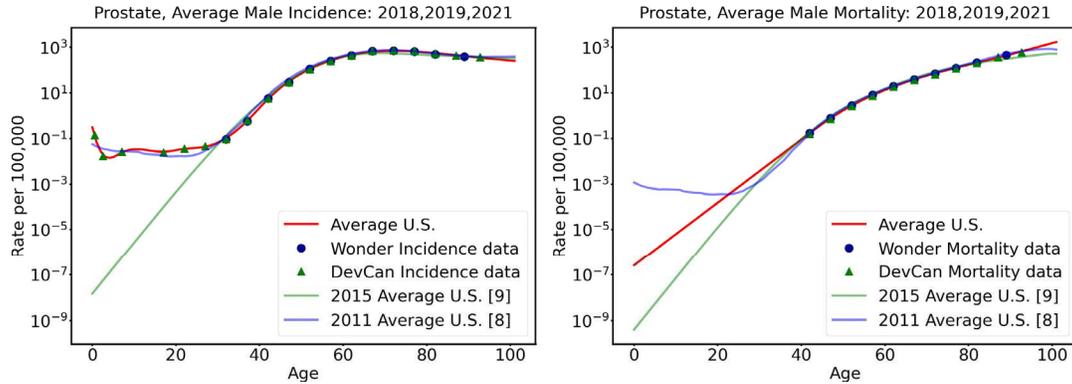
Figure 16. Prostate, 2018, 2019, 2021 average cancer incidence and mortality rates for males. Comparison of interpolated results to WONDER, DevCan, and prior analyses [8] [9].
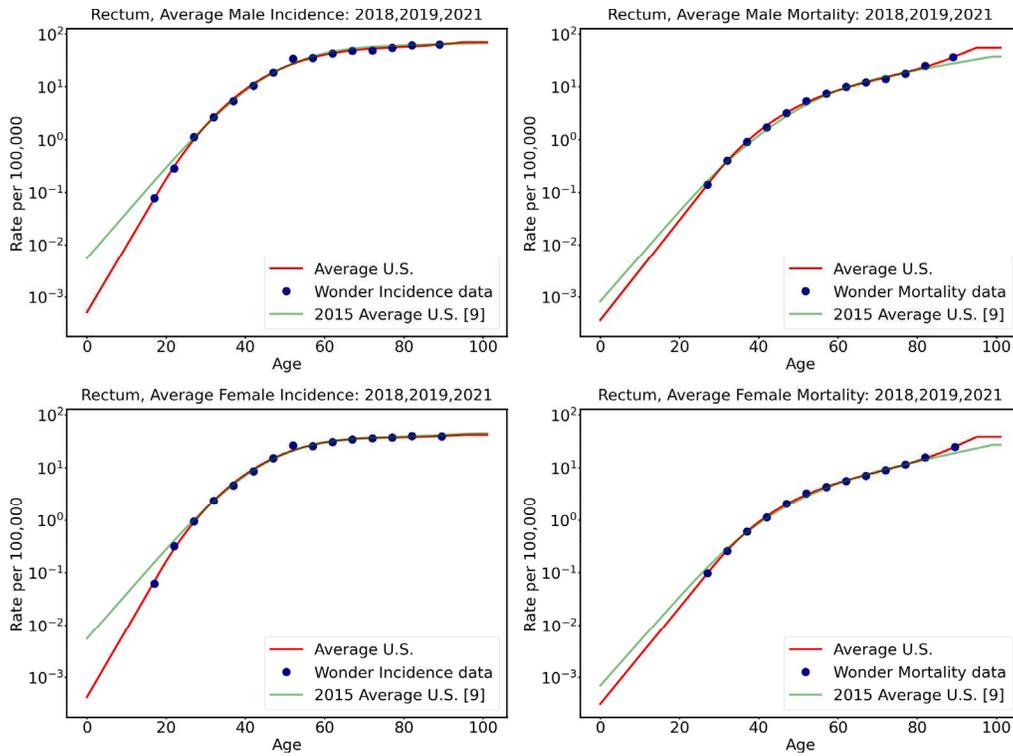
Figure 17. Rectum, 2018, 2019, 2021 average cancer incidence and mortality rates for males and females. Comparison of interpolated results to WONDER and prior analysis [9].
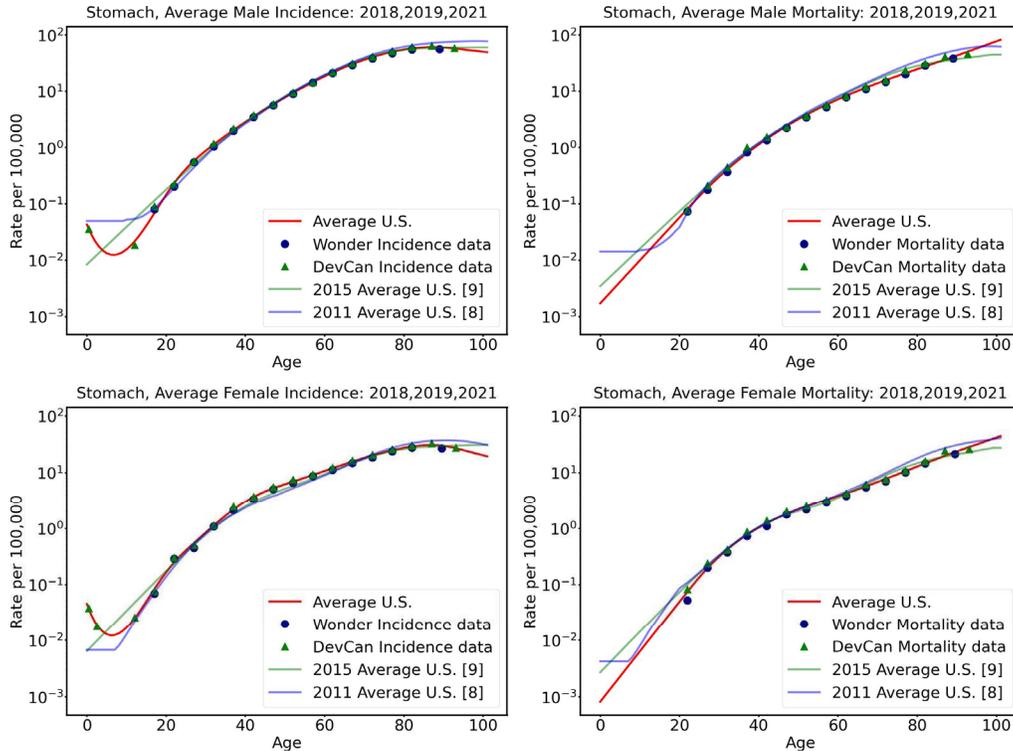
Figure 18. Stomach, 2018, 2019, 2021 average cancer incidence and mortality rates for males and females. Comparison of interpolated results to WONDER, DevCan, and prior analyses [8] [9].
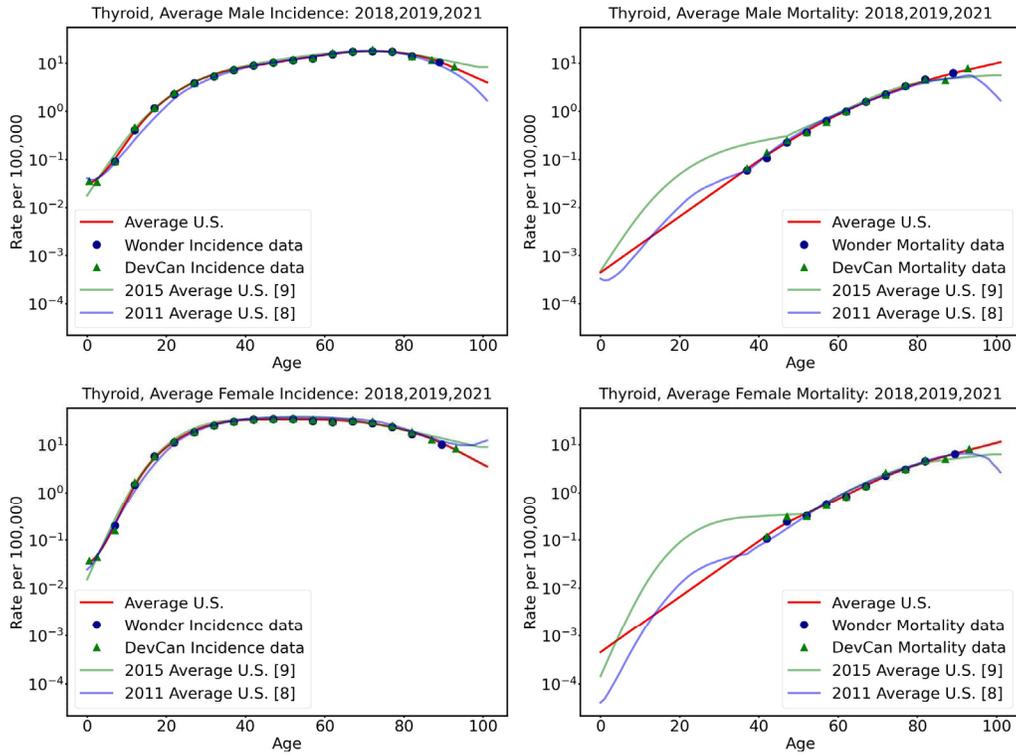
Figure 19. Thyroid, 2018, 2019, 2021 average cancer incidence and mortality rates for males and females. Comparison of interpolated results to WONDER, DevCan, and prior analyses [8] [9].
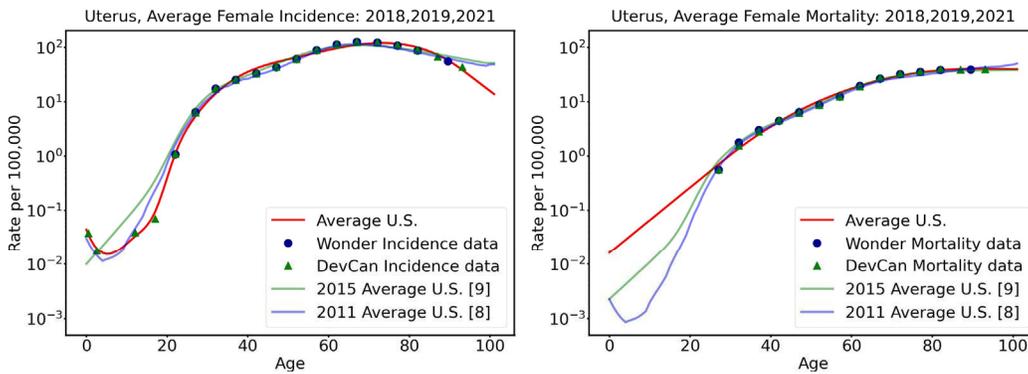
Figure 20. Uterus, 2018, 2019, 2021 average cancer incidence and mortality rates for females. Comparison of interpolated results to WONDER, DevCan, and prior analyses [8] [9].
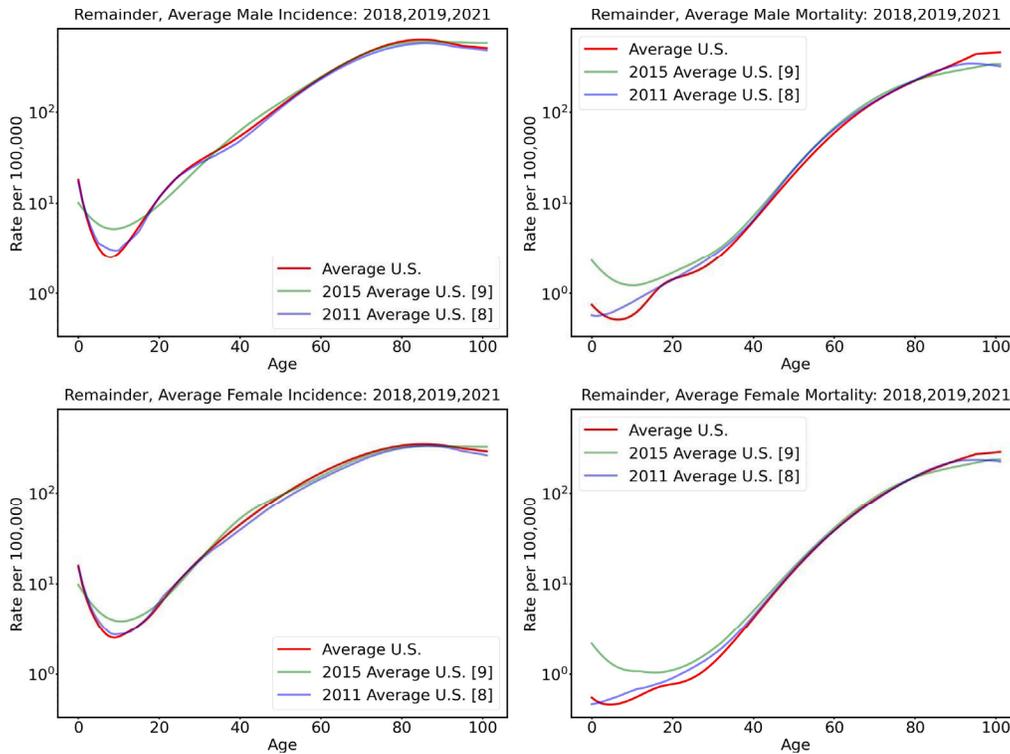
Figure 21. Remainder, 2018, 2019, 2021 average cancer incidence and mortality rates for males and females. Comparison of interpolated results to prior analyses [8] [9].

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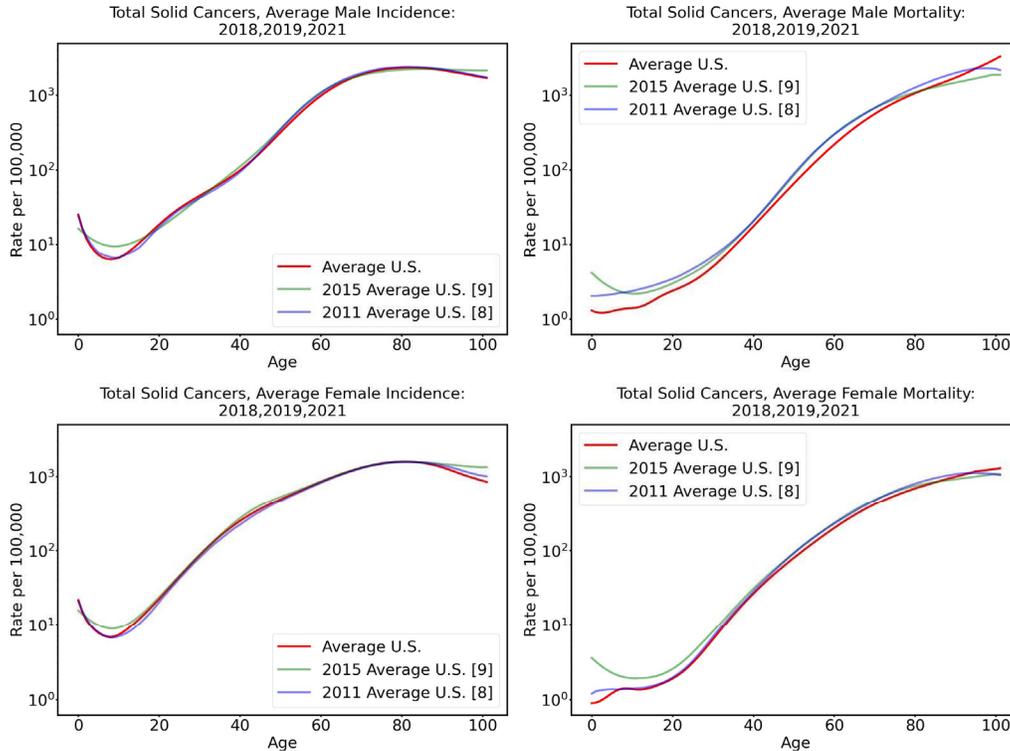
Figure 22. Total solid cancers, 2018, 2019, 2021 cancer incidence and mortality rates for males and females. Comparison of interpolated results to prior analyses [8] [9].

Average Background Mortality Rates for CHD and Stroke

The mortality rates for CHD and stroke for 2018, 2019 and 2021 are show in figures 23 and 24, respectively.
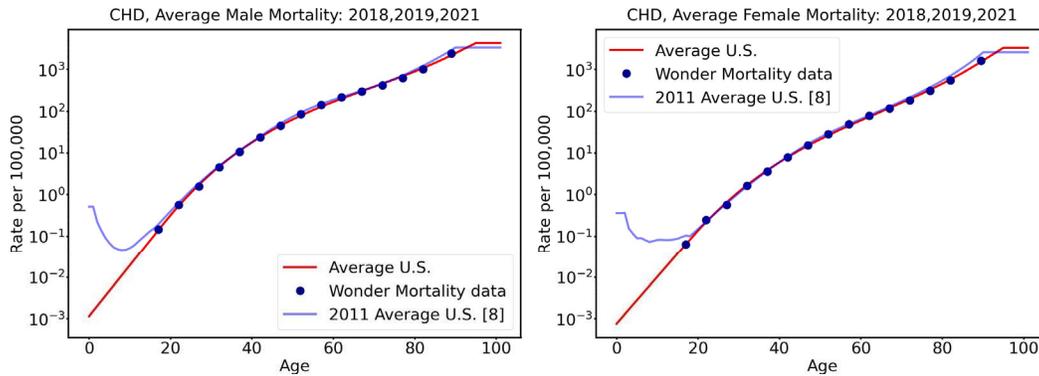
Figure 23. CHD, 2018, 2019, 2021 average mortality rates for males and females. Comparison of interpolated results to WONDER and prior analysis [8].
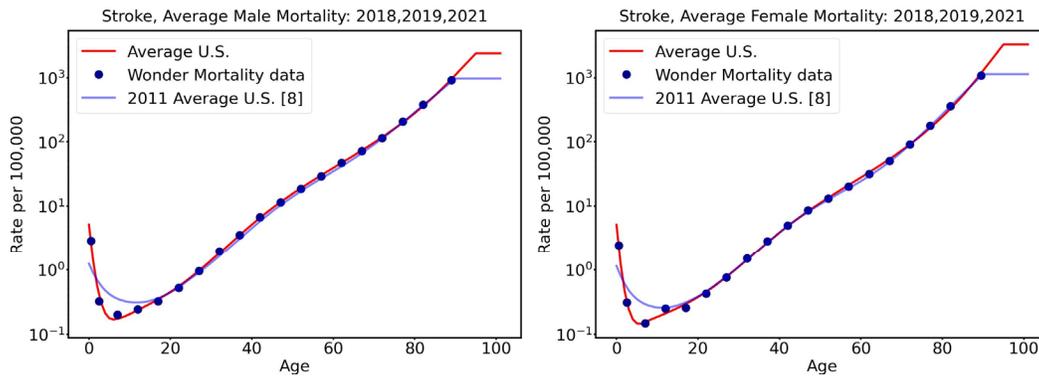
Figure 24. Stroke, 2018, 2019, 2021 average mortality rates for males and females. Comparison of interpolated results to WONDER and prior analysis [8].

IV.II U.S. Never Smoker Background Incidence and Mortality Data

Figures 25 - 33 present the incidence and mortality rates for never smoker U.S. male and female populations for the combined years of 2018, 2019, and 2021 across the NSCR cancer sites: bladder, esophagus, kidney, leukemia (BFO), lung, oral cavity, other, stomach, and uterus, respectively. The NS rates are shown as red solid lines, obtained using the method described in Section III.III.II. The average U.S. population data, represented by dashed red lines, are provided in the plots for comparison. Previous NS rates used in NSCR ([8], [9]) are also shown with blue and green lines, respectively. Since the "Other" cancer site is part of the NSCR's remainder category, the rate for the remainder site is also included as shown in Figure 34. The NSCR sites for leukemia, other, and uterus include both smoking-sensitive and non-sensitive cancer types. As explained in Section III.III.II, the NS incidence and mortality rates for the smoking-sensitive cancer tissues of these sites were obtained and the differences applied to the corresponding tissue sites. Figure 35 shows the NS rate for acute myeloid leukemia (AML), a subtype of leukemia, alongside the average population rate. Figure 36 presents the NS rate for larynx cancer, which falls under the "Other" category and, by extension, the remainder category. Figure 37 displays the rate for cervix uteri, which is part of the uterus category. Finally, Figure 38 shows the total NS rates for all solid cancers. The updated NS incidence and mortality background data as used for NSCR are given in Appendix B (Tables 12-15).
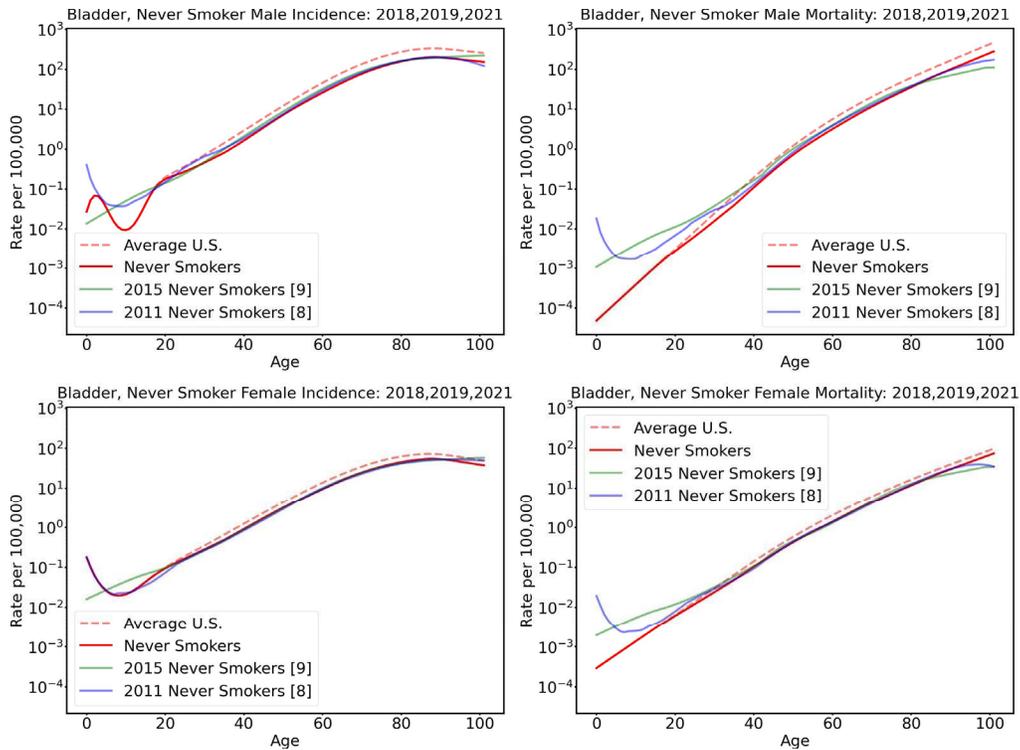
Figure 25. Bladdder, 2018, 2019, 2021 never smoker (NS) cancer incidence and mortality rates for males and females. The average U.S. population data for 2018, 2019, 2021 are shown in red dashed lines. The 2011 [8] and 2015 [9] NS data are shown by solid blue and green lines respectively.
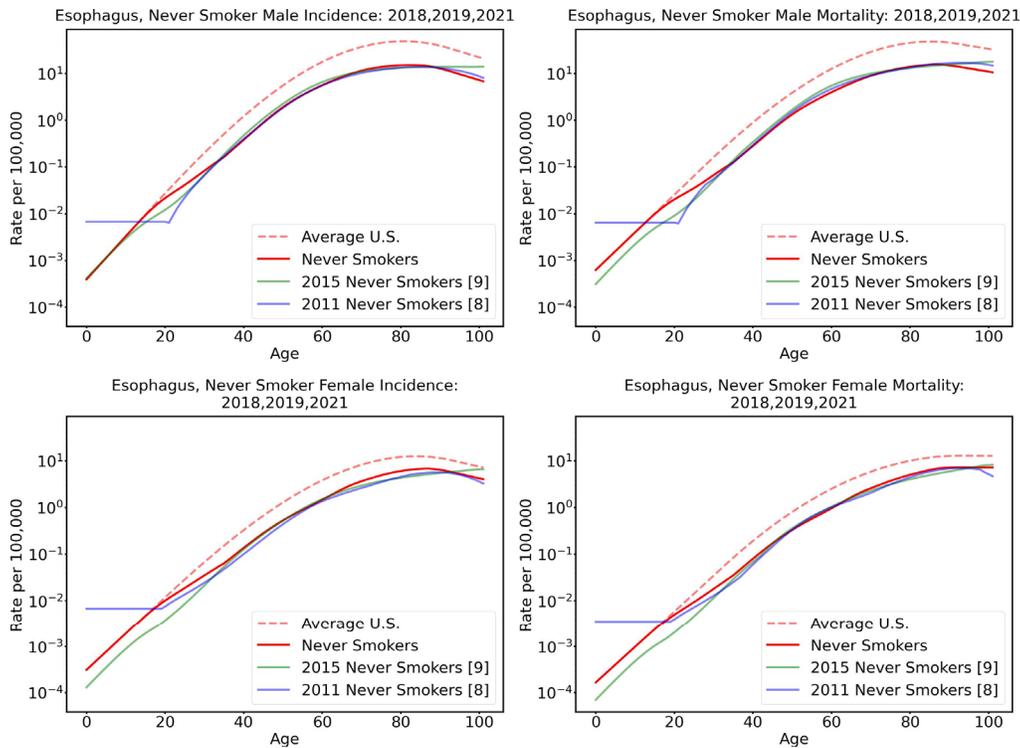
Figure 26. Esophagus, 2018, 2019, 2021 never smoker (NS) cancer incidence and mortality rates for males and females. The average U.S. population data for 2018, 2019, 2021 are shown in red dashed lines. The 2011 [8] and 2015 [9] NS data are shown by solid blue and green lines respectively.

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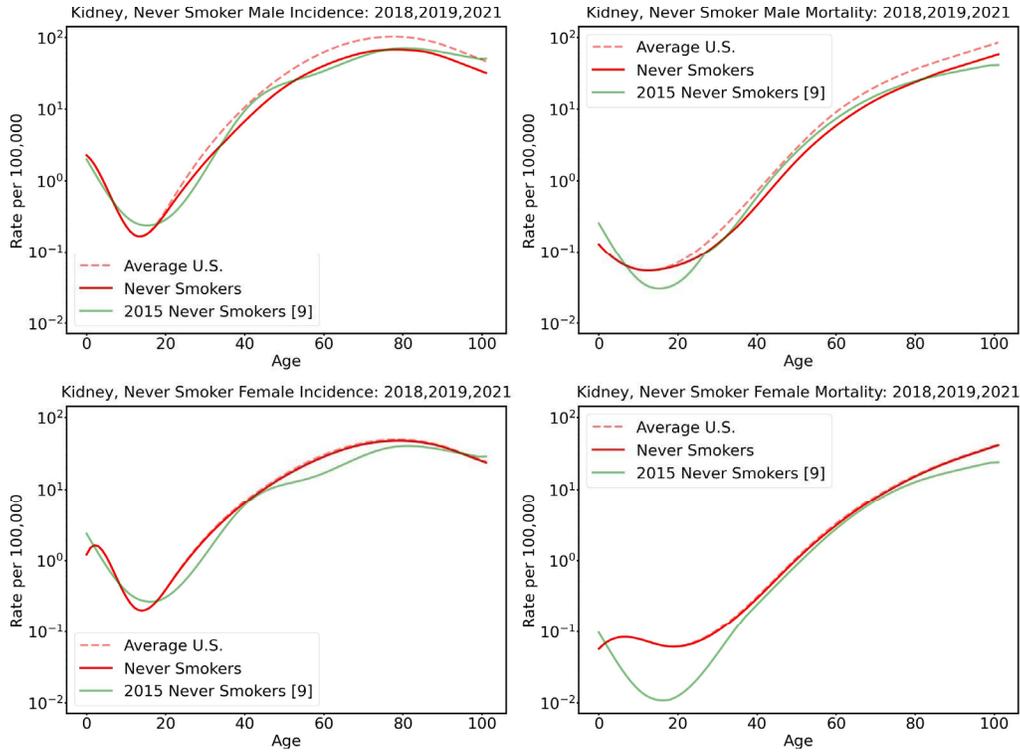
Figure 27. Kidney, 2018, 2019, 2021 never smoker (NS) cancer incidence and mortality rates for males and females. The average U.S. population data for 2018, 2019, 2021 are shown in red dashed lines. The 2015 [9] NS data are shown by solid green lines.
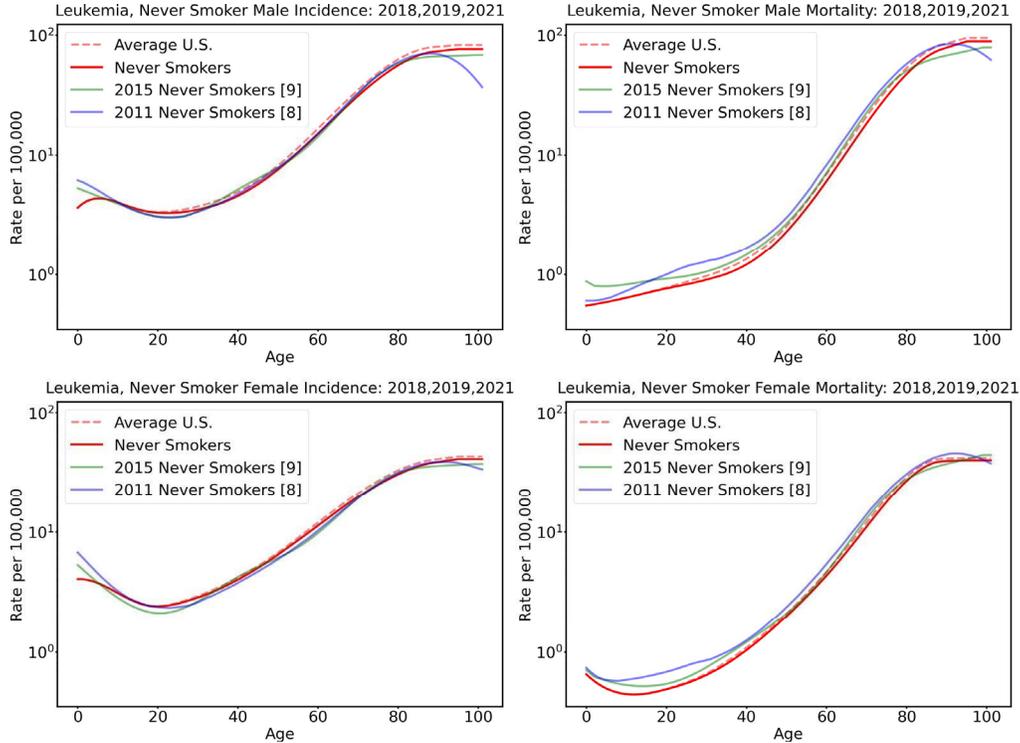
Figure 28. Leukemia, 2018, 2019, 2021 never smoker (NS) cancer incidence and mortality rates for males and females. The average U.S. population data for 2018, 2019, 2021 are shown in red dashed lines. The 2011 [8] and 2015 [9] NS data are shown by solid blue and green lines respectively.
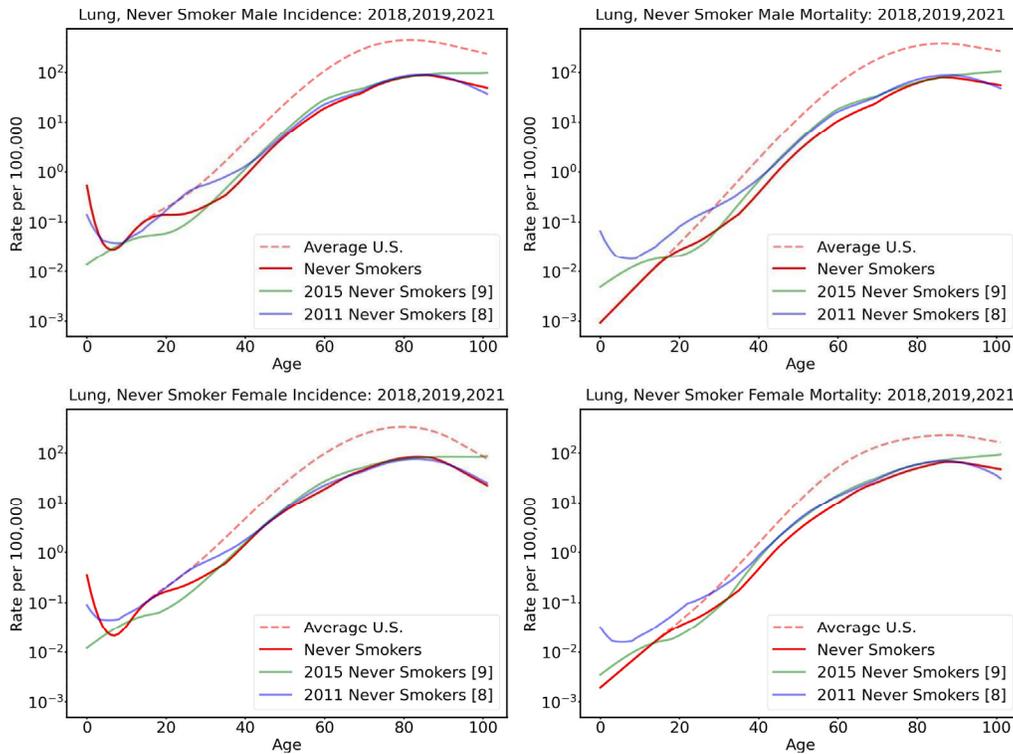
Figure 29. Lung, 2018, 2019, 2021 never smoker (NS) cancer incidence and mortality rates for males and females. The average U.S. population data for 2018, 2019, 2021 are shown in red dashed lines. The 2011 [8] and 2015 [9] NS data are shown by solid blue and green lines respectively.
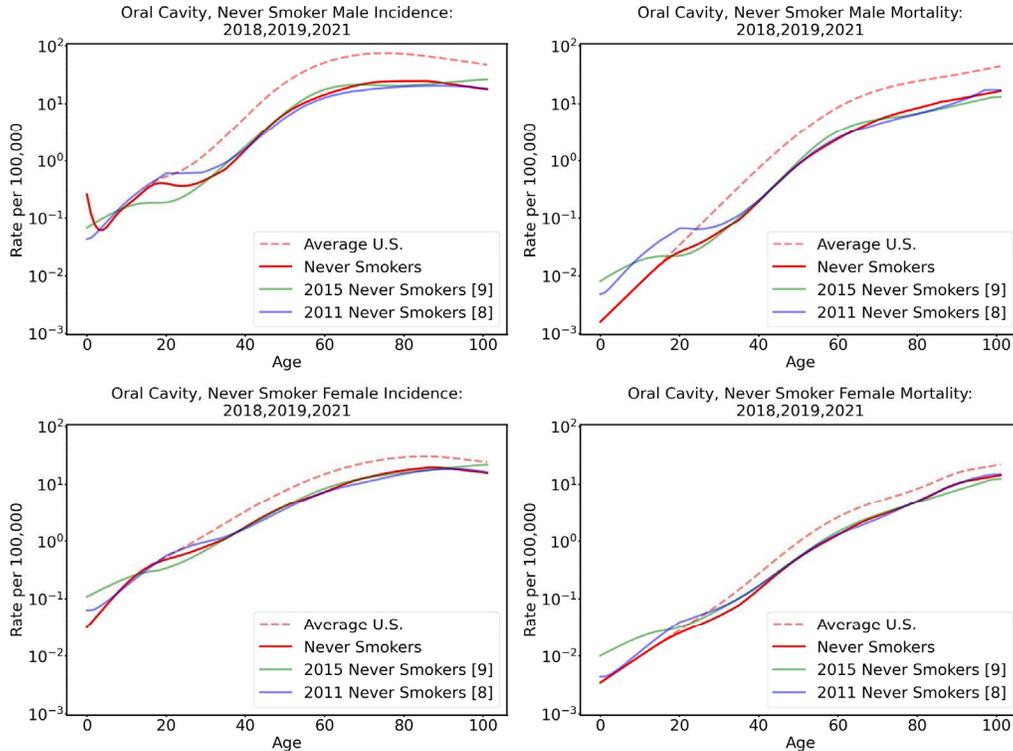
Figure 30. Oral cavity, 2018, 2019, 2021 never smoker (NS) cancer incidence and mortality rates for males and females. The average U.S. population data for 2018, 2019, 2021 are shown in red dashed lines. The 2011 [8] and 2015 [9] NS data are shown by solid blue and green lines respectively.

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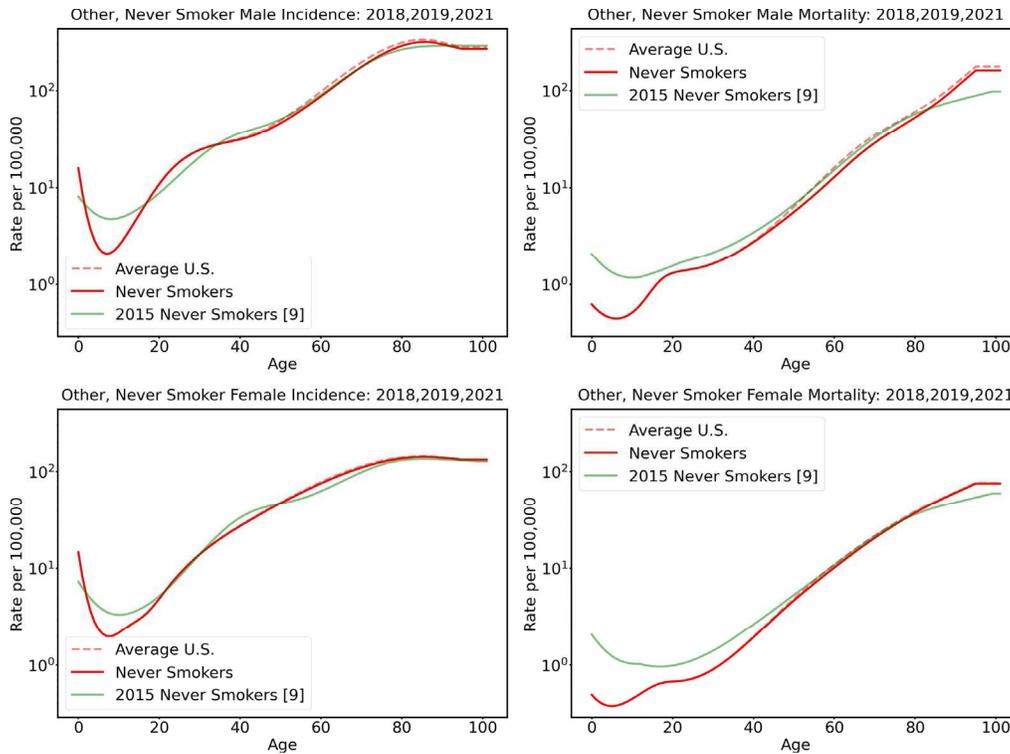
Figure 31. Other, 2018, 2019, 2021 never smoker (NS) cancer incidence and mortality rates for males and females. The average U.S. population data for 2018, 2019, 2021 are shown in red dashed lines. 2015 [9] NS data are shown by solid green lines.
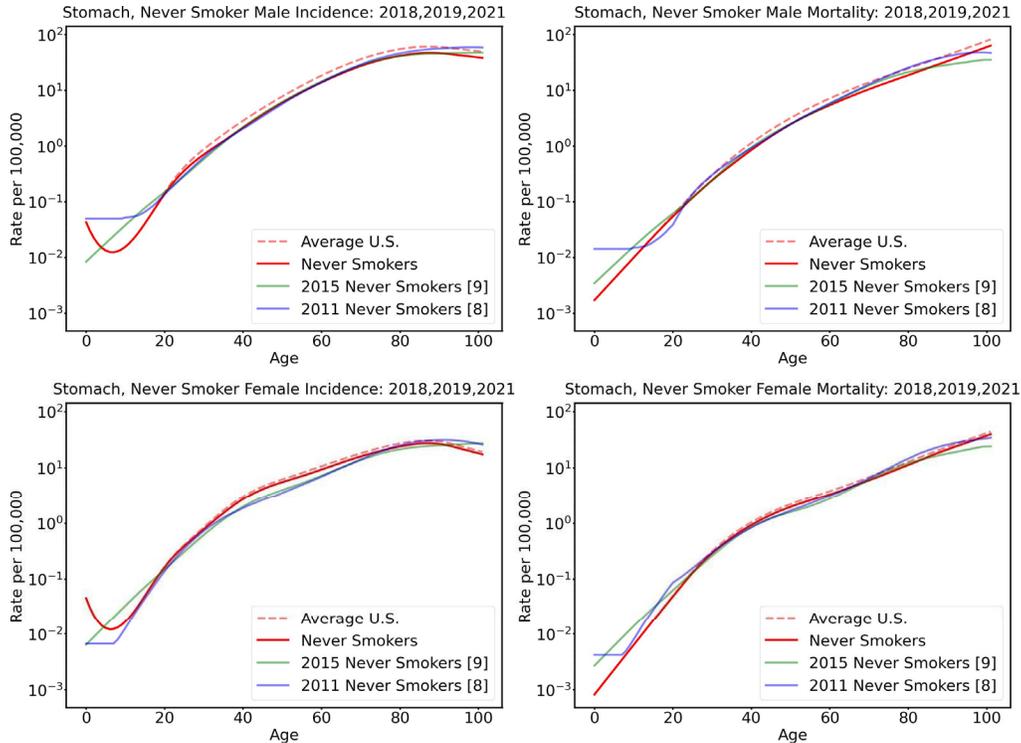
Figure 32. Stomach, 2018, 2019, 2021 never smoker (NS) cancer incidence and mortality rates for males and females. The average U.S. population data for 2018, 2019, 2021 are shown in red dashed lines. The 2011 [8] and 2015 [9] NS data are shown by solid blue and green lines respectively.
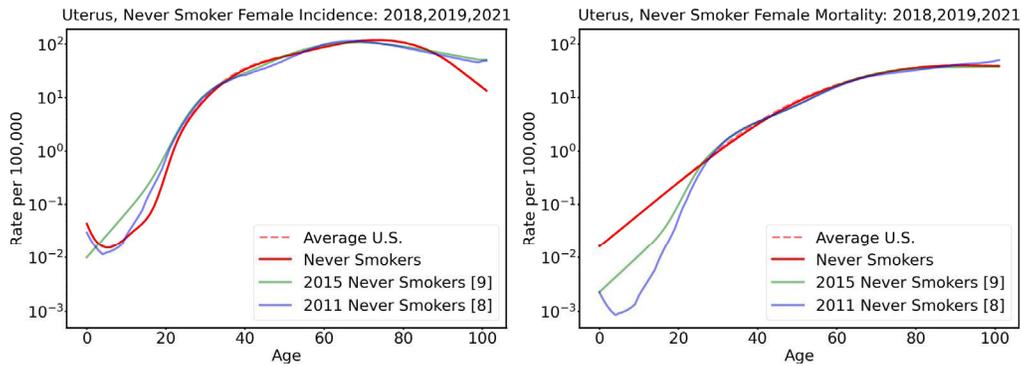
Figure 33. Uterus, 2018, 2019, 2021 never smoker (NS) cancer incidence and mortality rates for females. The average U.S. population data for 2018, 2019, 2021 are shown in red dashed lines. The 2011 [8] and 2015 [9] NS data are shown by solid blue and green lines respectively.
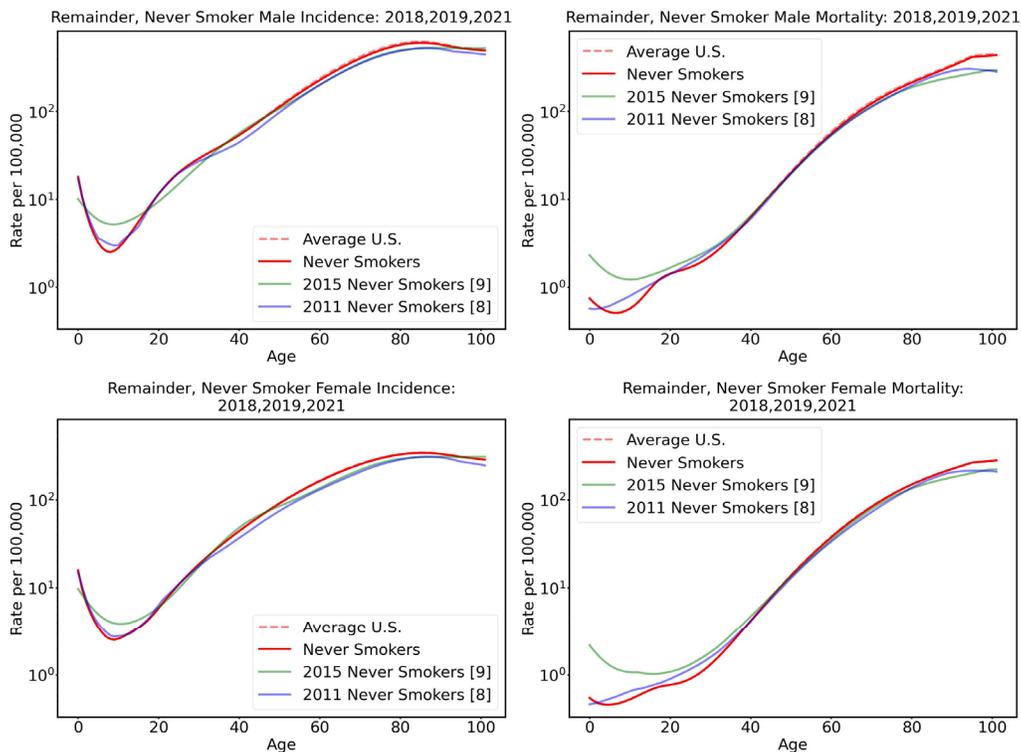
Figure 34. Remainder, 2018, 2019, 2021 never smoker (NS) cancer incidence and mortality rates for males and females. The average U.S. population data for 2018, 2019, 2021 are shown in red dashed lines. The 2011 [8] and 2015 [9] NS data are shown by solid blue and green lines respectively.
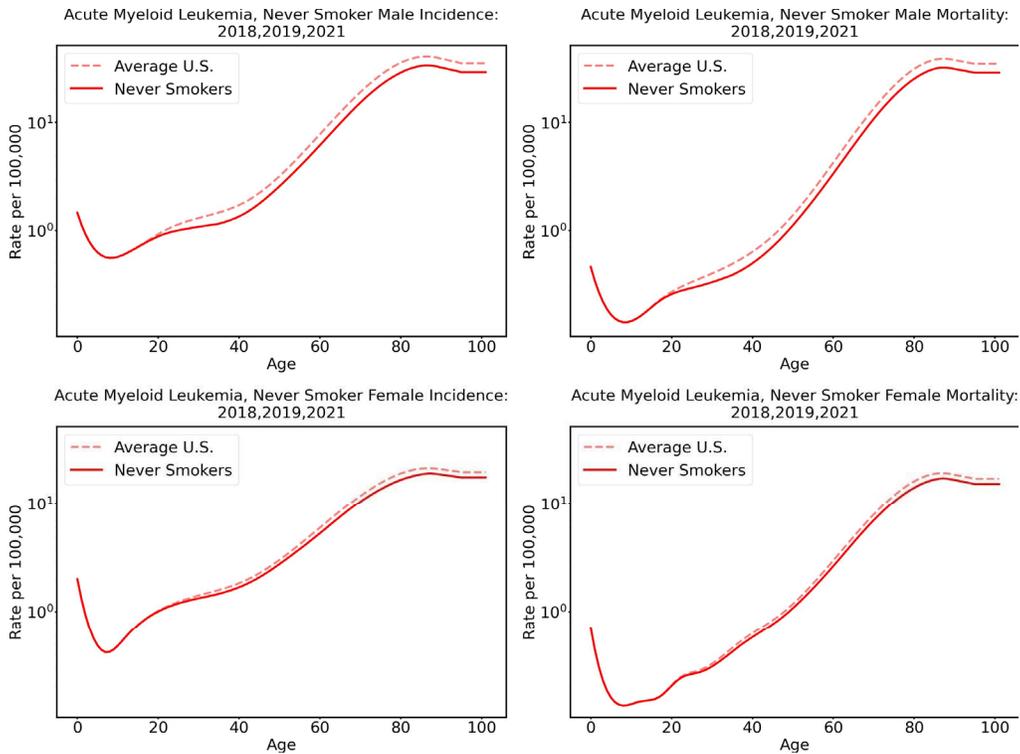
Figure 35. Acute Myeloid Leukema (AML), 2018, 2019, 2021 never smoker (NS) cancer incidence and mortality rates for males and females. The average U.S. population data for 2018, 2019, 2021 are shown in red dashed lines. AML is the smoking related component of Leukemia (BFO) NSCR cancer site.
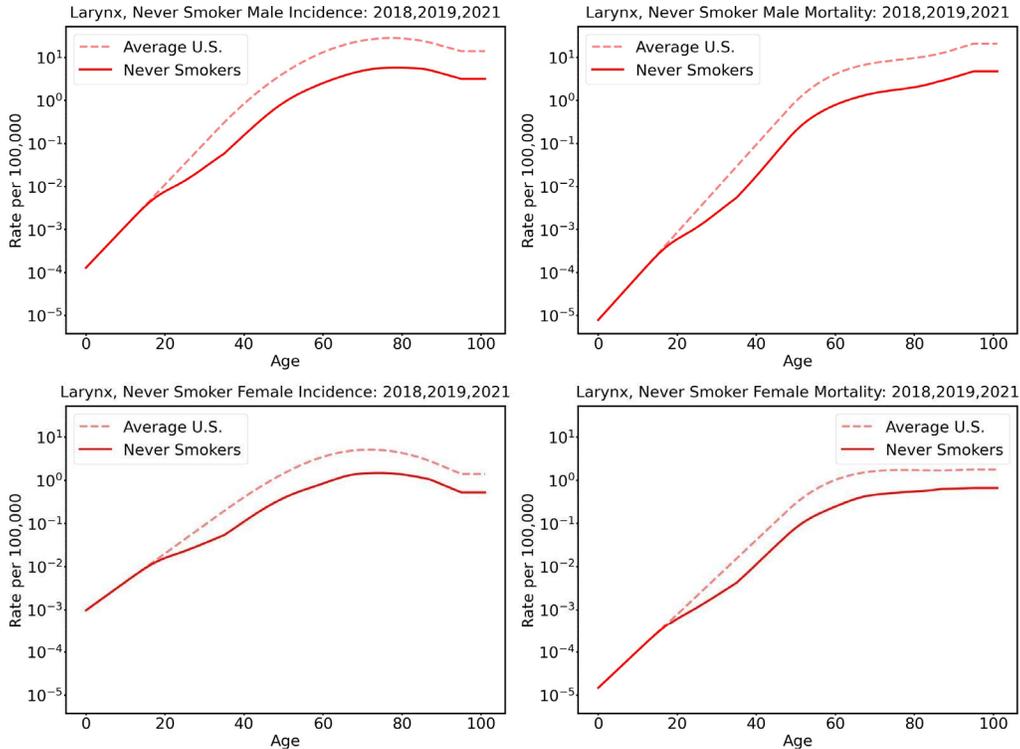
Figure 36. Larynx, 2018, 2019, 2021 never smoker (NS) cancer incidence and mortality rates for males and females. The average U.S. population data for 2018, 2019, 2021 are shown in red dashed lines. Larynx is the smoking related component of Remainder/Other cancer site in NSCR.
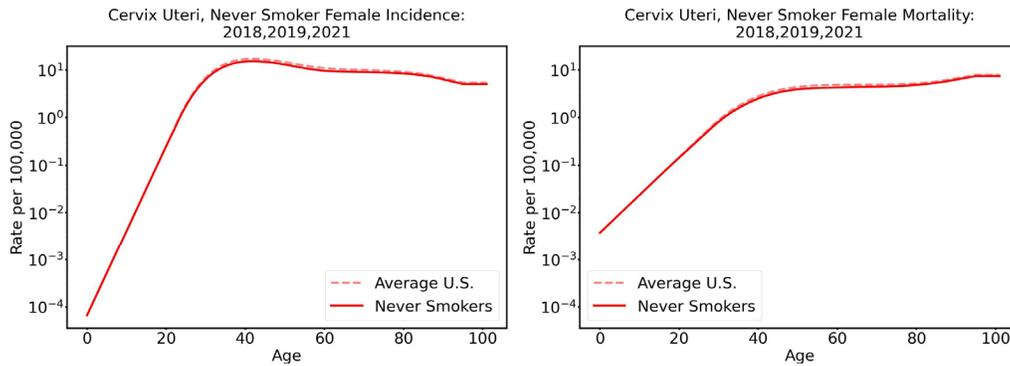
Figure 37. Cervix Uteri, 2018, 2019, 2021 never smoker (NS) cancer incidence and mortality rates for males and females. The average U.S. population data for 2018, 2019, 2021 are shown in red dashed lines. Cevix Uteri is the smoking related component of Uterus cancer site in NSCR.
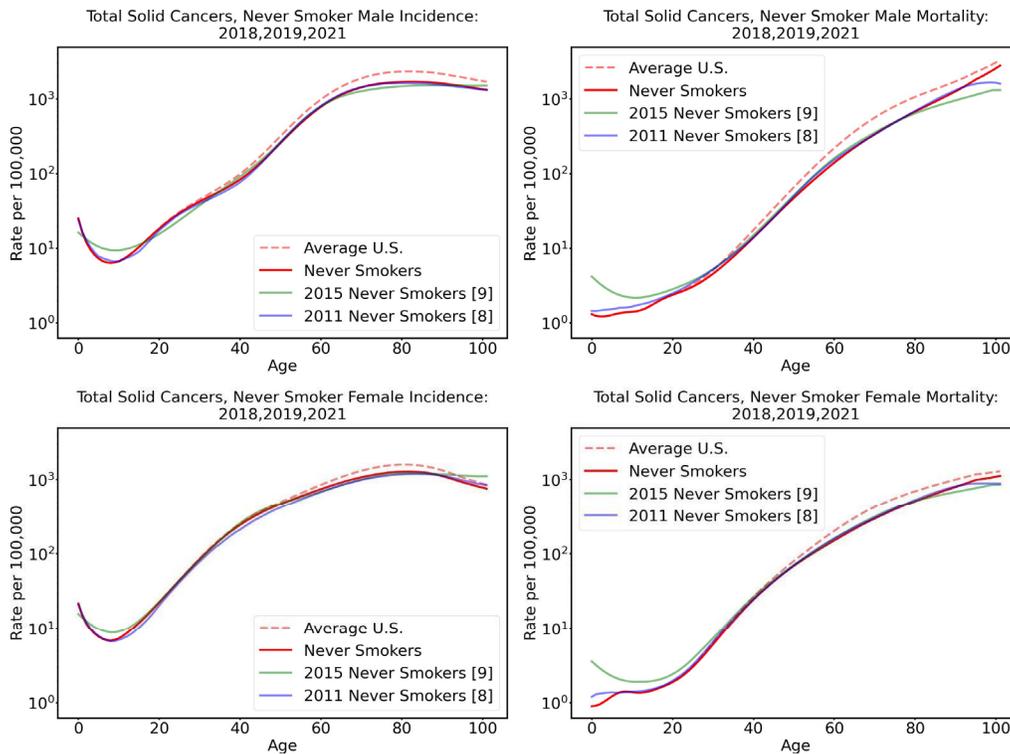
Figure 38. Total solid cancers, 2018, 2019, 2021 never smoker (NS) cancer incidence and mortality rates for males and females. The average U.S. population data for 2018, 2019, 2021 are shown in red dashed lines. The 2011 [8] and 2015 [9] NS data are shown by solid blue and green lines respectively.

Never Smoker Background Mortality Rates for CHD and Stroke

The never smoker mortality rates for CHD and stroke for 2018, 2019 and 2021 are shown in Figures 39 and 40, respectively.
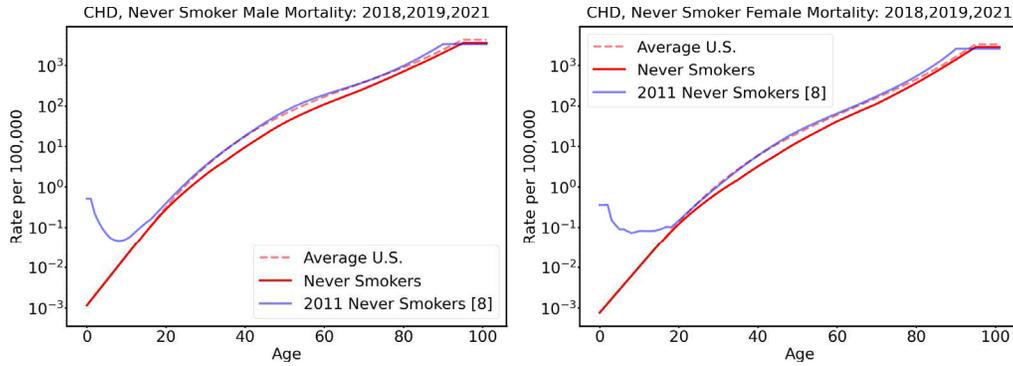
Figure 39. CHD, 2018, 2019, 2021 never smoker (NS) mortality rates for males and females. The average U.S. population data for 2018, 2019, 2021 are shown in red dashed lines. The 2011 [8] NS data are shown by solid blue lines.
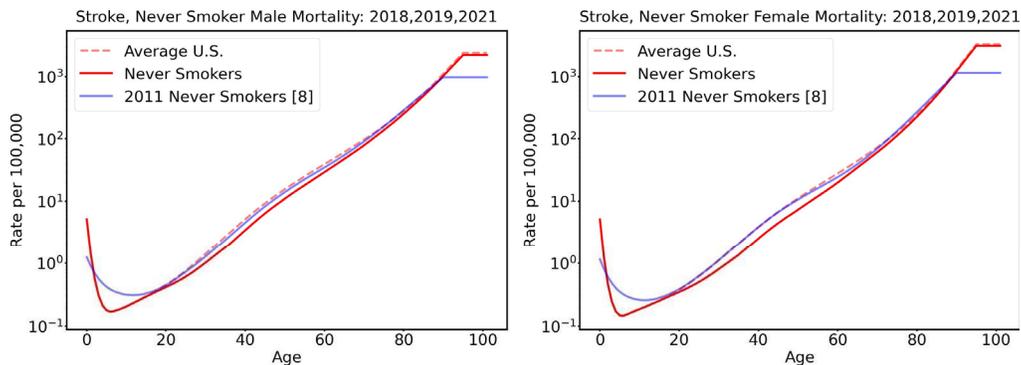
Figure 40. Stroke, 2018, 2019, 2021 never smoker (NS) mortality rates for males and females. The average U.S. population data for 2018, 2019, 2021 are shown in red dashed lines. The 2011 [8] NS data are shown by solid blue lines.

IV.III U.S. Background Survival Data

IV.III.I Average U.S. Background Survival Functions

Figure 41 shows the survival for the average U.S. male and female populations for 2019. The average survival functions for 2011 [8] and 2015 [9] are also shown in blue and green lines, respectively, for comparison. The updated 2019 survival and hazard functions for the average U.S. female and male population as used for NSCR are given in Appendix B (Tables 16-17).
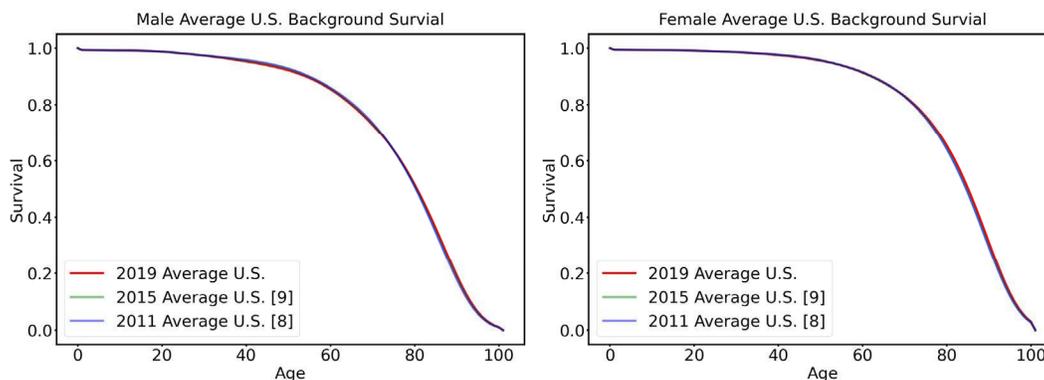
Figure 41. Survival for 2019 average male and female US population. Average survivals for 2011 [8] and 2015 [9] are shown blue and green lines, respectively, for comparison.

Figure 42 shows the survival for the NS male and female population for 2019 (solid red lines) and compares it to average survival (dashed red lines). The NS survival data for 2011 [8] and 2015 [9] are also shown by blue and green lines, respectively, for comparison. The updated 2019 survival and hazard functions for the NS female and male population as used for NSCR are given in Appendix B (Tables 18-19).
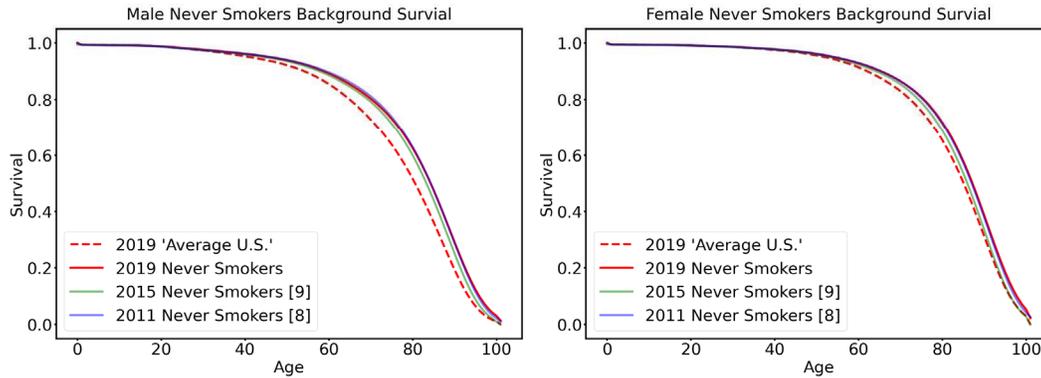
Figure 42. Survival for 2019 never smoker male and female US population. Survival for the average population is shown in dashed lines for comparison. The average U.S. population survival data 2019 are shown in red dashed lines. The 2011 [8] and 2015 [9] NS survival data are shown by solid blue and green lines respectively.

IV.IV REID Results with Updated Background Data

The REID calculations with updated background data are shown in Figures 43-44. The REID values are presented as 95% confidence intervals (horizontal lines), and the average value is shown as a triangle. The results with updated background data (solid red line) and previous background data (dashed lines) are provided for comparative purposes.
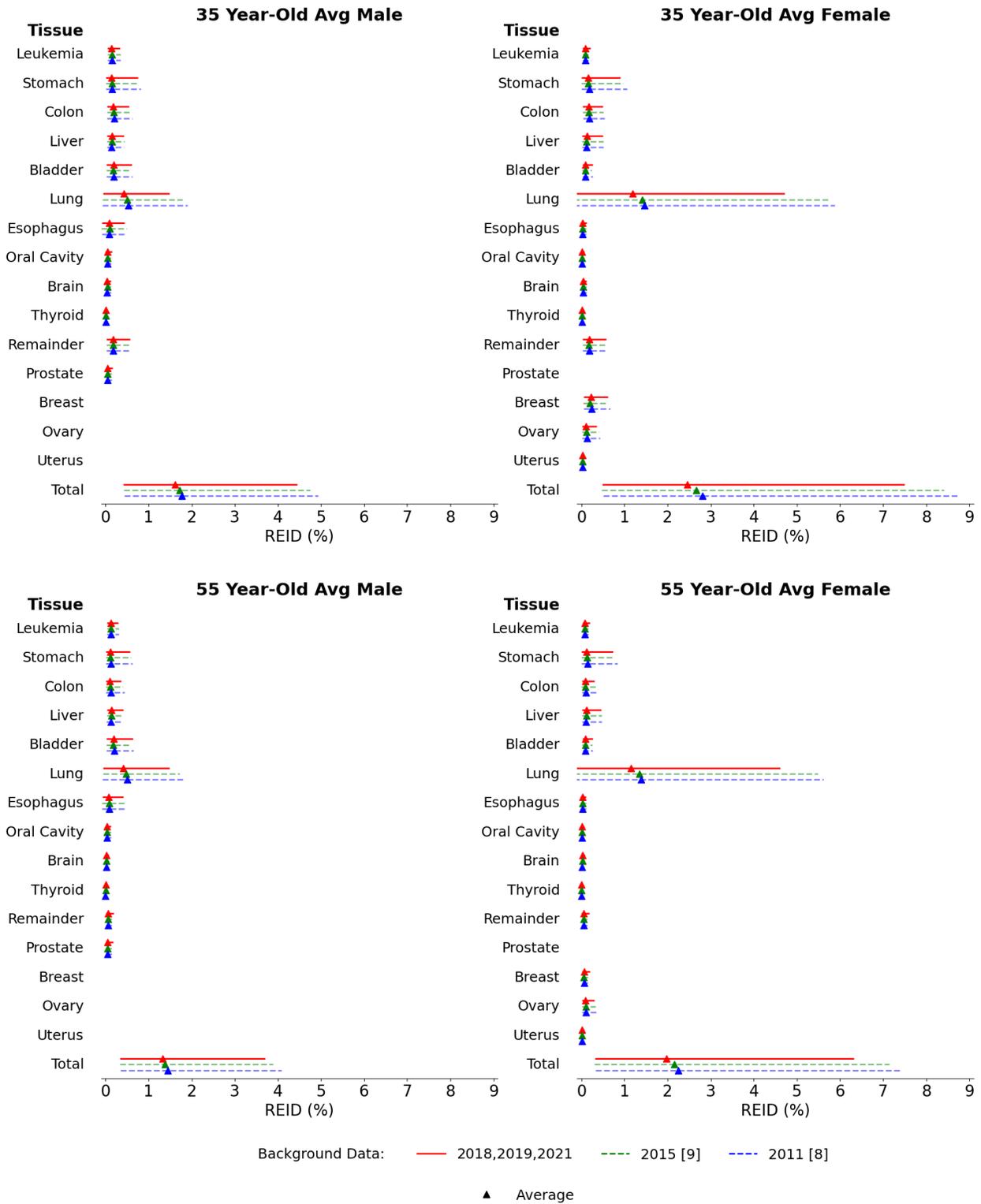
Figure 43. REID comparison for the average male (left) and female (right) population exposed to 365 days of GCR (October 1976 solar minimum conditions) behind 20 g/cm^2 aluminum shielding at ages 35 (top) and 55 (bottom). The blue and red dashed lines represent REID values calculated using the 2011 background data [8], and the 2015 background data [9], respectively.
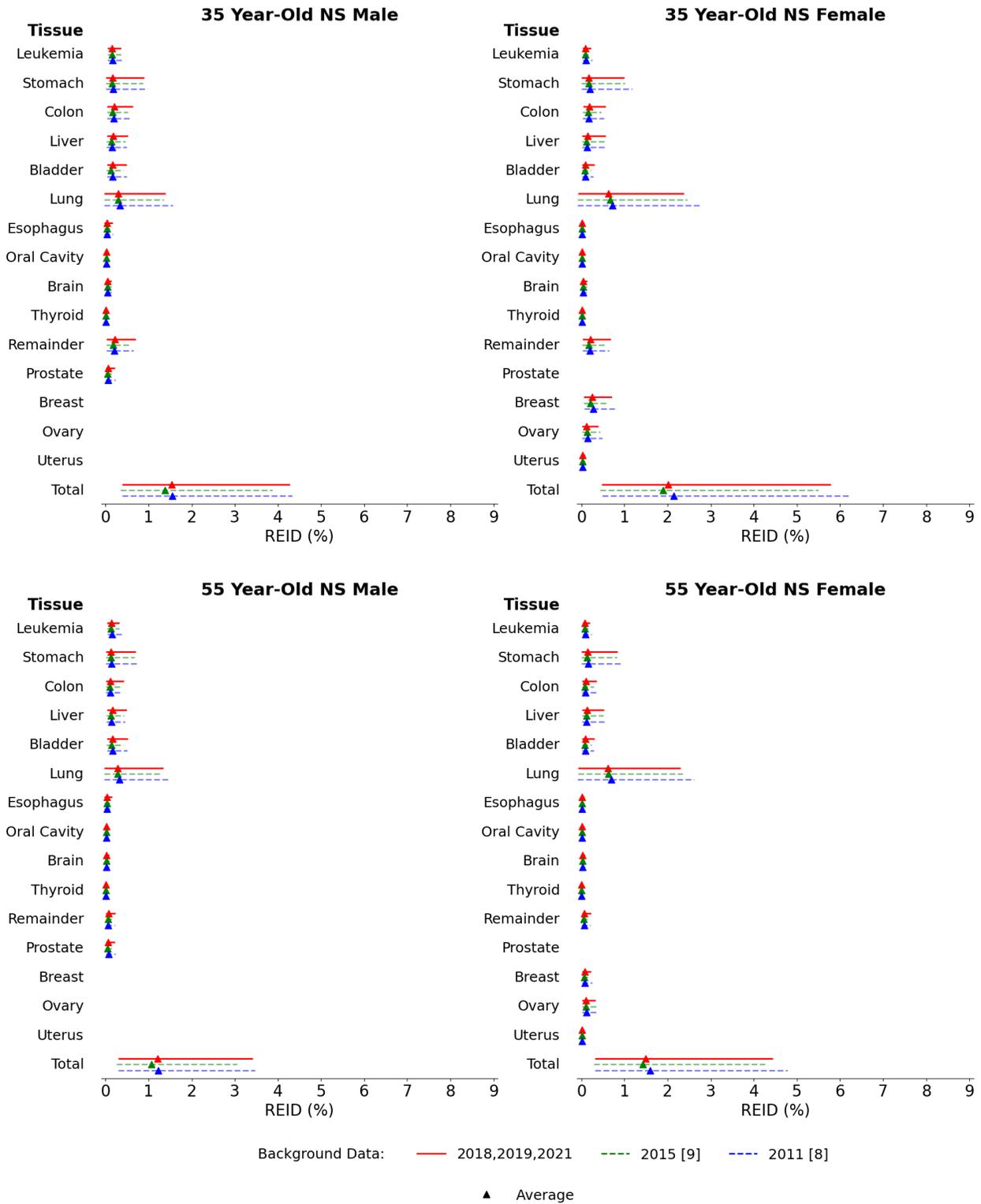
Figure 44. REID comparison for the NS male (left) and female (right) population exposed to 365 days of GCR (October 1976 solar minimum conditions) behind 20 g/cm² aluminum shielding at ages 35 (top) and 55 (bottom). The blue and red dashed lines represent REID values calculated using the 2011 background data [8], and the 2015 background data [9], respectively.

VI. Summary

The U.S. average population and never smoker background data for cancer incidence, mortality, and overall survival used in NSCR have been updated to the most recent data available as of April 2025. These data are provided at integer ages from 0 to 101 for both male and female populations.

For the average cancer mortality and incidence rates, data from the WONDER database [10], [11] were combined with DevCan software [12] outputs using rates from the years 2018, 2019, and 2021. The year 2020 was unavailable in DevCan due to COVID-related disruptions [12]. DevCan data were used to complement the WONDER data to provide additional data points for older ages, as DevCan includes rates up to age 90+, whereas WONDER is limited to 85+. Mortality data for CHD and stroke were also obtained from the WONDER mortality database [13]. Since the cancer data are provided in five-year age groups, cubic spline interpolation with B-spline smoothing (using Python's SciPy library) was applied to estimate rates for single-year ages. For cancer sites where DevCan data were unavailable, point-slope matching was used to extrapolate the WONDER data up to age 95, and then the rate at 95 was kept constant up to age 101. If DevCan data were available, point-slope matching was used to extrapolate data up to age 101 directly. Point-slope matching was also used to extrapolate data to lower ages down to 0 if data for lower ages were not available.

For survival data, the 2019 NVSR U.S. life table [15] was used to construct the survival function $S(a)$ for ages 0 to 101. Analysis of recent life tables revealed a decline in survival in the years following the COVID pandemic; however, the 2022 table showed signs of recovery. Since COVID-related mortality is not relevant for space radiation risk projections, only the pre-pandemic 2019 table was used.

For never smoker background data, which are considered more representative of astronauts due to their healthier lifestyle profiles, recommendations from the 2014 Surgeon General's report were followed to calculate the NSAF for smoking-sensitive cancers, which include lung, oral cavity, esophagus, pancreas, larynx, kidney, cervix, bladder, AML, CHD, and stroke. Estimation of NS background rates relied on two key inputs: relative risks (RRs) of cancer mortality for never smokers versus former and current smokers, and smoking prevalence [7], [8], [9]. RRs were taken from the 2014 Surgeon General's Report [20]. Smoking prevalence data for CS, FS and NS male and female populations were obtained from the BRFSS WEAT online platform [22] for the years 2018, 2019, and 2021. These data, which are provided for 14 different age categories were interpolated to single-year ages using cubic interpolation with B-spline smoothing. Using these interpolated prevalence and RR data, NSAF values were computed for applicable disease sites for every single age. Never smoker incidence and mortality rates were then obtained by multiplying the average U.S. population rates by the corresponding NSAF values.

To calculate the NS survival functions, NSAF for hazard rates was calculated using the "all causes" mortality category in the 2014 Surgeon General's Report. The hazard rates for the average U.S. population, derived from the average U.S. survival function, were then scaled by the all-cause NSAF to obtain NS hazard rates. Subsequently, the NS survival function was computed using the exponential relation between survival and hazard functions.

Finally, the REID calculations were performed using the updated background data for GCR exposure (1976 solar minimum conditions), based on a nominal mission duration of 365 days, for both male and female astronauts at ages 35 and 55 behind 20 g/cm^2 aluminum shielding. These calculations were performed for both average and never smoker populations and compared against results from previous years to assess the impact of the updated background data.

In Figure 43, it was found that the total REID has consistently decreased over the past few iterations of background databases covering 2011 [8], 2015 [9], and the present work. This trend is attributed to decreases in cancer hazard rates and all-cause mortality in the U.S. population over the same time frame. In Figure 44, REID results calculated with various background databases for the never smoker population did not exhibit clear trends. This is attributed to variations in analysis methods employed in [8] and [9] for the never smoker population, as discussed in Section III.III.

VII. Acknowledgements

Appendix A. Obtaining Hazard Functions from U.S. Life Tables

The background survival data files used in the NSCR code, in addition to age a and $S(a)$, include additional columns for the hazard function, $m(a)$, and the probability of dying at age a (conditional on survival to that age), $q(a)$. These additional values are not directly required for the NSCR model, but they can be derived directly from $S(a)$ if needed. However, for the calculation of never smoker survival data, the hazard function, $m(a)$, is required, which will be discussed in this appendix.

The NVSR life tables [14], [15], [17], [18], [19] contain a column, q_a, which represents the probability of dying between ages a and $a + 1$. This q_a column forms the basis of the life table, with all the other columns derived from it, including the l_a column, which is used for deriving $S(a)$ as described in section *III.II.II* [4]. The relationship between l_a and q_a in the life tables can be expressed with the recursive relationship [15], [17], [18]

$$l_{a+1} = l_a \times (1 - q_a), \tag{12}$$

where $l_{a=0} = 10^5$.

In the context of survival tables, where survival and mortality are defined at discrete ages, $q(a)$ is defined analogously to q_a, but with a slight distinction. While q_a represents the probability of death between a and $a + 1$, the $q(a)$ function represents the probability of death at age a, conditional on survival to that age. Additionally, in the survival-based formulation, mortality at birth is assumed to be zero, so $q(0) = 0$. This contrasts with the original life table, where q_0 reflects infant mortality (i.e., deaths between birth and age 1), and thus is typically non-zero. To represent this difference, $q(a)$ can be obtained from q_a using a shift represented by

$$q(a) = \begin{cases} 0 & , a = 0 \\ q_{a-1} & , a > 0 \end{cases}. \tag{13}$$

The relationship between $q(a)$ and $S(a)$ is

$$q(a) = \begin{cases} 0 & , a = 0 \\ \frac{S(a-1)-S(a)}{S(a-1)} & , a > 0 \end{cases}. \tag{14}$$

The mortality rate m_a for death occurring between a and $a + 1$ is related to q_a according to [15], [17], [18]

$$m_a = \frac{q_a}{1 - \frac{q_a}{2}}. \tag{15}$$

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[4] As stated earlier in section *III.II.II*, l_a is the number of individuals from a "hypothetical cohort of 100,000 live births who survive to the beginning of each age interval" [15].

For the survival table, $m(a)$ is defined as an estimate of the hazard rate at a specific age a, rather than the average mortality rate over the interval. Assuming the hazard rate is approximately constant over each one-year interval, $m(a)$ can be estimated from $q(a)$ using one of two common approaches.

The first approach uses an analogous relationship employed in the previous equation:

$$m(a) = \frac{q(a)}{1 - \frac{q(a)}{2}}. \tag{16}$$

Alternatively, $m(a)$ can be derived from the exponential survival model according to

$$m(a) = -\ln[1 - q(a)]. \tag{17}$$

Equation (16) aligns with the mortality rate formulation used in life tables and may better represent hazard rates at older ages, which is the approach used in the previous report [9]. In contrast, equation (17) was used in an earlier study [7] and is based on the exponential survival model which is more consistent with the definition of hazard rate as used in REID and REIC calculations and the NS survival shown in equation (14). Equation (17) is therefore used in this report. While both approaches yield nearly identical results at younger ages, where $q(a)$ is small, they diverge slightly (<3% relative difference) at older ages where $q(a)$ increases, with equation (17) typically yielding slightly higher hazard rates. Finally, as discussed in Section III.II, the last age interval in the life tables is 100+, and $q_{100+} = 1$, reflecting that all individuals eventually reach death. To provide consistency with the lifetable data for q, the hazard rate is specified at age 101 as $m(101) = 1$.

Appendix B. Updated Background Data

Table 8. Average male cancer incidence rates per 100,000 for 2018, 2019, 2021.

age	BFO	stomach	colon	liver	bladder	lungs	esophagus	oral cavity	brain	thyroid	skin	remainder	prostate	total solid
0	3.95	0.04	0.27	2.29	0.03	0.56	0.00	0.26	3.51	0.03	0	19.37	0.30	26.7
1	4.09	0.03	0.29	1.37	0.05	0.21	0.00	0.12	3.59	0.03	0	10.59	0.07	16.3
2	4.19	0.02	0.31	0.86	0.06	0.10	0.00	0.08	3.63	0.04	0	6.67	0.03	11.8
3	4.26	0.02	0.33	0.57	0.05	0.06	0.00	0.06	3.61	0.04	0	4.67	0.02	9.4
4	4.30	0.01	0.36	0.40	0.04	0.04	0.00	0.06	3.57	0.05	0	3.54	0.01	8.1
5	4.31	0.01	0.38	0.29	0.03	0.03	0.00	0.07	3.49	0.06	0	2.86	0.02	7.3
6	4.29	0.01	0.41	0.23	0.02	0.03	0.00	0.09	3.39	0.08	0	2.47	0.02	6.8
7	4.25	0.01	0.44	0.18	0.01	0.03	0.00	0.11	3.28	0.10	0	2.29	0.02	6.5
8	4.19	0.01	0.47	0.15	0.01	0.03	0.00	0.13	3.16	0.13	0	2.25	0.03	6.4
9	4.12	0.01	0.51	0.13	0.01	0.04	0.00	0.15	3.05	0.18	0	2.36	0.03	6.5
10	4.04	0.02	0.55	0.12	0.01	0.05	0.00	0.17	2.93	0.23	0	2.60	0.03	6.7
11	3.95	0.02	0.59	0.11	0.01	0.06	0.00	0.19	2.83	0.30	0	2.96	0.03	7.1
12	3.86	0.02	0.63	0.10	0.01	0.08	0.01	0.21	2.75	0.39	0	3.45	0.03	7.7
13	3.77	0.03	0.68	0.10	0.02	0.10	0.01	0.24	2.68	0.49	0	4.05	0.03	8.4
14	3.68	0.03	0.73	0.10	0.03	0.11	0.01	0.28	2.62	0.62	0	4.75	0.03	9.3
15	3.61	0.04	0.79	0.10	0.04	0.13	0.01	0.33	2.58	0.76	0	5.57	0.03	10.4
16	3.54	0.06	0.85	0.11	0.07	0.14	0.01	0.38	2.56	0.93	0	6.52	0.03	11.6
17	3.48	0.07	0.93	0.12	0.10	0.15	0.01	0.43	2.54	1.12	0	7.60	0.03	13.1
18	3.44	0.09	1.01	0.13	0.13	0.17	0.02	0.47	2.54	1.33	0	8.81	0.03	14.7
19	3.41	0.12	1.10	0.14	0.16	0.18	0.02	0.50	2.54	1.56	0	10.15	0.03	16.5
20	3.39	0.15	1.21	0.15	0.19	0.20	0.03	0.53	2.56	1.81	0	11.62	0.03	18.5
21	3.39	0.19	1.33	0.17	0.22	0.22	0.03	0.56	2.58	2.08	0	13.19	0.03	20.6
22	3.39	0.23	1.46	0.19	0.25	0.24	0.04	0.59	2.61	2.38	0	14.84	0.03	22.9
23	3.40	0.28	1.61	0.22	0.29	0.27	0.05	0.63	2.65	2.69	0	16.55	0.04	25.3
24	3.43	0.34	1.78	0.24	0.33	0.31	0.06	0.68	2.69	3.01	0	18.29	0.04	27.8
25	3.46	0.41	1.97	0.27	0.37	0.35	0.08	0.75	2.75	3.35	0	20.05	0.04	30.4
26	3.50	0.48	2.18	0.31	0.42	0.40	0.09	0.82	2.81	3.70	0	21.83	0.04	33.1
27	3.54	0.57	2.43	0.35	0.48	0.45	0.11	0.91	2.87	4.06	0	23.61	0.04	35.9
28	3.59	0.66	2.70	0.39	0.55	0.52	0.14	1.02	2.95	4.43	0	25.41	0.05	38.8
29	3.65	0.76	3.01	0.45	0.63	0.61	0.17	1.16	3.03	4.79	0	27.22	0.06	41.9
30	3.72	0.87	3.36	0.51	0.72	0.71	0.20	1.31	3.12	5.16	0	29.06	0.07	45.1
31	3.79	1.00	3.76	0.58	0.83	0.83	0.24	1.50	3.23	5.52	0	30.95	0.08	48.5
32	3.87	1.14	4.21	0.66	0.95	0.98	0.29	1.73	3.34	5.88	0	32.90	0.10	52.2
33	3.96	1.29	4.71	0.75	1.09	1.16	0.35	2.00	3.46	6.23	0	34.95	0.14	56.1
34	4.06	1.46	5.28	0.86	1.26	1.38	0.43	2.32	3.59	6.57	0	37.11	0.19	60.4
35	4.17	1.65	5.92	0.98	1.45	1.64	0.51	2.70	3.73	6.90	0	39.42	0.27	65.2
36	4.30	1.86	6.64	1.13	1.67	1.95	0.61	3.14	3.89	7.22	0	41.92	0.39	70.4
37	4.43	2.08	7.45	1.30	1.92	2.33	0.73	3.67	4.05	7.53	0	44.64	0.58	76.3
38	4.58	2.34	8.35	1.49	2.22	2.80	0.87	4.29	4.23	7.83	0	47.61	0.89	82.9
39	4.75	2.61	9.36	1.72	2.56	3.35	1.04	5.02	4.43	8.12	0	50.88	1.40	90.5
40	4.93	2.91	10.49	1.99	2.95	4.02	1.23	5.86	4.63	8.40	0	54.48	2.20	99.2
41	5.13	3.24	11.74	2.30	3.40	4.83	1.45	6.84	4.86	8.68	0	58.47	3.44	109.2
42	5.36	3.60	13.12	2.66	3.93	5.80	1.71	7.96	5.10	8.95	0	62.88	5.29	121.0
43	5.60	3.99	14.65	3.08	4.53	6.96	2.01	9.24	5.36	9.22	0	67.76	7.93	134.7
44	5.87	4.41	16.32	3.58	5.23	8.34	2.36	10.69	5.63	9.48	0	73.13	11.59	150.8
45	6.17	4.87	18.16	4.15	6.03	9.99	2.76	12.32	5.93	9.76	0	79.02	16.52	169.5
46	6.50	5.37	20.15	4.83	6.95	11.95	3.21	14.11	6.24	10.03	0	85.45	22.98	191.3
47	6.87	5.91	22.32	5.63	8.01	14.27	3.72	16.08	6.58	10.32	0	92.43	31.27	216.6
48	7.28	6.50	24.65	6.56	9.23	16.99	4.30	18.21	6.94	10.63	0	99.99	41.66	245.7
49	7.73	7.13	27.16	7.65	10.63	20.18	4.96	20.49	7.33	10.94	0	108.15	54.43	279.0
50	8.22	7.82	29.82	8.93	12.22	23.90	5.69	22.91	7.74	11.27	0	116.91	69.80	317.0

Table 8 continued

age	BFO	stomach	colon	liver	bladder	lungs	esophagus	oral cavity	brain	thyroid	skin	remainder	prostate	total solid
51	8.74	8.57	33.88	10.42	14.09	28.19	6.37	25.45	8.17	11.62	0	125.95	88.06	360.8
52	9.34	9.39	36.91	12.12	16.18	33.18	7.26	28.12	8.63	11.97	0	135.85	109.28	408.9
53	10.00	10.28	40.06	14.06	18.56	38.94	8.24	30.88	9.12	12.34	0	146.39	133.65	462.5
54	10.72	11.23	43.31	16.29	21.25	45.53	9.31	33.72	9.63	12.71	0	157.59	161.19	521.8
55	11.51	12.25	46.66	18.80	24.29	53.04	10.48	36.62	10.18	13.09	0	169.47	191.79	586.7
56	12.37	13.35	50.09	21.64	27.73	61.55	11.76	39.56	10.74	13.48	0	182.02	225.20	657.1
57	13.31	14.52	53.61	24.80	31.59	71.14	13.13	42.51	11.34	13.87	0	195.27	261.10	732.9
58	14.34	15.77	57.20	28.30	35.91	81.87	14.61	45.45	11.96	14.25	0	209.20	298.99	813.5
59	15.45	17.10	60.85	32.12	40.74	93.80	16.18	48.35	12.61	14.64	0	223.83	338.33	898.5
60	16.67	18.50	64.56	36.26	46.11	106.98	17.84	51.18	13.28	15.02	0	239.15	378.46	987.3
61	17.98	19.99	68.31	40.68	52.06	121.43	19.60	53.93	13.98	15.40	0	255.14	418.67	1079.2
62	19.40	21.55	72.11	45.33	58.63	137.14	21.43	56.57	14.69	15.76	0	271.79	458.22	1173.2
63	20.93	23.18	75.94	50.15	65.85	154.09	23.33	59.08	15.43	16.11	0	289.07	496.36	1268.6
64	22.57	24.90	79.81	55.05	73.76	172.19	25.29	61.44	16.18	16.43	0	306.95	532.39	1364.4
65	24.33	26.67	83.71	59.93	82.37	191.36	27.30	63.63	16.94	16.74	0	325.39	565.65	1459.7
66	26.22	28.52	87.64	64.66	91.70	211.44	29.33	65.64	17.71	17.02	0	344.34	595.55	1553.6
67	28.23	30.42	91.61	69.11	101.75	232.25	31.38	67.45	18.49	17.27	0	363.71	621.63	1645.1
68	30.36	32.37	95.61	73.14	112.53	253.55	33.41	69.05	19.27	17.48	0	383.44	643.51	1733.4
69	32.61	34.36	99.66	76.58	124.01	275.05	35.42	70.45	20.04	17.66	0	403.43	660.95	1817.6
70	34.98	36.38	103.76	79.31	136.17	296.44	37.38	71.62	20.80	17.80	0	423.56	673.83	1897.1
71	37.47	38.43	107.92	81.18	148.95	317.37	39.26	72.58	21.55	17.89	0	443.72	682.15	1971.0
72	40.07	40.48	112.14	82.09	162.30	337.44	41.05	73.32	22.27	17.93	0	463.76	686.02	2038.8
73	42.76	42.52	116.46	82.00	176.12	356.27	42.71	73.85	22.96	17.92	0	483.52	685.63	2100.0
74	45.53	44.54	120.87	81.01	190.32	373.58	44.24	74.17	23.61	17.86	0	502.83	681.28	2154.3
75	48.38	46.52	125.41	79.31	204.77	389.13	45.60	74.30	24.22	17.74	0	521.51	673.30	2201.8
76	51.27	48.45	130.09	77.07	219.34	402.72	46.78	74.23	24.78	17.57	0	539.35	662.11	2242.5
77	54.19	50.31	134.94	74.49	233.86	414.18	47.76	73.98	25.27	17.34	0	556.14	648.13	2276.4
78	57.11	52.08	139.98	71.71	248.17	423.39	48.52	73.56	25.70	17.05	0	571.67	631.80	2303.6
79	60.01	53.74	145.25	68.90	262.06	430.29	49.06	73.00	26.06	16.70	0	585.72	613.57	2324.3
80	62.85	55.27	150.78	66.19	275.35	434.83	49.35	72.29	26.33	16.30	0	598.07	593.87	2338.6
81	65.59	56.66	156.61	63.69	287.82	437.03	49.41	71.45	26.52	15.84	0	608.52	573.10	2346.7
82	68.21	57.89	162.79	61.49	299.27	436.94	49.21	70.51	26.62	15.33	0	616.85	551.66	2348.6
83	70.67	58.94	169.36	59.67	309.48	434.66	48.77	69.46	26.63	14.78	0	622.90	529.89	2344.6
84	72.91	59.80	176.39	58.30	318.27	430.31	48.10	68.34	26.53	14.19	0	626.51	508.10	2334.8
85	74.92	60.45	183.93	57.47	325.44	424.03	47.19	67.14	26.34	13.55	0	627.56	486.57	2319.7
86	76.65	60.89	192.06	57.25	330.84	415.99	46.05	65.89	26.04	12.89	0	625.95	465.53	2299.4
87	78.05	61.10	200.86	57.74	334.32	406.39	44.72	64.60	25.64	12.20	0	621.64	445.18	2274.4
88	79.11	61.08	210.41	58.90	335.77	395.41	43.20	63.28	25.14	11.48	0	614.62	425.67	2245.0
89	79.79	60.82	220.83	60.08	335.13	383.26	41.51	61.94	24.55	10.76	0	604.96	407.16	2211.0
90	80.27	60.32	231.99	60.42	332.35	370.14	39.68	60.60	23.86	10.03	0	593.79	389.73	2172.9
91	80.75	59.59	243.72	59.08	327.46	356.26	37.73	59.25	23.09	9.29	0	582.24	373.46	2131.2
92	81.23	58.62	256.04	55.37	320.49	341.79	35.68	57.92	22.24	8.57	0	570.34	358.43	2085.5
93	81.72	57.55	268.98	50.56	312.61	327.41	33.65	56.62	21.36	7.88	0	558.51	344.32	2039.5
94	82.21	56.50	282.57	46.18	304.92	313.63	31.74	55.34	20.53	7.24	0	547.10	330.77	1996.5
95	82.70	55.47	296.85	42.17	297.43	300.44	29.94	54.09	19.72	6.66	0	536.10	317.74	1956.6
96	82.70	54.45	296.85	38.51	290.11	287.80	28.24	52.87	18.95	6.12	0	530.55	305.23	1909.7
97	82.70	53.46	296.85	35.17	282.98	275.69	26.64	51.68	18.21	5.63	0	525.21	293.21	1864.7
98	82.70	52.48	296.85	32.12	276.02	264.09	25.12	50.51	17.49	5.17	0	520.08	281.67	1821.6
99	82.70	51.52	296.85	29.33	269.24	252.97	23.70	49.37	16.81	4.75	0	515.13	270.58	1780.3
100	82.70	50.58	296.85	26.79	262.62	242.33	22.35	48.26	16.15	4.37	0	510.37	259.93	1740.6
101	82.70	49.66	296.85	24.46	256.16	232.13	21.08	47.17	15.51	4.02	0	505.79	249.69	1702.5

Table 9. Average male cancer mortality rates per 100,000 for 2018, 2019, 2021.

age	BFO	stomach	colon	liver	bladder	lungs	esophagus	oral cavity	brain	thyroid	skin	remainder	prostate	total solid	CHD	stroke
0	0.55	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.40	0.00	0	0.75	0.00	1.3	0.00	5.14
1	0.56	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.44	0.00	0	0.67	0.00	1.2	0.00	1.42
2	0.57	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.48	0.00	0	0.62	0.00	1.2	0.00	0.56
3	0.57	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.54	0.00	0	0.57	0.00	1.2	0.00	0.31
4	0.58	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.60	0.00	0	0.54	0.00	1.2	0.00	0.21
5	0.59	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.66	0.00	0	0.52	0.00	1.3	0.00	0.18
6	0.60	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.71	0.00	0	0.51	0.00	1.3	0.01	0.17
7	0.61	0.01	0.00	0.07	0.00	0.00	0.00	0.00	0.75	0.00	0	0.51	0.00	1.4	0.01	0.17
8	0.62	0.01	0.00	0.07	0.00	0.00	0.00	0.01	0.76	0.00	0	0.52	0.00	1.4	0.01	0.18
9	0.63	0.01	0.01	0.07	0.00	0.00	0.00	0.01	0.76	0.00	0	0.54	0.00	1.4	0.01	0.19
10	0.64	0.01	0.01	0.07	0.00	0.01	0.00	0.01	0.74	0.00	0	0.57	0.00	1.4	0.02	0.20
11	0.65	0.01	0.01	0.06	0.00	0.01	0.00	0.01	0.71	0.00	0	0.62	0.00	1.4	0.03	0.22
12	0.67	0.01	0.01	0.06	0.00	0.01	0.01	0.01	0.68	0.00	0	0.68	0.00	1.5	0.03	0.24
13	0.68	0.02	0.02	0.06	0.00	0.01	0.01	0.01	0.66	0.00	0	0.75	0.00	1.5	0.05	0.25
14	0.69	0.02	0.02	0.07	0.00	0.01	0.01	0.01	0.64	0.00	0	0.85	0.00	1.6	0.06	0.27
15	0.70	0.02	0.03	0.07	0.00	0.02	0.01	0.02	0.63	0.00	0	0.96	0.00	1.8	0.08	0.30
16	0.72	0.03	0.03	0.07	0.00	0.02	0.01	0.02	0.63	0.00	0	1.08	0.00	1.9	0.11	0.32
17	0.73	0.03	0.04	0.07	0.00	0.02	0.01	0.02	0.63	0.00	0	1.19	0.00	2.0	0.14	0.35
18	0.75	0.04	0.05	0.08	0.00	0.03	0.02	0.03	0.63	0.00	0	1.29	0.00	2.2	0.18	0.38
19	0.76	0.05	0.07	0.08	0.00	0.03	0.02	0.03	0.64	0.01	0	1.37	0.00	2.3	0.24	0.41
20	0.78	0.06	0.08	0.09	0.00	0.04	0.03	0.03	0.65	0.01	0	1.43	0.00	2.4	0.32	0.45
21	0.80	0.07	0.10	0.09	0.00	0.05	0.03	0.04	0.66	0.01	0	1.48	0.00	2.5	0.42	0.50
22	0.81	0.08	0.13	0.10	0.00	0.06	0.04	0.05	0.68	0.01	0	1.53	0.00	2.7	0.54	0.55
23	0.83	0.10	0.16	0.11	0.01	0.07	0.04	0.05	0.70	0.01	0	1.58	0.00	2.8	0.69	0.61
24	0.85	0.12	0.20	0.12	0.01	0.08	0.05	0.06	0.73	0.01	0	1.63	0.00	3.0	0.87	0.68
25	0.87	0.14	0.24	0.14	0.01	0.10	0.06	0.07	0.77	0.01	0	1.70	0.00	3.2	1.11	0.76
26	0.89	0.16	0.30	0.15	0.01	0.12	0.08	0.09	0.80	0.01	0	1.77	0.00	3.5	1.39	0.86
27	0.91	0.19	0.36	0.17	0.01	0.14	0.09	0.10	0.85	0.02	0	1.86	0.00	3.8	1.73	0.96
28	0.93	0.22	0.43	0.19	0.02	0.17	0.11	0.12	0.90	0.02	0	1.98	0.00	4.2	2.14	1.09
29	0.95	0.26	0.52	0.22	0.02	0.21	0.14	0.14	0.96	0.02	0	2.11	0.00	4.6	2.64	1.24
30	0.97	0.30	0.62	0.25	0.02	0.26	0.16	0.16	1.02	0.02	0	2.28	0.00	5.1	3.23	1.40
31	1.00	0.35	0.74	0.28	0.03	0.31	0.19	0.19	1.09	0.03	0	2.47	0.01	5.7	3.93	1.60
32	1.02	0.41	0.87	0.33	0.04	0.38	0.23	0.22	1.17	0.03	0	2.69	0.01	6.4	4.75	1.82
33	1.05	0.47	1.03	0.38	0.05	0.47	0.28	0.26	1.26	0.04	0	2.96	0.01	7.2	5.71	2.08
34	1.08	0.54	1.20	0.43	0.06	0.57	0.33	0.30	1.37	0.04	0	3.26	0.01	8.1	6.83	2.37
35	1.12	0.61	1.40	0.50	0.07	0.69	0.39	0.35	1.48	0.05	0	3.62	0.02	9.2	8.13	2.70
36	1.15	0.70	1.63	0.59	0.09	0.84	0.47	0.41	1.60	0.06	0	4.03	0.02	10.4	9.62	3.08
37	1.20	0.79	1.88	0.68	0.11	1.03	0.55	0.48	1.74	0.06	0	4.50	0.03	11.9	11.32	3.51
38	1.24	0.90	2.17	0.80	0.13	1.25	0.65	0.55	1.90	0.07	0	5.05	0.05	13.5	13.26	4.00
39	1.29	1.01	2.49	0.93	0.16	1.53	0.76	0.64	2.07	0.08	0	5.67	0.06	15.4	15.46	4.54
40	1.35	1.14	2.85	1.09	0.20	1.86	0.90	0.75	2.25	0.09	0	6.37	0.09	17.6	17.94	5.15
41	1.41	1.28	3.24	1.28	0.24	2.26	1.05	0.87	2.46	0.11	0	7.18	0.12	20.1	20.73	5.83
42	1.48	1.43	3.68	1.51	0.29	2.74	1.23	1.00	2.68	0.12	0	8.09	0.17	22.9	23.84	6.57
43	1.56	1.60	4.16	1.77	0.35	3.33	1.43	1.15	2.93	0.14	0	9.13	0.23	26.2	27.31	7.39
44	1.66	1.78	4.68	2.07	0.42	4.03	1.67	1.33	3.20	0.16	0	10.29	0.32	30.0	31.17	8.29
45	1.76	1.97	5.26	2.43	0.51	4.87	1.94	1.53	3.49	0.18	0	11.61	0.43	34.2	35.42	9.27
46	1.88	2.18	5.88	2.85	0.61	5.87	2.24	1.75	3.81	0.20	0	13.08	0.58	39.1	40.11	10.34
47	2.02	2.41	6.56	3.34	0.73	7.07	2.58	2.00	4.15	0.22	0	14.73	0.76	44.6	45.26	11.50
48	2.17	2.66	7.30	3.91	0.87	8.49	2.97	2.29	4.52	0.25	0	16.57	1.00	50.8	50.90	12.76
49	2.35	2.92	8.09	4.56	1.03	10.17	3.41	2.60	4.92	0.28	0	18.62	1.30	57.9	57.06	14.13
50	2.56	3.20	8.95	5.32	1.22	12.15	3.90	2.95	5.34	0.31	0	20.89	1.67	65.9	63.76	15.62
51	2.79	3.51	9.86	6.18	1.44	14.48	4.45	3.34	5.79	0.35	0	23.40	2.14	74.9	71.04	17.23
52	3.06	3.83	10.85	7.17	1.70	17.20	5.06	3.76	6.27	0.39	0	26.18	2.70	85.1	78.93	18.97

Table 9 continued

age	BFO	stomach	colon	liver	bladder	lungs	esophagus	oral cavity	brain	thyroid	skin	remainder	prostate	total solid	CHD	stroke
53	3.36	4.17	11.90	8.28	1.99	20.35	5.73	4.23	6.78	0.43	0	29.22	3.39	96.5	87.47	20.86
54	3.70	4.54	13.02	9.54	2.33	24.01	6.48	4.74	7.32	0.48	0	32.56	4.21	109.2	96.70	22.90
55	4.09	4.92	14.21	10.95	2.72	28.22	7.30	5.29	7.90	0.53	0	36.20	5.19	123.4	106.6	25.12
56	4.53	5.33	15.48	12.51	3.16	33.04	8.21	5.89	8.50	0.59	0	40.16	6.36	139.2	117.4	27.52
57	5.04	5.77	16.82	14.23	3.66	38.54	9.19	6.53	9.14	0.65	0	44.44	7.72	156.7	128.9	30.12
58	5.60	6.23	18.25	16.11	4.24	44.75	10.25	7.21	9.80	0.71	0	49.06	9.32	175.9	141.3	32.95
59	6.24	6.71	19.75	18.16	4.89	51.74	11.41	7.92	10.50	0.78	0	54.01	11.17	197.1	154.6	36.03
60	6.97	7.22	21.35	20.36	5.64	59.55	12.65	8.67	11.23	0.86	0	59.32	13.29	220.1	169.0	39.37
61	7.78	7.75	23.03	22.73	6.47	68.21	13.97	9.45	11.98	0.94	0	64.97	15.72	245.2	184.4	43.03
62	8.70	8.32	24.80	25.24	7.42	77.75	15.39	10.26	12.77	1.03	0	70.97	18.48	272.4	200.9	47.02
63	9.73	8.91	26.67	27.90	8.48	88.16	16.88	11.08	13.57	1.12	0	77.32	21.61	301.7	218.7	51.39
64	10.89	9.53	28.63	30.69	9.68	99.46	18.46	11.92	14.40	1.22	0	83.99	25.13	333.1	237.8	56.18
65	12.18	10.19	30.71	33.59	11.02	111.6	20.11	12.76	15.25	1.33	0	90.98	29.06	366.6	258.5	61.46
66	13.62	10.87	32.89	36.59	12.51	124.6	21.83	13.61	16.12	1.44	0	98.27	33.46	402.2	280.7	67.27
67	15.22	11.59	35.19	39.66	14.19	138.4	23.61	14.46	16.99	1.56	0	105.8	38.34	439.8	304.7	73.69
68	17.00	12.34	37.61	42.78	16.05	153.0	25.44	15.31	17.88	1.69	0	113.6	43.74	479.4	330.6	80.80
69	18.95	13.13	40.16	45.92	18.12	168.1	27.31	16.15	18.77	1.83	0	121.7	49.71	520.9	358.7	88.71
70	21.11	13.96	42.85	49.05	20.43	183.9	29.20	16.98	19.66	1.97	0	129.9	56.28	564.2	389.1	97.51
71	23.46	14.82	45.69	52.13	22.99	200.0	31.10	17.80	20.54	2.12	0	138.4	63.50	609.1	422.2	107.4
72	26.02	15.73	48.69	55.12	25.82	216.5	33.00	18.61	21.41	2.28	0	147.0	71.42	655.6	458.2	118.4
73	28.79	16.68	51.85	58.00	28.95	233.0	34.87	19.40	22.26	2.45	0	155.8	80.09	703.4	497.5	130.8
74	31.77	17.68	55.21	60.73	32.41	249.5	36.70	20.18	23.08	2.62	0	164.8	89.59	752.6	540.5	144.8
75	34.96	18.72	58.76	63.27	36.23	265.8	38.47	20.95	23.88	2.81	0	174.0	99.98	802.9	587.6	160.6
76	38.35	19.82	62.53	65.58	40.44	281.7	40.16	21.69	24.64	3.00	0	183.3	111.3	854.2	639.4	178.6
77	41.91	20.97	66.53	67.64	45.07	296.9	41.75	22.42	25.35	3.20	0	192.7	123.8	906.4	696.5	199.1
78	45.64	22.18	70.79	69.41	50.17	311.3	43.22	23.14	26.02	3.41	0	202.4	137.4	959.4	759.7	222.6
79	49.49	23.45	75.33	70.87	55.76	324.7	44.55	23.85	26.63	3.62	0	212.1	152.4	1013.3	829.7	249.5
80	53.44	24.79	80.19	71.99	61.91	336.9	45.72	24.55	27.17	3.85	0	222.1	168.8	1068.0	907.4	280.5
81	57.43	26.21	85.38	72.76	68.66	347.6	46.72	25.24	27.65	4.08	0	232.3	186.9	1123.6	994.1	316.4
82	61.42	27.70	90.95	73.16	76.05	356.8	47.54	25.93	28.05	4.32	0	242.8	206.9	1180.2	1091.1	358.1
83	65.35	29.27	96.93	73.19	84.15	364.3	48.15	26.62	28.38	4.57	0	253.5	229.0	1238.1	1199.9	406.7
84	69.14	30.93	103.4	72.85	93.03	370.0	48.54	27.32	28.62	4.83	0	264.6	253.5	1297.5	1322.4	463.6
85	72.73	32.70	110.3	72.13	102.7	373.8	48.72	28.03	28.77	5.09	0	276.1	280.7	1359.1	1460.6	530.4
86	76.05	34.57	117.8	71.06	113.4	375.5	48.68	28.75	28.84	5.36	0	288.2	311.2	1423.4	1617.2	609.4
87	79.01	36.55	126.0	69.64	125.0	375.3	48.41	29.50	28.81	5.64	0	300.9	345.3	1491.0	1795.2	703.0
88	81.54	38.66	134.8	67.89	137.7	373.0	47.91	30.28	28.69	5.92	0	314.4	383.7	1563.1	1998.3	814.6
89	83.58	40.91	144.5	65.85	151.6	368.8	47.20	31.09	28.47	6.21	0	328.9	427.1	1640.6	2230.7	948.1
90	85.36	43.31	154.9	63.54	166.9	362.6	46.27	31.95	28.16	6.51	0	344.3	476.4	1724.7	2493.9	1106.1
91	87.18	45.87	166.1	60.98	183.5	354.6	45.14	32.87	27.76	6.81	0	360.4	532.4	1816.4	2788.1	1290.4
92	89.04	48.61	178.0	58.23	201.7	345.0	43.82	33.85	27.27	7.11	0	377.3	596.6	1917.6	3117.1	1505.5
93	90.94	51.53	190.9	55.45	221.7	334.6	42.44	34.88	26.75	7.43	0	395.4	669.4	2030.4	3484.8	1756.3
94	92.88	54.63	204.6	52.81	243.6	324.6	41.10	35.94	26.23	7.76	0	414.7	751.1	2157.1	3896.0	2049.0
95	94.86	57.91	219.4	50.29	267.7	314.9	39.80	37.04	25.72	8.10	0	435.4	842.8	2299.1	4355.7	2390.4
96	94.86	61.39	219.4	47.89	294.2	305.5	38.55	38.17	25.23	8.46	0	438.6	945.7	2423.1	4355.7	2390.4
97	94.86	65.08	219.4	45.61	323.3	296.3	37.33	39.33	24.74	8.83	0	442.0	1061.1	2563.0	4355.7	2390.4
98	94.86	69.00	219.4	43.43	355.3	287.5	36.15	40.53	24.26	9.23	0	445.4	1190.6	2720.8	4355.7	2390.4
99	94.86	73.14	219.4	41.36	390.4	278.9	35.01	41.76	23.79	9.63	0	449.0	1335.9	2898.3	4355.7	2390.4
100	94.86	77.54	219.4	39.39	429.1	270.5	33.91	43.03	23.34	10.06	0	452.7	1499.0	3097.9	4355.7	2390.4
101	94.86	82.20	219.4	37.51	471.5	262.4	32.84	44.35	22.89	10.51	0	456.5	1681.9	3322.0	4355.7	2390.4

Table 10. Average female cancer incidence rates per 100,000 for 2018, 2019, 2021.

Age	BFO	Stomach	Colon	Liver	Bladder	Lungs	Esophagus	Oral cavity	Brain	Thyroid	Skin	Remainder	Breast	Ovaries	Uterus	Total solid
0	4.08	0.05	0.00	1.65	0.18	0.36	0.00	0.03	3.38	0.03	0	15.80	0.04	0.19	0.04	21.8
1	4.08	0.03	0.01	1.04	0.10	0.16	0.00	0.04	3.50	0.04	0	9.75	0.04	0.15	0.03	14.9
2	4.05	0.02	0.01	0.69	0.06	0.08	0.00	0.05	3.56	0.04	0	6.86	0.03	0.14	0.02	11.6
3	3.98	0.02	0.02	0.48	0.04	0.05	0.00	0.05	3.57	0.05	0	5.25	0.02	0.13	0.02	9.7
4	3.89	0.01	0.04	0.35	0.03	0.03	0.00	0.07	3.53	0.07	0	4.22	0.02	0.14	0.02	8.5
5	3.79	0.01	0.06	0.27	0.03	0.03	0.00	0.08	3.45	0.10	0	3.51	0.01	0.17	0.02	7.7
6	3.66	0.01	0.09	0.21	0.02	0.02	0.00	0.09	3.34	0.14	0	3.02	0.01	0.20	0.02	7.2
7	3.53	0.01	0.14	0.18	0.02	0.02	0.00	0.11	3.21	0.21	0	2.72	0.01	0.25	0.02	6.9
8	3.40	0.01	0.21	0.15	0.02	0.02	0.00	0.13	3.06	0.31	0	2.56	0.01	0.31	0.02	6.8
9	3.26	0.01	0.29	0.13	0.02	0.03	0.00	0.16	2.91	0.46	0	2.53	0.00	0.39	0.02	7.0
10	3.13	0.02	0.39	0.12	0.02	0.03	0.00	0.18	2.76	0.68	0	2.58	0.00	0.49	0.02	7.3
11	3.00	0.02	0.50	0.12	0.02	0.04	0.00	0.21	2.62	0.98	0	2.71	0.01	0.61	0.03	7.9
12	2.88	0.02	0.63	0.11	0.03	0.06	0.00	0.24	2.49	1.39	0	2.87	0.01	0.74	0.03	8.6
13	2.78	0.03	0.76	0.11	0.03	0.07	0.00	0.28	2.37	1.91	0	3.06	0.01	0.88	0.04	9.5
14	2.68	0.04	0.91	0.11	0.04	0.09	0.00	0.31	2.27	2.54	0	3.25	0.02	1.02	0.04	10.6
15	2.60	0.05	1.06	0.11	0.04	0.10	0.00	0.35	2.18	3.30	0	3.48	0.05	1.15	0.05	11.9
16	2.54	0.06	1.21	0.12	0.05	0.12	0.01	0.38	2.10	4.18	0	3.76	0.09	1.27	0.07	13.4
17	2.49	0.08	1.36	0.12	0.06	0.14	0.01	0.42	2.04	5.18	0	4.12	0.19	1.38	0.09	15.2
18	2.45	0.11	1.51	0.13	0.07	0.16	0.01	0.46	1.99	6.29	0	4.58	0.34	1.48	0.14	17.3
19	2.44	0.13	1.65	0.14	0.09	0.19	0.01	0.50	1.95	7.49	0	5.16	0.58	1.58	0.23	19.7
20	2.44	0.17	1.79	0.15	0.10	0.21	0.01	0.54	1.93	8.78	0	5.86	0.92	1.67	0.39	22.5
21	2.45	0.20	1.93	0.17	0.12	0.24	0.01	0.59	1.92	10.14	0	6.68	1.38	1.76	0.67	25.8
22	2.47	0.25	2.07	0.18	0.13	0.27	0.02	0.64	1.93	11.57	0	7.61	2.02	1.85	1.09	29.6
23	2.51	0.30	2.21	0.20	0.15	0.31	0.02	0.69	1.95	13.06	0	8.63	2.87	1.96	1.66	34.0
24	2.55	0.35	2.36	0.22	0.17	0.35	0.02	0.76	1.99	14.60	0	9.75	4.03	2.08	2.38	39.1
25	2.60	0.41	2.52	0.24	0.19	0.40	0.03	0.82	2.04	16.18	0	10.96	5.54	2.21	3.23	44.8
26	2.66	0.47	2.70	0.27	0.22	0.46	0.03	0.90	2.10	17.76	0	12.27	7.49	2.36	4.23	51.3
27	2.73	0.55	2.90	0.29	0.25	0.54	0.04	0.99	2.18	19.33	0	13.69	9.95	2.53	5.37	58.6
28	2.80	0.63	3.13	0.33	0.28	0.63	0.05	1.08	2.26	20.87	0	15.22	12.98	2.71	6.71	66.9
29	2.87	0.73	3.40	0.36	0.31	0.74	0.06	1.18	2.35	22.35	0	16.87	16.67	2.91	8.25	76.2
30	2.96	0.85	3.71	0.40	0.35	0.86	0.07	1.30	2.45	23.77	0	18.64	21.05	3.14	10.00	86.6
31	3.04	0.98	4.07	0.44	0.40	1.02	0.08	1.43	2.56	25.11	0	20.54	26.19	3.38	11.96	98.2
32	3.14	1.13	4.49	0.49	0.46	1.20	0.09	1.57	2.66	26.35	0	22.57	32.09	3.66	14.10	110.9
33	3.24	1.29	4.96	0.55	0.52	1.42	0.11	1.72	2.77	27.48	0	24.75	38.78	3.96	16.42	124.7
34	3.35	1.48	5.50	0.61	0.59	1.69	0.13	1.89	2.88	28.50	0	27.07	46.23	4.28	18.90	139.7
35	3.46	1.69	6.10	0.68	0.66	2.00	0.15	2.08	2.98	29.40	0	29.55	54.41	4.64	21.51	155.9
36	3.59	1.92	6.79	0.76	0.75	2.38	0.18	2.29	3.09	30.19	0	32.20	63.27	5.03	24.22	173.1
37	3.72	2.17	7.56	0.85	0.86	2.83	0.21	2.52	3.19	30.86	0	35.02	72.73	5.46	27.00	191.3
38	3.87	2.44	8.43	0.95	0.97	3.38	0.24	2.76	3.30	31.42	0	38.02	82.71	5.92	29.82	210.4
39	4.02	2.74	9.39	1.07	1.10	4.02	0.28	3.03	3.41	31.88	0	41.22	93.11	6.42	32.65	230.3
40	4.19	3.04	10.46	1.19	1.25	4.79	0.33	3.33	3.52	32.24	0	44.63	103.84	6.96	35.46	251.0
41	4.37	3.36	11.64	1.34	1.42	5.70	0.38	3.65	3.63	32.52	0	48.26	114.78	7.54	38.24	272.5
42	4.57	3.68	12.92	1.50	1.61	6.78	0.44	3.99	3.75	32.72	0	52.12	125.85	8.17	40.97	294.5
43	4.77	4.01	14.31	1.68	1.83	8.06	0.51	4.37	3.88	32.86	0	56.23	136.96	8.83	43.62	317.1
44	5.00	4.33	15.81	1.88	2.07	9.56	0.58	4.77	4.01	32.95	0	60.61	148.04	9.54	46.21	340.4
45	5.24	4.65	17.41	2.10	2.35	11.32	0.67	5.20	4.16	33.01	0	65.24	159.04	10.28	48.72	364.1
46	5.50	4.97	19.09	2.36	2.66	13.37	0.76	5.66	4.32	33.04	0	70.14	169.93	11.07	51.16	388.5
47	5.78	5.28	20.83	2.64	3.01	15.76	0.87	6.15	4.49	33.06	0	75.32	180.69	11.89	53.54	413.5
48	6.09	5.60	22.62	2.96	3.41	18.52	0.99	6.67	4.68	33.09	0	80.77	191.34	12.75	55.89	439.3
49	6.41	5.91	24.45	3.31	3.85	21.70	1.13	7.22	4.89	33.12	0	86.50	201.92	13.63	58.23	465.9
50	6.77	6.24	26.31	3.71	4.35	25.34	1.28	7.80	5.13	33.15	0	92.51	212.49	14.55	60.58	493.4
51	7.15	6.57	28.20	4.15	4.91	29.49	1.45	8.41	5.38	33.17	0	98.79	223.14	15.49	62.99	522.1
52	7.55	6.93	30.11	4.63	5.53	34.21	1.63	9.05	5.65	33.19	0	105.35	233.98	16.46	65.49	552.2

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Table 10 continued

Age	BFO	Stomach	Colon	Liver	Bladder	Lungs	Esophagus	Oral cavity	Brain	Thyroid	Skin	Remainder	Breast	Ovaries	Uterus	Total solid
53	7.99	7.31	32.04	5.17	6.22	39.55	1.83	9.71	5.95	33.19	0	112.19	245.11	17.45	68.13	583.9
54	8.46	7.71	34.00	5.77	7.00	45.55	2.06	10.40	6.27	33.18	0	119.29	256.55	18.46	70.90	617.1
55	8.96	8.14	35.99	6.42	7.86	52.26	2.30	11.12	6.61	33.15	0	126.65	268.25	19.48	73.80	652.0
56	9.50	8.60	38.01	7.13	8.81	59.74	2.56	11.87	6.97	33.09	0	134.26	280.17	20.52	76.82	688.5
57	10.07	9.08	40.06	7.91	9.87	68.00	2.84	12.63	7.36	33.02	0	142.13	292.26	21.56	79.94	726.7
58	10.67	9.60	42.17	8.76	11.02	77.09	3.15	13.42	7.78	32.91	0	150.23	304.48	22.60	83.15	766.4
59	11.32	10.15	44.34	9.68	12.30	87.02	3.47	14.23	8.21	32.78	0	158.55	316.75	23.65	86.42	807.6
60	12.00	10.73	46.59	10.67	13.69	97.80	3.82	15.06	8.67	32.61	0	167.09	329.02	24.69	89.73	850.2
61	12.73	11.34	48.93	11.74	15.20	109.42	4.19	15.90	9.15	32.40	0	175.83	341.20	25.72	93.06	894.1
62	13.50	11.98	51.40	12.87	16.85	121.85	4.58	16.75	9.66	32.15	0	184.74	353.22	26.73	96.38	939.2
63	14.30	12.66	54.01	14.08	18.63	135.05	4.99	17.60	10.18	31.86	0	193.80	364.99	27.73	99.64	985.2
64	15.15	13.36	56.79	15.35	20.54	148.95	5.42	18.47	10.72	31.53	0	203.00	376.42	28.70	102.82	1032.1
65	16.05	14.10	59.79	16.68	22.59	163.45	5.86	19.33	11.27	31.16	0	212.30	387.42	29.64	105.88	1079.5
66	16.98	14.88	63.03	18.07	24.78	178.45	6.32	20.19	11.84	30.73	0	221.67	397.87	30.54	108.77	1127.1
67	17.95	15.68	66.58	19.50	27.09	193.81	6.79	21.05	12.41	30.26	0	231.07	407.69	31.40	111.44	1174.8
68	18.97	16.51	70.47	20.97	29.54	209.35	7.27	21.89	12.99	29.74	0	240.47	416.76	32.22	113.86	1222.0
69	20.02	17.36	74.73	22.47	32.10	224.90	7.75	22.72	13.56	29.17	0	249.81	424.98	32.99	115.98	1268.5
70	21.11	18.24	79.36	23.97	34.77	240.25	8.23	23.52	14.12	28.55	0	259.07	432.25	33.70	117.75	1313.8
71	22.23	19.15	84.35	25.47	37.53	255.17	8.71	24.31	14.67	27.88	0	268.17	438.47	34.36	119.12	1357.4
72	23.38	20.07	89.71	26.94	40.37	269.43	9.18	25.06	15.20	27.17	0	277.07	443.55	34.95	120.05	1398.7
73	24.55	21.00	95.42	28.36	43.26	282.78	9.64	25.78	15.70	26.42	0	285.71	447.39	35.48	120.51	1437.4
74	25.75	21.94	101.46	29.72	46.18	294.98	10.08	26.46	16.17	25.62	0	294.03	449.91	35.94	120.45	1473.0
75	26.96	22.89	107.81	30.99	49.11	305.79	10.49	27.10	16.59	24.78	0	301.97	451.06	36.33	119.87	1504.8
76	28.18	23.84	114.43	32.14	52.01	314.98	10.89	27.70	16.96	23.90	0	309.45	450.76	36.65	118.72	1532.4
77	29.39	24.78	121.26	33.17	54.84	322.35	11.24	28.24	17.27	22.99	0	316.42	448.98	36.89	117.00	1555.4
78	30.60	25.70	128.25	34.04	57.58	327.70	11.56	28.73	17.51	22.05	0	322.82	445.68	37.06	114.72	1573.4
79	31.80	26.59	135.32	34.74	60.19	330.91	11.84	29.16	17.68	21.09	0	328.57	440.86	37.14	111.87	1586.0
80	32.97	27.44	142.37	35.24	62.63	331.86	12.08	29.53	17.77	20.10	0	333.62	434.51	37.15	108.49	1592.8
81	34.11	28.23	149.31	35.54	64.86	330.49	12.26	29.84	17.78	19.10	0	337.91	426.66	37.08	104.58	1593.7
82	35.20	28.94	156.01	35.62	66.84	326.80	12.39	30.09	17.70	18.09	0	341.38	417.36	36.94	100.21	1588.4
83	36.23	29.56	162.35	35.47	68.54	320.81	12.47	30.26	17.52	17.08	0	344.00	406.66	36.71	95.41	1576.9
84	37.20	30.06	168.19	35.10	69.92	312.62	12.49	30.37	17.26	16.07	0	345.71	394.64	36.41	90.25	1559.1
85	38.09	30.43	173.38	34.50	70.96	302.37	12.46	30.41	16.90	15.06	0	346.50	381.39	36.04	84.78	1535.2
86	38.89	30.65	177.78	33.67	71.63	290.23	12.36	30.38	16.45	14.06	0	346.34	367.03	35.60	79.09	1505.3
87	39.59	30.70	181.24	32.64	71.91	276.44	12.21	30.28	15.92	13.08	0	345.21	351.67	35.10	73.25	1469.6
88	40.18	30.59	183.63	31.40	71.78	261.23	12.00	30.11	15.31	12.12	0	343.12	335.46	34.52	67.33	1428.6
89	40.65	30.28	184.83	29.99	71.25	244.90	11.74	29.87	14.62	11.19	0	340.07	318.55	33.89	61.41	1382.6
90	41.06	29.79	185.40	28.43	70.30	227.74	11.43	29.56	13.87	10.28	0	336.29	301.08	33.20	55.57	1332.9
91	41.47	29.10	185.96	26.74	68.94	210.04	11.07	29.19	13.07	9.41	0	331.97	283.21	32.46	49.87	1281.1
92	41.89	28.23	186.53	24.96	67.20	192.11	10.67	28.75	12.23	8.58	0	327.16	265.12	31.66	44.38	1227.6
93	42.31	27.17	187.10	23.10	65.09	174.22	10.23	28.26	11.36	7.78	0	321.87	246.94	30.83	39.15	1173.1
94	42.74	26.06	187.68	21.29	62.85	157.33	9.79	27.74	10.51	7.04	0	316.46	229.44	29.98	34.39	1120.5
95	43.17	24.98	188.25	19.63	60.69	142.07	9.36	27.23	9.72	6.38	0	311.23	213.17	29.16	30.20	1072.1
96	43.17	23.96	188.25	18.09	58.60	128.29	8.95	26.73	8.99	5.77	0	307.15	198.06	28.36	26.53	1027.7
97	43.17	22.97	188.25	16.68	56.58	115.85	8.57	26.24	8.32	5.23	0	303.21	184.02	27.59	23.30	986.8
98	43.17	22.02	188.25	15.38	54.63	104.61	8.19	25.76	7.69	4.73	0	299.42	170.97	26.83	20.47	949.0
99	43.17	21.12	188.25	14.17	52.75	94.47	7.84	25.28	7.12	4.28	0	295.77	158.85	26.10	17.98	914.0
100	43.17	20.25	188.25	13.07	50.93	85.30	7.50	24.82	6.58	3.88	0	292.24	147.59	25.38	15.79	881.6
101	43.17	19.42	188.25	12.04	49.18	77.03	7.17	24.36	6.09	3.51	0	288.85	137.13	24.69	13.87	851.6

Table 11. Average female cancer mortality rates per 100,000 for 2018, 2019, 2021.

age	BFO	stomach	colon	liver	bladder	lungs	esophagus	oral cavity	brain	thyroid	skin	remainder	breast	ovaries	uterus	total solid	CHD	stroke
0	0.65	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.31	0.00	0	0.55	0.00	0.01	0.02	0.9	0.00	5.11
1	0.61	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.36	0.00	0	0.51	0.00	0.01	0.02	0.9	0.00	1.24
2	0.57	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.42	0.00	0	0.48	0.00	0.01	0.02	1.0	0.00	0.46
3	0.54	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.50	0.00	0	0.47	0.00	0.01	0.02	1.0	0.00	0.24
4	0.52	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.59	0.00	0	0.46	0.00	0.01	0.03	1.1	0.00	0.17
5	0.49	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.68	0.00	0	0.46	0.00	0.02	0.03	1.2	0.00	0.15
6	0.48	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.76	0.00	0	0.47	0.00	0.02	0.04	1.3	0.00	0.15
7	0.47	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.80	0.00	0	0.48	0.00	0.02	0.04	1.4	0.00	0.15
8	0.46	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.80	0.00	0	0.49	0.00	0.02	0.05	1.4	0.01	0.16
9	0.45	0.01	0.00	0.02	0.00	0.01	0.00	0.01	0.76	0.00	0	0.51	0.00	0.03	0.06	1.4	0.01	0.18
10	0.44	0.01	0.01	0.02	0.00	0.01	0.00	0.01	0.70	0.00	0	0.53	0.00	0.03	0.07	1.4	0.01	0.19
11	0.44	0.01	0.01	0.02	0.00	0.01	0.00	0.01	0.63	0.00	0	0.55	0.00	0.03	0.08	1.4	0.01	0.20
12	0.44	0.01	0.01	0.02	0.00	0.01	0.00	0.01	0.57	0.00	0	0.58	0.00	0.04	0.09	1.4	0.02	0.21
13	0.44	0.01	0.01	0.03	0.00	0.01	0.00	0.01	0.53	0.00	0	0.61	0.00	0.04	0.10	1.4	0.02	0.22
14	0.44	0.01	0.02	0.03	0.00	0.02	0.00	0.01	0.50	0.00	0	0.64	0.00	0.05	0.11	1.4	0.03	0.24
15	0.45	0.02	0.02	0.03	0.00	0.02	0.00	0.02	0.47	0.00	0	0.68	0.01	0.06	0.13	1.5	0.04	0.25
16	0.45	0.02	0.02	0.04	0.00	0.02	0.00	0.02	0.46	0.00	0	0.70	0.01	0.07	0.15	1.5	0.05	0.27
17	0.46	0.03	0.03	0.04	0.00	0.03	0.00	0.02	0.45	0.00	0	0.73	0.01	0.08	0.17	1.6	0.06	0.29
18	0.47	0.03	0.04	0.05	0.00	0.03	0.00	0.02	0.44	0.01	0	0.75	0.02	0.09	0.20	1.7	0.08	0.32
19	0.48	0.04	0.05	0.05	0.01	0.04	0.00	0.03	0.44	0.01	0	0.76	0.03	0.10	0.23	1.8	0.11	0.35
20	0.49	0.05	0.06	0.06	0.01	0.04	0.01	0.03	0.45	0.01	0	0.77	0.05	0.11	0.26	1.9	0.14	0.38
21	0.50	0.06	0.08	0.06	0.01	0.05	0.01	0.03	0.46	0.01	0	0.79	0.07	0.13	0.30	2.0	0.17	0.41
22	0.51	0.07	0.10	0.07	0.01	0.06	0.01	0.03	0.47	0.01	0	0.81	0.10	0.15	0.35	2.2	0.22	0.45
23	0.53	0.09	0.12	0.08	0.01	0.07	0.01	0.04	0.48	0.01	0	0.83	0.15	0.17	0.40	2.5	0.28	0.50
24	0.54	0.11	0.16	0.09	0.01	0.08	0.01	0.04	0.50	0.01	0	0.86	0.22	0.19	0.46	2.8	0.35	0.55
25	0.56	0.14	0.19	0.10	0.01	0.09	0.01	0.05	0.52	0.01	0	0.91	0.32	0.22	0.53	3.1	0.43	0.62
26	0.57	0.16	0.24	0.11	0.02	0.11	0.02	0.05	0.55	0.01	0	0.96	0.45	0.25	0.61	3.5	0.53	0.69
27	0.59	0.19	0.30	0.13	0.02	0.13	0.02	0.06	0.58	0.02	0	1.03	0.62	0.28	0.70	4.1	0.65	0.77
28	0.61	0.23	0.36	0.14	0.02	0.16	0.02	0.06	0.61	0.02	0	1.11	0.84	0.32	0.80	4.7	0.80	0.87
29	0.63	0.27	0.44	0.16	0.03	0.19	0.03	0.07	0.65	0.02	0	1.20	1.12	0.37	0.92	5.5	0.97	0.98
30	0.66	0.31	0.53	0.18	0.03	0.22	0.03	0.08	0.69	0.03	0	1.32	1.46	0.42	1.05	6.4	1.17	1.11
31	0.69	0.36	0.63	0.21	0.04	0.27	0.04	0.09	0.73	0.03	0	1.46	1.88	0.48	1.20	7.4	1.41	1.26
32	0.72	0.42	0.75	0.23	0.04	0.32	0.05	0.10	0.79	0.03	0	1.61	2.37	0.55	1.37	8.6	1.69	1.42
33	0.75	0.48	0.88	0.26	0.05	0.39	0.06	0.11	0.85	0.04	0	1.80	2.95	0.63	1.55	10.1	2.01	1.61
34	0.79	0.54	1.04	0.30	0.06	0.48	0.07	0.13	0.91	0.04	0	2.02	3.62	0.71	1.76	11.7	2.38	1.83
35	0.83	0.61	1.21	0.34	0.07	0.58	0.08	0.14	0.98	0.05	0	2.27	4.38	0.81	1.98	13.5	2.81	2.08
36	0.87	0.69	1.40	0.39	0.08	0.70	0.10	0.16	1.06	0.06	0	2.56	5.23	0.92	2.23	15.6	3.30	2.35
37	0.92	0.77	1.62	0.44	0.09	0.86	0.12	0.19	1.15	0.06	0	2.89	6.16	1.05	2.50	17.9	3.86	2.67
38	0.97	0.85	1.86	0.50	0.10	1.04	0.14	0.21	1.25	0.07	0	3.27	7.18	1.19	2.80	20.5	4.49	3.02
39	1.03	0.94	2.13	0.57	0.12	1.27	0.16	0.24	1.36	0.08	0	3.71	8.28	1.35	3.12	23.4	5.21	3.41
40	1.09	1.04	2.43	0.65	0.14	1.55	0.19	0.27	1.48	0.10	0	4.20	9.46	1.52	3.48	26.5	6.02	3.85
41	1.15	1.14	2.75	0.74	0.16	1.89	0.22	0.31	1.62	0.11	0	4.76	10.70	1.72	3.86	30.0	6.92	4.33
42	1.22	1.24	3.10	0.84	0.19	2.31	0.26	0.36	1.76	0.12	0	5.40	12.01	1.95	4.27	33.8	7.94	4.86
43	1.30	1.35	3.48	0.96	0.22	2.81	0.30	0.41	1.92	0.14	0	6.11	13.38	2.20	4.72	38.0	9.08	5.44
44	1.39	1.46	3.89	1.09	0.26	3.42	0.35	0.46	2.10	0.16	0	6.91	14.80	2.48	5.20	42.6	10.34	6.07
45	1.48	1.57	4.33	1.24	0.29	4.16	0.41	0.53	2.29	0.18	0	7.80	16.26	2.78	5.71	47.6	11.75	6.76
46	1.58	1.69	4.80	1.42	0.34	5.04	0.47	0.60	2.49	0.21	0	8.80	17.75	3.13	6.26	53.0	13.31	7.51
47	1.70	1.82	5.30	1.61	0.39	6.10	0.54	0.68	2.71	0.23	0	9.91	19.27	3.51	6.84	58.9	15.03	8.31
48	1.82	1.94	5.84	1.83	0.45	7.36	0.62	0.77	2.95	0.25	0	11.13	20.81	3.93	7.46	65.3	16.93	9.19
49	1.95	2.07	6.41	2.07	0.51	8.86	0.70	0.86	3.21	0.28	0	12.49	22.35	4.39	8.11	72.3	19.02	10.14
50	2.10	2.20	7.01	2.35	0.58	10.64	0.80	0.97	3.49	0.30	0	13.98	23.90	4.89	8.80	79.9	21.32	11.17
51	2.26	2.34	7.65	2.66	0.67	12.72	0.91	1.09	3.78	0.33	0	15.62	25.45	5.45	9.53	88.2	23.85	12.28
52	2.44	2.48	8.32	3.01	0.76	15.15	1.03	1.22	4.10	0.36	0	17.41	27.00	6.06	10.29	97.2	26.62	13.49

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Table 11 continued

age	BFO	stomach	colon	liver	bladder	lungs	esophagus	oral cavity	brain	thyroid	skin	remainder	breast	ovaries	uterus	total solid	CHD	stroke
53	2.64	2.63	9.03	3.40	0.86	17.98	1.17	1.36	4.44	0.40	0	19.37	28.54	6.72	11.09	107.0	29.66	14.80
54	2.85	2.78	9.77	3.83	0.98	21.24	1.31	1.51	4.80	0.43	0	21.50	30.09	7.44	11.92	117.6	32.98	16.23
55	3.09	2.93	10.55	4.31	1.11	24.97	1.47	1.68	5.18	0.47	0	23.81	31.63	8.22	12.78	129.1	36.62	17.78
56	3.35	3.10	11.36	4.84	1.26	29.21	1.65	1.85	5.58	0.52	0	26.32	33.18	9.05	13.67	141.6	40.61	19.46
57	3.64	3.27	12.22	5.43	1.42	33.98	1.84	2.04	6.00	0.56	0	29.03	34.74	9.96	14.59	155.1	44.97	21.30
58	3.96	3.45	13.11	6.08	1.60	39.30	2.05	2.23	6.44	0.62	0	31.96	36.32	10.92	15.54	169.6	49.74	23.32
59	4.31	3.64	14.05	6.79	1.80	45.19	2.27	2.44	6.91	0.68	0	35.09	37.94	11.95	16.51	185.3	54.96	25.52
60	4.70	3.84	15.03	7.57	2.03	51.62	2.51	2.65	7.40	0.74	0	38.46	39.60	13.05	17.51	202.0	60.68	27.94
61	5.14	4.05	16.06	8.42	2.28	58.58	2.77	2.87	7.90	0.81	0	42.05	41.33	14.21	18.52	219.9	66.94	30.61
62	5.62	4.28	17.15	9.34	2.56	66.01	3.04	3.10	8.42	0.89	0	45.87	43.15	15.43	19.55	238.8	73.81	33.55
63	6.15	4.53	18.29	10.33	2.86	73.84	3.34	3.33	8.96	0.98	0	49.93	45.06	16.71	20.59	258.8	81.35	36.80
64	6.75	4.79	19.49	11.39	3.20	82.02	3.65	3.56	9.52	1.08	0	54.23	47.09	18.05	21.65	279.7	89.64	40.42
65	7.41	5.08	20.75	12.53	3.58	90.48	3.97	3.80	10.08	1.18	0	58.78	49.24	19.45	22.71	301.6	98.8	44.45
66	8.15	5.38	22.09	13.75	3.99	99.15	4.32	4.03	10.66	1.30	0	63.55	51.52	20.89	23.77	324.4	108.8	48.95
67	8.97	5.71	23.51	15.03	4.45	108.0	4.67	4.28	11.24	1.42	0	68.57	53.94	22.37	24.83	348.0	119.9	54.00
68	9.88	6.07	25.01	16.39	4.95	116.9	5.05	4.52	11.83	1.55	0	73.82	56.50	23.88	25.88	372.3	132.2	59.67
69	10.90	6.45	26.62	17.80	5.50	125.7	5.43	4.77	12.41	1.70	0	79.29	59.21	25.41	26.93	397.3	145.8	66.09
70	12.02	6.85	28.34	19.27	6.10	134.6	5.83	5.02	13.00	1.85	0	84.98	62.09	26.96	27.96	422.8	160.9	73.35
71	13.25	7.29	30.17	20.79	6.76	143.2	6.24	5.29	13.57	2.01	0	90.89	65.14	28.51	28.98	448.9	177.8	81.62
72	14.60	7.76	32.15	22.34	7.49	151.7	6.66	5.56	14.13	2.19	0	96.99	68.38	30.05	29.97	475.3	196.5	91.05
73	16.07	8.26	34.28	23.92	8.28	159.8	7.09	5.84	14.67	2.36	0	103.3	71.82	31.56	30.94	502.2	217.5	101.9
74	17.65	8.79	36.59	25.52	9.15	167.7	7.52	6.13	15.19	2.55	0	109.8	75.46	33.04	31.88	529.3	241.1	114.3
75	19.35	9.36	39.09	27.10	10.10	175.2	7.95	6.44	15.69	2.75	0	116.4	79.34	34.46	32.79	556.6	267.5	128.7
76	21.15	9.97	41.82	28.67	11.13	182.2	8.38	6.77	16.15	2.95	0	123.2	83.45	35.82	33.66	584.2	297.3	145.4
77	23.04	10.63	44.81	30.20	12.26	188.9	8.80	7.13	16.58	3.16	0	130.1	87.81	37.10	34.49	611.9	331.0	164.9
78	25.00	11.32	48.08	31.66	13.48	195.1	9.22	7.51	16.96	3.38	0	137.1	92.45	38.28	35.28	639.8	369.1	187.7
79	27.01	12.06	51.69	33.05	14.81	200.8	9.64	7.93	17.29	3.60	0	144.3	97.38	39.34	36.03	667.9	412.5	214.5
80	29.05	12.85	55.68	34.34	16.26	206.1	10.04	8.39	17.58	3.83	0	151.5	102.62	40.28	36.72	696.2	461.9	246.2
81	31.07	13.69	60.09	35.51	17.83	210.9	10.42	8.90	17.81	4.07	0	158.9	108.19	41.08	37.36	724.7	518.5	283.8
82	33.04	14.58	65.01	36.54	19.54	215.3	10.79	9.47	17.98	4.32	0	166.2	114.11	41.73	37.95	753.6	583.4	328.7
83	34.92	15.52	70.51	37.41	21.39	219.3	11.13	10.11	18.09	4.58	0	173.7	120.4	42.22	38.49	782.8	658.1	382.5
84	36.65	16.52	76.67	38.11	23.39	222.7	11.45	10.81	18.13	4.84	0	181.2	127.1	42.54	38.96	812.4	744.4	447.4
85	38.19	17.57	83.60	38.62	25.56	225.5	11.75	11.57	18.11	5.11	0	188.7	134.2	42.68	39.38	842.4	844.5	526.0
86	39.48	18.69	91.43	38.92	27.90	227.5	12.01	12.38	18.02	5.40	0	196.3	141.8	42.63	39.74	872.7	960.9	621.8
87	40.47	19.86	100.3	39.01	30.44	228.6	12.24	13.22	17.87	5.69	0	204.0	149.9	42.40	40.04	903.5	1096.8	739.2
88	41.12	21.09	110.4	38.88	33.18	228.6	12.44	14.09	17.64	5.99	0	211.7	158.5	41.99	40.28	934.7	1256.2	883.8
89	41.40	22.39	121.9	38.53	36.13	227.5	12.61	14.95	17.36	6.30	0	219.4	167.6	41.40	40.45	966.6	1443.6	1063.1
90	41.48	23.75	134.9	37.96	39.32	225.2	12.73	15.79	17.00	6.63	0	227.3	177.3	40.63	40.57	999.1	1662.0	1282.8
91	41.55	25.17	149.3	37.17	42.76	221.7	12.82	16.57	16.59	6.97	0	235.2	187.7	39.69	40.62	1032.2	1913.5	1547.8
92	41.63	26.66	165.2	36.18	46.47	216.8	12.87	17.25	16.12	7.32	0	243.2	198.7	38.58	40.62	1066.0	2203.0	1867.6
93	41.71	28.20	182.8	34.99	50.47	210.6	12.88	17.81	15.60	7.69	0	251.3	210.5	37.34	40.55	1100.8	2536.3	2253.5
94	41.79	29.83	202.3	33.74	54.79	203.9	12.87	18.30	15.06	8.08	0	259.7	223.0	36.04	40.46	1138.1	2920.1	2719.0
95	41.86	31.54	223.9	32.54	59.48	197.4	12.86	18.81	14.54	8.49	0	268.5	236.3	34.79	40.37	1179.4	3361.9	3280.8
96	41.86	33.35	223.9	31.37	64.58	191.1	12.85	19.32	14.03	8.92	0	271.0	250.3	33.59	40.28	1194.5	3361.9	3280.8
97	41.86	35.27	223.9	30.25	70.11	184.9	12.84	19.86	13.55	9.37	0	273.5	265.1	32.42	40.18	1211.3	3361.9	3280.8
98	41.86	37.30	223.9	29.17	76.11	179.0	12.83	20.40	13.08	9.84	0	276.0	280.9	31.30	40.09	1230.0	3361.9	3280.8
99	41.86	39.45	223.9	28.12	82.63	173.3	12.82	20.96	12.63	10.34	0	278.7	297.6	30.21	40.00	1250.6	3361.9	3280.8
100	41.86	41.71	223.9	27.12	89.70	167.8	12.81	21.54	12.19	10.86	0	281.4	315.2	29.16	39.91	1273.3	3361.9	3280.8
101	41.86	44.11	223.9	26.15	97.4	162.4	12.80	22.14	11.77	11.41	0	284.2	334.0	28.15	39.82	1298.2	3361.9	3280.8

Table 12. NS male cancer incidence rates per 100,000 for 2018, 2019, 2021.

age	BFO	stomach	colon	liver	bladder	lungs	esophagus	oral cavity	brain	thyroid	skin	remainder	prostate	total solid
0	3.64	0.04	0.00	2.29	0.03	0.53	0.00	0.26	3.51	0.03	0	18.16	0.30	25.2
1	3.89	0.03	0.00	1.36	0.05	0.20	0.00	0.12	3.59	0.03	0	10.76	0.07	16.2
2	4.09	0.02	0.01	0.86	0.07	0.10	0.00	0.08	3.63	0.04	0	7.12	0.03	11.9
3	4.23	0.02	0.02	0.57	0.07	0.06	0.00	0.06	3.61	0.04	0	5.13	0.02	9.6
4	4.32	0.01	0.03	0.40	0.05	0.04	0.00	0.06	3.57	0.05	0	3.95	0.01	8.2
5	4.36	0.01	0.05	0.29	0.03	0.03	0.00	0.07	3.49	0.06	0	3.23	0.02	7.3
6	4.35	0.01	0.08	0.22	0.02	0.03	0.00	0.09	3.39	0.08	0	2.80	0.02	6.8
7	4.31	0.01	0.13	0.18	0.01	0.03	0.00	0.11	3.28	0.10	0	2.59	0.02	6.5
8	4.24	0.01	0.18	0.15	0.01	0.03	0.00	0.13	3.16	0.13	0	2.53	0.03	6.4
9	4.14	0.01	0.25	0.13	0.01	0.04	0.00	0.15	3.05	0.18	0	2.61	0.03	6.5
10	4.04	0.02	0.33	0.12	0.01	0.05	0.00	0.17	2.93	0.23	0	2.82	0.03	6.7
11	3.92	0.02	0.43	0.11	0.01	0.06	0.00	0.19	2.83	0.30	0	3.14	0.03	7.1
12	3.82	0.02	0.53	0.10	0.01	0.07	0.01	0.21	2.75	0.39	0	3.58	0.03	7.7
13	3.71	0.03	0.63	0.10	0.02	0.08	0.01	0.24	2.68	0.49	0	4.13	0.03	8.4
14	3.62	0.03	0.74	0.10	0.03	0.10	0.01	0.28	2.62	0.62	0	4.79	0.03	9.3
15	3.54	0.04	0.85	0.10	0.04	0.11	0.01	0.32	2.58	0.76	0	5.57	0.03	10.4
16	3.47	0.05	0.95	0.11	0.06	0.12	0.01	0.36	2.56	0.93	0	6.48	0.03	11.7
17	3.41	0.07	1.06	0.12	0.09	0.13	0.01	0.39	2.54	1.12	0	7.54	0.03	13.1
18	3.37	0.09	1.17	0.13	0.13	0.14	0.02	0.41	2.54	1.33	0	8.74	0.03	14.7
19	3.33	0.11	1.27	0.14	0.15	0.14	0.02	0.41	2.54	1.56	0	10.09	0.03	16.4
20	3.31	0.14	1.38	0.15	0.18	0.14	0.02	0.40	2.56	1.81	0	11.59	0.03	18.4
21	3.30	0.17	1.49	0.17	0.20	0.14	0.02	0.39	2.58	2.08	0	13.20	0.03	20.4
22	3.29	0.21	1.61	0.19	0.21	0.14	0.03	0.38	2.61	2.38	0	14.91	0.04	22.6
23	3.29	0.26	1.73	0.21	0.23	0.14	0.03	0.37	2.65	2.69	0	16.67	0.04	24.9
24	3.30	0.31	1.86	0.24	0.25	0.14	0.04	0.36	2.69	3.01	0	18.46	0.04	27.2
25	3.32	0.36	2.00	0.27	0.28	0.15	0.04	0.37	2.75	3.35	0	20.26	0.04	29.6
26	3.35	0.42	2.17	0.31	0.30	0.16	0.05	0.37	2.81	3.70	0	22.07	0.04	32.1
27	3.38	0.49	2.35	0.35	0.34	0.17	0.05	0.39	2.87	4.06	0	23.88	0.04	34.6
28	3.42	0.55	2.57	0.39	0.37	0.18	0.06	0.41	2.95	4.43	0	25.70	0.05	37.1
29	3.46	0.63	2.83	0.44	0.41	0.19	0.07	0.44	3.03	4.79	0	27.51	0.06	39.7
30	3.52	0.71	3.13	0.51	0.46	0.21	0.08	0.47	3.12	5.16	0	29.35	0.07	42.4
31	3.58	0.80	3.47	0.58	0.52	0.23	0.10	0.51	3.23	5.52	0	31.21	0.08	45.2
32	3.65	0.89	3.88	0.66	0.58	0.25	0.11	0.55	3.34	5.88	0	33.13	0.10	48.1
33	3.72	0.99	4.34	0.75	0.65	0.28	0.13	0.60	3.46	6.23	0	35.13	0.14	51.2
34	3.80	1.11	4.88	0.86	0.73	0.31	0.14	0.65	3.59	6.57	0	37.24	0.19	54.4
35	3.89	1.23	5.50	0.99	0.81	0.34	0.16	0.72	3.73	6.90	0	39.48	0.27	57.9
36	4.00	1.38	6.21	1.13	0.93	0.41	0.19	0.83	3.89	7.22	0	41.90	0.39	61.9
37	4.13	1.54	7.02	1.30	1.07	0.48	0.23	0.96	4.05	7.53	0	44.53	0.58	66.3
38	4.26	1.72	7.95	1.50	1.23	0.58	0.27	1.12	4.23	7.83	0	47.40	0.89	71.2
39	4.41	1.92	9.00	1.73	1.42	0.69	0.32	1.31	4.43	8.12	0	50.56	1.39	76.9
40	4.58	2.14	10.19	2.00	1.64	0.84	0.38	1.54	4.63	8.40	0	54.04	2.19	83.5
41	4.77	2.39	11.53	2.31	1.90	1.01	0.45	1.82	4.86	8.68	0	57.89	3.44	91.2
42	4.97	2.67	13.03	2.68	2.21	1.23	0.54	2.14	5.10	8.95	0	62.14	5.29	100.3
43	5.20	2.97	14.69	3.10	2.57	1.50	0.64	2.52	5.36	9.22	0	66.84	7.94	111.0
44	5.45	3.31	16.53	3.60	2.99	1.83	0.76	2.96	5.63	9.48	0	72.00	11.60	123.6
45	5.72	3.68	18.54	4.18	3.48	2.20	0.89	3.46	5.93	9.76	0	77.64	16.53	138.5
46	6.02	4.08	20.73	4.86	4.05	2.64	1.05	4.02	6.24	10.03	0	83.76	23.01	155.9
47	6.36	4.52	23.07	5.66	4.71	3.16	1.23	4.63	6.58	10.32	0	90.39	31.31	176.2
48	6.73	4.99	25.57	6.59	5.45	3.75	1.44	5.29	6.94	10.62	0	97.54	41.71	199.6
49	7.14	5.50	28.20	7.68	6.30	4.42	1.66	5.99	7.33	10.94	0	105.22	54.48	226.4
50	7.58	6.05	30.98	8.95	7.27	5.19	1.91	6.71	7.74	11.27	0	113.45	69.86	256.9
51	8.07	6.63	33.88	10.42	8.36	6.05	2.19	7.46	8.17	11.62	0	122.23	88.06	291.4
52	8.61	7.26	36.91	12.12	9.57	7.00	2.48	8.21	8.63	11.97	0	131.59	109.28	330.0

Table 12 continued

age	BFO	stomach	colon	liver	bladder	lungs	esophagus	oral cavity	brain	thyroid	skin	remainder	prostate	total solid
53	9.20	7.92	40.06	14.06	10.93	8.05	2.80	8.96	9.12	12.34	0	141.53	133.65	373.0
54	9.83	8.63	43.31	16.29	12.45	9.21	3.13	9.70	9.63	12.71	0	152.08	161.19	420.3
55	10.53	9.38	46.66	18.80	14.15	10.49	3.49	10.45	10.18	13.09	0	163.23	191.79	471.9
56	11.29	10.18	50.09	21.64	16.04	11.92	3.87	11.19	10.74	13.48	0	175.01	225.20	527.7
57	12.11	11.04	53.61	24.80	18.15	13.50	4.27	11.95	11.34	13.87	0	187.43	261.10	587.5
58	13.01	11.95	57.20	28.30	20.52	15.29	4.70	12.72	11.96	14.25	0	200.48	298.99	650.9
59	13.99	12.92	60.85	32.12	23.18	17.28	5.16	13.50	12.61	14.64	0	214.19	338.33	717.4
60	15.05	13.95	64.56	36.26	26.13	19.19	5.64	14.30	13.28	15.02	0	228.54	378.46	786.0
61	16.19	15.04	68.31	40.68	29.42	21.01	6.16	15.10	13.98	15.40	0	243.54	418.67	856.0
62	17.43	16.20	72.11	45.33	33.06	22.92	6.69	15.90	14.69	15.76	0	259.17	458.22	926.8
63	18.77	17.42	75.94	50.15	37.09	24.90	7.26	16.70	15.43	16.11	0	275.43	496.36	997.6
64	20.21	18.70	79.81	55.05	41.53	26.96	7.84	17.49	16.18	16.43	0	292.28	532.39	1067.7
65	21.76	20.04	83.71	59.93	46.40	29.08	8.45	18.28	16.94	16.74	0	309.70	565.65	1136.2
66	23.42	21.44	87.64	64.66	51.73	31.24	9.07	19.07	17.71	17.02	0	327.65	595.55	1202.5
67	25.19	22.89	91.61	69.11	57.51	33.42	9.70	19.86	18.49	17.27	0	346.07	621.63	1265.8
68	27.07	24.38	95.61	73.14	63.74	35.58	10.33	20.63	19.27	17.48	0	364.89	643.51	1325.5
69	29.06	25.91	99.66	76.58	70.39	37.64	10.95	21.36	20.04	17.66	0	384.03	660.95	1380.9
70	31.16	27.46	103.76	79.31	77.42	41.13	11.54	22.04	20.80	17.80	0	403.38	673.83	1433.1
71	33.36	29.02	107.92	81.18	84.78	45.44	12.10	22.65	21.55	17.89	0	422.83	682.15	1481.1
72	35.65	30.57	112.14	82.09	92.43	49.77	12.63	23.16	22.27	17.93	0	442.25	686.02	1524.0
73	38.02	32.12	116.46	82.00	100.33	54.02	13.10	23.57	22.96	17.92	0	461.48	685.63	1561.5
74	40.48	33.64	120.87	81.01	108.43	58.15	13.54	23.90	23.61	17.86	0	480.38	681.28	1593.9
75	42.99	35.14	125.41	79.31	116.69	62.13	13.93	24.16	24.22	17.74	0	498.75	673.30	1621.4
76	45.56	36.61	130.09	77.07	125.06	65.93	14.27	24.35	24.78	17.57	0	516.41	662.11	1644.4
77	48.17	38.03	134.94	74.49	133.47	69.55	14.56	24.49	25.27	17.34	0	533.16	648.13	1663.4
78	50.81	39.40	139.98	71.71	141.87	72.96	14.81	24.58	25.70	17.05	0	548.78	631.80	1678.6
79	53.44	40.71	145.25	68.90	150.18	76.15	15.00	24.64	26.06	16.70	0	563.05	613.57	1690.4
80	56.04	41.95	150.78	66.19	158.31	79.13	15.15	24.68	26.33	16.30	0	575.76	593.87	1699.0
81	58.60	43.10	156.61	63.69	166.17	81.88	15.24	24.70	26.52	15.84	0	586.69	573.10	1704.8
82	61.08	44.16	162.79	61.49	173.66	84.41	15.29	24.70	26.62	15.33	0	595.63	551.66	1708.0
83	63.45	45.12	169.36	59.67	180.70	85.69	15.29	24.70	26.63	14.78	0	602.40	529.89	1707.6
84	65.68	45.96	176.39	58.30	187.16	86.54	15.23	24.71	26.53	14.19	0	606.83	508.10	1704.7
85	67.72	46.67	183.93	57.47	192.95	87.18	15.13	24.71	26.34	13.55	0	608.78	486.57	1699.6
86	69.55	47.25	192.06	57.25	197.95	87.60	14.97	24.73	26.04	12.89	0	608.15	465.53	1692.5
87	70.96	47.41	200.86	57.74	200.03	85.58	14.54	24.25	25.64	12.20	0	604.77	445.18	1677.1
88	72.08	47.39	210.41	58.90	200.90	83.26	14.04	23.75	25.14	11.48	0	598.73	425.67	1659.6
89	72.87	47.19	220.83	60.08	200.52	80.71	13.50	23.25	24.55	10.76	0	590.08	407.16	1639.7
90	73.48	46.81	231.99	60.42	198.86	77.94	12.90	22.74	23.86	10.03	0	579.89	389.73	1617.5
91	74.10	46.24	243.72	59.08	195.93	75.02	12.27	22.24	23.09	9.29	0	569.26	373.46	1593.2
92	74.71	45.49	256.04	55.37	191.76	71.97	11.60	21.74	22.24	8.57	0	558.22	358.43	1566.4
93	75.33	44.65	268.98	50.56	187.04	68.95	10.94	21.25	21.36	7.88	0	547.20	344.32	1539.5
94	75.94	43.84	282.57	46.18	182.44	66.04	10.32	20.77	20.53	7.24	0	536.53	330.77	1515.0
95	76.56	43.04	296.85	42.17	177.96	63.27	9.73	20.30	19.72	6.66	0	526.23	317.74	1492.7
96	76.56	42.25	296.85	38.51	173.58	60.60	9.18	19.84	18.95	6.12	0	520.68	305.23	1462.1
97	76.56	41.48	296.85	35.17	169.32	58.05	8.66	19.39	18.21	5.63	0	515.34	293.21	1432.8
98	76.56	40.72	296.85	32.12	165.15	55.61	8.17	18.96	17.49	5.17	0	510.21	281.67	1404.7
99	76.56	39.98	296.85	29.33	161.09	53.27	7.70	18.53	16.81	4.75	0	505.26	270.58	1377.8
100	76.56	39.25	296.85	26.79	157.13	51.03	7.27	18.11	16.15	4.37	0	500.50	259.93	1352.1
101	76.56	38.53	296.85	24.46	153.27	48.88	6.85	17.70	15.51	4.02	0	495.92	249.69	1327.4

Table 13. NS male cancer mortality rates per 100,000 for 2018, 2019, 2021.

age	BFO	stomach	colon	liver	bladder	lungs	esophagus	oral cavity	brain	thyroid	skin	remainder	prostate	total solid	CHD	stroke
0	0.55	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.40	0.00	0	0.75	0.00	1.3	0.00	5.14
1	0.56	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.44	0.00	0	0.67	0.00	1.2	0.00	1.42
2	0.57	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.48	0.00	0	0.62	0.00	1.2	0.00	0.56
3	0.57	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.54	0.00	0	0.57	0.00	1.2	0.00	0.31
4	0.58	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.60	0.00	0	0.54	0.00	1.2	0.00	0.21
5	0.59	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.66	0.00	0	0.52	0.00	1.3	0.00	0.18
6	0.60	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.71	0.00	0	0.51	0.00	1.3	0.01	0.17
7	0.61	0.01	0.00	0.07	0.00	0.00	0.00	0.00	0.75	0.00	0	0.51	0.00	1.4	0.01	0.17
8	0.62	0.01	0.00	0.07	0.00	0.00	0.00	0.01	0.76	0.00	0	0.52	0.00	1.4	0.01	0.18
9	0.63	0.01	0.01	0.07	0.00	0.00	0.00	0.01	0.76	0.00	0	0.54	0.00	1.4	0.01	0.19
10	0.64	0.01	0.01	0.07	0.00	0.01	0.00	0.01	0.74	0.00	0	0.57	0.00	1.4	0.02	0.20
11	0.65	0.01	0.01	0.06	0.00	0.01	0.00	0.01	0.71	0.00	0	0.62	0.00	1.4	0.03	0.22
12	0.66	0.01	0.01	0.06	0.00	0.01	0.01	0.01	0.68	0.00	0	0.68	0.00	1.5	0.03	0.24
13	0.68	0.02	0.02	0.06	0.00	0.01	0.01	0.01	0.66	0.00	0	0.75	0.00	1.5	0.04	0.25
14	0.69	0.02	0.02	0.07	0.00	0.01	0.01	0.01	0.64	0.00	0	0.85	0.00	1.6	0.06	0.27
15	0.70	0.02	0.03	0.07	0.00	0.01	0.01	0.02	0.63	0.00	0	0.96	0.00	1.8	0.08	0.29
16	0.72	0.03	0.03	0.07	0.00	0.02	0.01	0.02	0.63	0.00	0	1.08	0.00	1.9	0.10	0.32
17	0.73	0.03	0.04	0.07	0.00	0.02	0.01	0.02	0.63	0.00	0	1.19	0.00	2.0	0.13	0.34
18	0.74	0.04	0.05	0.08	0.00	0.02	0.02	0.02	0.63	0.00	0	1.29	0.00	2.2	0.17	0.36
19	0.75	0.05	0.07	0.08	0.00	0.02	0.02	0.02	0.64	0.01	0	1.37	0.00	2.3	0.22	0.39
20	0.77	0.05	0.08	0.09	0.00	0.03	0.02	0.03	0.65	0.01	0	1.43	0.00	2.4	0.28	0.42
21	0.78	0.06	0.10	0.09	0.00	0.03	0.02	0.03	0.66	0.01	0	1.48	0.00	2.5	0.35	0.45
22	0.79	0.07	0.13	0.10	0.00	0.03	0.03	0.03	0.68	0.01	0	1.53	0.00	2.6	0.44	0.48
23	0.80	0.09	0.16	0.11	0.00	0.04	0.03	0.03	0.70	0.01	0	1.58	0.00	2.7	0.54	0.52
24	0.81	0.10	0.20	0.12	0.01	0.04	0.03	0.03	0.73	0.01	0	1.63	0.00	2.9	0.66	0.56
25	0.83	0.12	0.24	0.14	0.01	0.04	0.04	0.04	0.77	0.01	0	1.70	0.00	3.1	0.80	0.61
26	0.84	0.14	0.30	0.15	0.01	0.05	0.04	0.04	0.80	0.01	0	1.77	0.00	3.3	0.97	0.67
27	0.86	0.16	0.36	0.17	0.01	0.05	0.05	0.04	0.85	0.02	0	1.86	0.00	3.5	1.17	0.74
28	0.87	0.18	0.43	0.19	0.01	0.06	0.05	0.05	0.90	0.02	0	1.98	0.00	3.8	1.41	0.82
29	0.89	0.21	0.52	0.22	0.01	0.07	0.06	0.05	0.96	0.02	0	2.11	0.00	4.2	1.69	0.91
30	0.91	0.24	0.62	0.25	0.02	0.08	0.07	0.06	1.02	0.02	0	2.27	0.00	4.6	2.01	1.02
31	0.92	0.28	0.74	0.28	0.02	0.09	0.08	0.06	1.09	0.03	0	2.46	0.01	5.0	2.39	1.14
32	0.94	0.32	0.87	0.33	0.02	0.10	0.09	0.07	1.17	0.03	0	2.69	0.01	5.6	2.81	1.28
33	0.96	0.36	1.03	0.38	0.03	0.11	0.10	0.08	1.26	0.04	0	2.95	0.01	6.2	3.29	1.43
34	0.99	0.41	1.20	0.43	0.03	0.13	0.11	0.09	1.37	0.04	0	3.25	0.01	6.9	3.83	1.60
35	1.01	0.46	1.40	0.50	0.04	0.15	0.13	0.09	1.48	0.05	0	3.61	0.02	7.7	4.43	1.79
36	1.04	0.52	1.63	0.59	0.05	0.18	0.15	0.11	1.60	0.06	0	4.01	0.02	8.6	5.21	2.03
37	1.08	0.59	1.88	0.68	0.06	0.21	0.17	0.12	1.74	0.06	0	4.48	0.03	9.7	6.10	2.31
38	1.12	0.67	2.17	0.80	0.07	0.26	0.20	0.14	1.90	0.07	0	5.02	0.05	10.9	7.14	2.63
39	1.16	0.76	2.49	0.93	0.09	0.32	0.24	0.17	2.07	0.08	0	5.63	0.06	12.3	8.33	3.00
40	1.21	0.85	2.85	1.09	0.11	0.39	0.28	0.20	2.25	0.09	0	6.32	0.09	14.0	9.70	3.42
41	1.27	0.96	3.24	1.28	0.13	0.47	0.33	0.23	2.46	0.11	0	7.11	0.12	15.8	11.26	3.89
42	1.33	1.08	3.68	1.51	0.16	0.58	0.39	0.27	2.68	0.12	0	7.99	0.17	17.8	13.04	4.42
43	1.40	1.21	4.16	1.77	0.20	0.72	0.46	0.31	2.93	0.14	0	8.99	0.23	20.2	15.07	5.01
44	1.49	1.35	4.68	2.07	0.24	0.88	0.54	0.37	3.20	0.16	0	10.11	0.32	22.9	17.34	5.66
45	1.58	1.51	5.26	2.43	0.29	1.07	0.64	0.43	3.49	0.18	0	11.36	0.43	25.9	20.02	6.38
46	1.69	1.67	5.88	2.85	0.36	1.30	0.75	0.50	3.81	0.20	0	12.77	0.58	29.3	23.11	7.16
47	1.81	1.86	6.56	3.34	0.43	1.57	0.87	0.58	4.15	0.22	0	14.33	0.76	33.1	26.53	8.00
48	1.95	2.05	7.30	3.91	0.51	1.88	1.01	0.66	4.52	0.25	0	16.06	1.00	37.3	30.30	8.92
49	2.11	2.26	8.09	4.56	0.61	2.23	1.17	0.76	4.92	0.28	0	17.99	1.30	42.0	34.43	9.89
50	2.29	2.48	8.95	5.32	0.72	2.64	1.34	0.86	5.34	0.31	0	20.12	1.67	47.3	38.92	11.01
51	2.50	2.71	9.86	6.18	0.85	3.11	1.53	0.98	5.79	0.35	0	22.47	2.14	53.2	43.79	12.22
52	2.73	2.96	10.85	7.17	1.00	3.63	1.73	1.10	6.27	0.39	0	25.06	2.70	59.6	49.05	13.53

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Table 13 continued.

age	BFO	stomach	colon	liver	bladder	lungs	esophagus	oral cavity	brain	thyroid	skin	remainder	prostate	total solid	CHD	stroke
53	2.99	3.22	11.90	8.28	1.17	4.21	1.95	1.23	6.78	0.43	0	27.90	3.39	66.7	54.72	14.95
54	3.29	3.49	13.02	9.54	1.36	4.86	2.18	1.36	7.32	0.48	0	31.00	4.21	74.6	60.82	16.48
55	3.62	3.77	14.21	10.95	1.58	5.58	2.43	1.51	7.90	0.53	0	34.39	5.19	83.2	67.4	18.15
56	4.00	4.07	15.48	12.51	1.83	6.40	2.70	1.67	8.50	0.59	0	38.08	6.36	92.7	74.6	19.97
57	4.43	4.38	16.82	14.23	2.11	7.32	2.99	1.83	9.14	0.65	0	42.08	7.72	103.1	82.5	21.98
58	4.91	4.72	18.25	16.11	2.42	8.36	3.30	2.02	9.80	0.71	0	46.40	9.32	114.4	91.1	24.19
59	5.46	5.07	19.75	18.16	2.78	9.53	3.64	2.21	10.50	0.78	0	51.06	11.17	126.9	100.6	26.65
60	6.08	5.44	21.35	20.36	3.19	10.68	4.00	2.42	11.23	0.86	0	56.06	13.29	140.3	110.5	29.35
61	6.78	5.84	23.03	22.73	3.66	11.80	4.39	2.65	11.98	0.94	0	61.40	15.72	154.7	120.8	32.34
62	7.57	6.25	24.80	25.24	4.18	12.99	4.80	2.88	12.77	1.03	0	67.09	18.48	170.2	132.0	35.63
63	8.46	6.69	26.67	27.90	4.78	14.25	5.25	3.13	13.57	1.12	0	73.13	21.61	186.8	144.1	39.26
64	9.46	7.16	28.63	30.69	5.45	15.57	5.72	3.39	14.40	1.22	0	79.51	25.13	204.7	157.3	43.27
65	10.58	7.65	30.71	33.59	6.21	17.0	6.22	3.67	15.25	1.33	0	86.22	29.06	223.7	171.7	47.72
66	11.84	8.17	32.89	36.59	7.06	18.4	6.75	3.95	16.12	1.44	0	93.24	33.46	244.0	187.4	52.66
67	13.23	8.72	35.19	39.66	8.02	19.9	7.30	4.26	16.99	1.56	0	100.5	38.34	265.6	204.4	58.15
68	14.79	9.30	37.61	42.78	9.09	21.5	7.87	4.57	17.88	1.69	0	108.1	43.74	288.3	223.0	64.26
69	16.51	9.90	40.16	45.92	10.29	23.0	8.44	4.90	18.77	1.83	0	115.9	49.71	312.2	243.1	71.04
70	18.40	10.53	42.85	49.05	11.61	25.5	9.02	5.23	19.66	1.97	0	124.0	56.28	338.2	267.1	79.03
71	20.48	11.19	45.69	52.13	13.08	28.6	9.59	5.55	20.54	2.12	0	132.2	63.50	365.9	294.5	88.2
72	22.74	11.88	48.69	55.12	14.70	31.9	10.15	5.88	21.41	2.28	0	140.7	71.42	395.0	324.5	98.5
73	25.19	12.60	51.85	58.00	16.49	35.3	10.70	6.19	22.26	2.45	0	149.3	80.09	425.3	357.4	110.1
74	27.84	13.35	55.21	60.73	18.46	38.8	11.23	6.50	23.08	2.62	0	158.1	89.59	456.9	393.8	123.2
75	30.69	14.14	58.76	63.27	20.64	42.4	11.75	6.81	23.88	2.81	0	167.1	99.98	489.9	434.0	138.1
76	33.72	14.97	62.53	65.58	23.06	46.1	12.25	7.12	24.64	3.00	0	176.2	111.3	524.3	478.6	155.1
77	36.93	15.85	66.53	67.64	25.72	49.9	12.73	7.42	25.35	3.20	0	185.5	123.8	560.3	528.4	174.5
78	40.31	16.78	70.79	69.41	28.68	53.6	13.19	7.73	26.02	3.41	0	195.0	137.4	597.9	584.2	196.8
79	43.84	17.77	75.33	70.87	31.96	57.5	13.62	8.05	26.63	3.62	0	204.6	152.4	637.4	646.7	222.6
80	47.49	18.82	80.19	71.99	35.60	61.3	14.04	8.38	27.17	3.85	0	214.4	168.8	679.0	717.0	252.4
81	51.21	19.93	85.38	72.76	39.64	65.1	14.42	8.72	27.65	4.08	0	224.4	186.9	722.9	796.4	287.1
82	54.98	21.13	90.95	73.16	44.13	68.9	14.77	9.08	28.05	4.32	0	234.6	206.9	769.4	886.3	327.6
83	58.74	22.40	96.93	73.19	49.14	71.8	15.09	9.47	28.38	4.57	0	245.1	229.0	818.0	979.7	373.2
84	62.43	23.77	103.4	72.85	54.71	74.4	15.37	9.88	28.62	4.83	0	255.9	253.5	869.8	1083.9	426.2
85	65.98	25.24	110.3	72.13	60.9	76.8	15.62	10.32	28.77	5.09	0	267.2	280.7	925.6	1202.4	488.8
86	69.33	26.82	117.8	71.06	67.8	79.1	15.83	10.79	28.84	5.36	0	278.9	311.2	985.8	1337.6	562.9
87	72.24	28.36	126.0	69.64	74.8	79.0	15.74	11.07	28.81	5.64	0	291.1	345.3	1047.0	1484.8	649.3
88	74.79	30.00	134.8	67.89	82.4	78.5	15.58	11.36	28.69	5.92	0	304.1	383.7	1113.7	1652.8	752.4
89	76.90	31.74	144.5	65.85	90.7	77.7	15.34	11.67	28.47	6.21	0	318.0	427.1	1187.0	1845.0	875.7
90	78.79	33.60	154.9	63.54	99.8	76.4	15.04	11.99	28.16	6.51	0	332.7	476.4	1268.0	2062.7	1021.7
91	80.71	35.59	166.1	60.98	109.8	74.7	14.67	12.34	27.76	6.81	0	348.1	532.4	1357.4	2306.1	1191.9
92	82.68	37.72	178.0	58.23	120.7	72.6	14.25	12.70	27.27	7.11	0	364.3	596.6	1457.0	2578.2	1390.5
93	84.68	39.99	190.9	55.45	132.6	70.5	13.80	13.09	26.75	7.43	0	381.6	669.4	1568.0	2882.4	1622.2
94	86.71	42.39	204.6	52.81	145.8	68.4	13.36	13.49	26.23	7.76	0	400.0	751.1	1691.7	3222.4	1892.5
95	88.79	44.94	219.4	50.29	160.2	66.3	12.94	13.90	25.72	8.10	0	419.9	842.8	1829.3	3602.6	2207.9
96	88.79	47.64	219.4	47.89	176.0	64.3	12.53	14.32	25.23	8.46	0	423.1	945.7	1948.5	3602.6	2207.9
97	88.79	50.50	219.4	45.61	193.4	62.4	12.14	14.76	24.74	8.83	0	426.4	1061.1	2082.3	3602.6	2207.9
98	88.79	53.54	219.4	43.43	212.6	60.5	11.75	15.21	24.26	9.23	0	429.9	1190.6	2232.4	3602.6	2207.9
99	88.79	56.76	219.4	41.36	233.6	58.7	11.38	15.67	23.79	9.63	0	433.4	1335.9	2400.6	3602.6	2207.9
100	88.79	60.17	219.4	39.39	256.7	57.0	11.02	16.15	23.34	10.06	0	437.1	1499.0	2589.2	3602.6	2207.9
101	88.79	63.78	219.4	37.51	282.1	55.3	10.68	16.64	22.89	10.51	0	440.9	1681.9	2800.5	3602.6	2207.9

Table 14. NS female cancer incidence rates per 100,000 for 2018, 2019, 2021.

Age	BFO	Stomach	Colon	Liver	Bladder	Lungs	Esophagus	Oral cavity	Brain	Thyroid	Skin	Remainder	Breast	Ovaries	Uterus	Total solid
0	4.08	0.05	0.00	1.65	0.18	0.36	0.00	0.03	3.38	0.03	0	15.80	0.04	0.19	0.04	21.8
1	4.08	0.03	0.01	1.04	0.10	0.16	0.00	0.04	3.50	0.04	0	9.75	0.04	0.15	0.03	14.9
2	4.05	0.02	0.01	0.69	0.06	0.08	0.00	0.05	3.56	0.04	0	6.86	0.03	0.14	0.02	11.6
3	3.98	0.02	0.02	0.48	0.04	0.05	0.00	0.05	3.57	0.05	0	5.25	0.02	0.13	0.02	9.7
4	3.89	0.01	0.04	0.35	0.03	0.03	0.00	0.07	3.53	0.07	0	4.22	0.02	0.14	0.02	8.5
5	3.79	0.01	0.06	0.27	0.03	0.03	0.00	0.08	3.45	0.10	0	3.51	0.01	0.17	0.02	7.7
6	3.66	0.01	0.09	0.21	0.02	0.02	0.00	0.09	3.34	0.14	0	3.02	0.01	0.20	0.02	7.2
7	3.53	0.01	0.14	0.18	0.02	0.02	0.00	0.11	3.21	0.21	0	2.72	0.01	0.25	0.02	6.9
8	3.40	0.01	0.21	0.15	0.02	0.02	0.00	0.13	3.06	0.31	0	2.56	0.01	0.31	0.02	6.8
9	3.26	0.01	0.29	0.13	0.02	0.03	0.00	0.16	2.91	0.46	0	2.53	0.00	0.39	0.02	7.0
10	3.13	0.02	0.39	0.12	0.02	0.03	0.00	0.18	2.76	0.68	0	2.58	0.00	0.49	0.02	7.3
11	3.00	0.02	0.50	0.12	0.02	0.04	0.00	0.21	2.62	0.98	0	2.71	0.01	0.61	0.03	7.9
12	2.88	0.02	0.63	0.11	0.03	0.06	0.00	0.24	2.49	1.39	0	2.87	0.01	0.74	0.03	8.6
13	2.78	0.03	0.76	0.11	0.03	0.07	0.00	0.28	2.37	1.91	0	3.05	0.01	0.88	0.04	9.5
14	2.68	0.04	0.91	0.11	0.04	0.09	0.00	0.31	2.27	2.54	0	3.25	0.02	1.02	0.04	10.6
15	2.60	0.05	1.06	0.11	0.04	0.10	0.00	0.34	2.18	3.30	0	3.48	0.05	1.15	0.05	11.9
16	2.53	0.06	1.21	0.12	0.05	0.12	0.01	0.37	2.10	4.18	0	3.76	0.09	1.27	0.07	13.4
17	2.48	0.08	1.36	0.12	0.06	0.13	0.01	0.41	2.04	5.18	0	4.12	0.19	1.38	0.09	15.2
18	2.45	0.10	1.51	0.13	0.07	0.15	0.01	0.43	1.99	6.29	0	4.58	0.34	1.48	0.14	17.2
19	2.43	0.13	1.65	0.14	0.08	0.16	0.01	0.46	1.95	7.49	0	5.16	0.58	1.58	0.23	19.6
20	2.43	0.16	1.79	0.15	0.10	0.17	0.01	0.48	1.93	8.78	0	5.85	0.92	1.67	0.39	22.4
21	2.43	0.20	1.93	0.17	0.11	0.18	0.01	0.51	1.92	10.14	0	6.67	1.38	1.76	0.66	25.6
22	2.45	0.24	2.07	0.18	0.12	0.19	0.01	0.53	1.93	11.57	0	7.60	2.02	1.85	1.07	29.3
23	2.48	0.28	2.21	0.20	0.14	0.20	0.01	0.55	1.95	13.06	0	8.62	2.87	1.96	1.62	33.6
24	2.51	0.33	2.36	0.22	0.15	0.21	0.02	0.58	1.99	14.60	0	9.73	4.03	2.08	2.31	38.5
25	2.56	0.39	2.52	0.24	0.17	0.23	0.02	0.61	2.04	16.18	0	10.94	5.54	2.21	3.13	44.1
26	2.61	0.45	2.70	0.27	0.19	0.24	0.02	0.64	2.10	17.76	0	12.25	7.49	2.36	4.07	50.4
27	2.67	0.51	2.90	0.29	0.21	0.27	0.02	0.68	2.18	19.33	0	13.66	9.95	2.53	5.14	57.5
28	2.73	0.59	3.13	0.33	0.23	0.29	0.03	0.72	2.26	20.87	0	15.18	12.98	2.71	6.38	65.5
29	2.80	0.68	3.40	0.36	0.26	0.32	0.03	0.76	2.35	22.35	0	16.83	16.67	2.91	7.81	74.5
30	2.87	0.78	3.71	0.40	0.28	0.36	0.04	0.81	2.45	23.77	0	18.59	21.05	3.14	9.43	84.6
31	2.95	0.90	4.07	0.44	0.32	0.40	0.04	0.86	2.56	25.11	0	20.47	26.19	3.38	11.23	95.7
32	3.04	1.03	4.49	0.49	0.35	0.44	0.04	0.92	2.66	26.35	0	22.49	32.09	3.66	13.21	107.9
33	3.13	1.17	4.96	0.55	0.39	0.49	0.05	0.98	2.77	27.48	0	24.65	38.78	3.96	15.36	121.2
34	3.23	1.34	5.50	0.61	0.44	0.55	0.06	1.04	2.88	28.50	0	26.96	46.23	4.28	17.65	135.6
35	3.34	1.52	6.10	0.68	0.49	0.62	0.06	1.11	2.98	29.40	0	29.42	54.41	4.64	20.08	151.0
36	3.46	1.72	6.79	0.76	0.56	0.73	0.07	1.22	3.09	30.19	0	32.04	63.27	5.03	22.67	167.6
37	3.59	1.95	7.56	0.85	0.63	0.86	0.09	1.33	3.19	30.86	0	34.84	72.73	5.46	25.35	185.1
38	3.73	2.19	8.43	0.95	0.72	1.03	0.10	1.46	3.30	31.42	0	37.81	82.71	5.92	28.09	203.4
39	3.88	2.45	9.39	1.07	0.81	1.23	0.12	1.61	3.41	31.88	0	40.98	93.11	6.42	30.88	222.6
40	4.04	2.73	10.46	1.19	0.92	1.47	0.14	1.77	3.52	32.24	0	44.35	103.84	6.96	33.67	242.4
41	4.22	3.01	11.64	1.34	1.05	1.76	0.16	1.94	3.63	32.52	0	47.94	114.78	7.54	36.44	262.7
42	4.40	3.30	12.92	1.50	1.19	2.11	0.18	2.13	3.75	32.72	0	51.75	125.85	8.17	39.17	283.6
43	4.60	3.59	14.31	1.68	1.35	2.51	0.21	2.34	3.88	32.86	0	55.82	136.96	8.83	41.84	305.0
44	4.82	3.88	15.81	1.88	1.53	2.99	0.24	2.55	4.01	32.95	0	60.13	148.04	9.54	44.45	326.6
45	5.05	4.17	17.41	2.10	1.74	3.50	0.28	2.79	4.16	33.01	0	64.69	159.04	10.28	46.98	348.6
46	5.30	4.45	19.09	2.36	1.96	4.04	0.32	3.03	4.32	33.04	0	69.52	169.93	11.07	49.46	370.9
47	5.57	4.73	20.83	2.64	2.22	4.64	0.37	3.29	4.49	33.06	0	74.61	180.69	11.89	51.88	393.5
48	5.86	5.01	22.62	2.96	2.51	5.30	0.42	3.55	4.68	33.09	0	79.97	191.34	12.75	54.26	416.4
49	6.18	5.29	24.45	3.31	2.83	6.03	0.47	3.83	4.89	33.12	0	85.60	201.92	13.63	56.62	439.6
50	6.51	5.58	26.31	3.71	3.19	6.81	0.53	4.11	5.13	33.15	0	91.49	212.49	14.55	59.01	463.4
51	6.87	5.87	28.20	4.15	3.58	7.66	0.59	4.39	5.38	33.17	0	97.66	223.14	15.49	61.44	487.7
52	7.25	6.17	30.11	4.63	4.01	8.57	0.66	4.68	5.65	33.19	0	104.08	233.98	16.46	63.97	512.8

Table 14 continued

Age	BFO	Stomach	Colon	Liver	Bladder	Lungs	Esophagus	Oral cavity	Brain	Thyroid	Skin	Remainder	Breast	Ovaries	Uterus	Total solid
53	7.66	6.49	32.04	5.17	4.49	9.53	0.73	4.97	5.95	33.19	0	110.77	245.11	17.45	66.63	538.7
54	8.09	6.82	34.00	5.77	5.00	10.55	0.81	5.27	6.27	33.18	0	117.71	256.55	18.46	69.42	565.6
55	8.55	7.17	35.99	6.42	5.57	11.65	0.89	5.57	6.61	33.15	0	124.91	268.25	19.48	72.35	593.2
56	9.04	7.55	38.01	7.13	6.19	12.84	0.98	5.89	6.97	33.09	0	132.35	280.17	20.52	75.38	621.7
57	9.56	7.95	40.06	7.91	6.88	14.13	1.08	6.22	7.36	33.02	0	140.03	292.26	21.56	78.53	651.1
58	10.12	8.38	42.17	8.76	7.65	15.57	1.20	6.58	7.78	32.91	0	147.95	304.48	22.60	81.76	681.2
59	10.71	8.85	44.34	9.68	8.50	17.17	1.32	6.97	8.21	32.78	0	156.10	316.75	23.65	85.07	712.2
60	11.33	9.34	46.59	10.67	9.45	19.00	1.46	7.40	8.67	32.61	0	164.47	329.02	24.69	88.42	744.0
61	12.00	9.87	48.93	11.74	10.50	21.08	1.62	7.87	9.15	32.40	0	173.03	341.20	25.72	91.79	776.5
62	12.71	10.44	51.40	12.87	11.67	23.44	1.80	8.38	9.66	32.15	0	181.79	353.22	26.73	95.14	809.7
63	13.46	11.05	54.01	14.08	12.97	26.07	1.99	8.94	10.18	31.86	0	190.71	364.99	27.73	98.46	843.4
64	14.25	11.69	56.79	15.35	14.39	28.96	2.21	9.53	10.72	31.53	0	199.78	376.42	28.70	101.69	877.6
65	15.08	12.37	59.79	16.68	15.92	32.03	2.44	10.13	11.27	31.16	0	208.96	387.42	29.64	104.79	911.9
66	15.95	13.07	63.03	18.07	17.56	35.16	2.68	10.74	11.84	30.73	0	218.23	397.87	30.54	107.73	946.0
67	16.85	13.79	66.58	19.50	19.28	38.21	2.93	11.33	12.41	30.26	0	227.54	407.69	31.40	110.44	979.4
68	17.79	14.53	70.47	20.97	21.06	41.03	3.17	11.88	12.99	29.74	0	236.85	416.76	32.22	112.88	1011.9
69	18.75	15.28	74.73	22.47	22.90	43.61	3.41	12.40	13.56	29.17	0	246.13	424.98	32.99	115.02	1043.3
70	19.74	16.05	79.36	23.97	24.79	46.72	3.65	12.90	14.12	28.55	0	255.33	432.25	33.70	116.80	1074.0
71	20.75	16.83	84.35	25.47	26.73	50.28	3.89	13.38	14.67	27.88	0	264.40	438.47	34.36	118.19	1103.9
72	21.79	17.63	89.71	26.94	28.73	53.92	4.13	13.87	15.20	27.17	0	273.30	443.55	34.95	119.14	1132.4
73	22.85	18.44	95.42	28.36	30.78	57.68	4.38	14.37	15.70	26.42	0	281.95	447.39	35.48	119.62	1159.4
74	23.92	19.26	101.46	29.72	32.86	61.49	4.64	14.87	16.17	25.62	0	290.31	449.91	35.94	119.60	1184.6
75	25.01	20.09	107.81	30.99	34.97	65.27	4.90	15.36	16.59	24.78	0	298.31	451.06	36.33	119.03	1207.6
76	26.11	20.92	114.43	32.14	37.06	68.90	5.15	15.85	16.96	23.90	0	305.89	450.76	36.65	117.92	1228.0
77	27.22	21.75	121.26	33.17	39.13	72.29	5.39	16.31	17.27	22.99	0	312.97	448.98	36.89	116.23	1245.6
78	28.32	22.57	128.25	34.04	41.16	75.37	5.62	16.75	17.51	22.05	0	319.48	445.68	37.06	113.98	1260.0
79	29.42	23.37	135.32	34.74	43.13	78.05	5.84	17.17	17.68	21.09	0	325.37	440.86	37.14	111.16	1271.1
80	30.52	24.15	142.37	35.24	45.03	80.29	6.04	17.56	17.77	20.10	0	330.58	434.51	37.15	107.80	1278.5
81	31.59	24.88	149.31	35.54	46.83	82.07	6.22	17.93	17.78	19.10	0	335.03	426.66	37.08	103.93	1282.1
82	32.65	25.56	156.01	35.62	48.53	83.35	6.38	18.28	17.70	18.09	0	338.68	417.36	36.94	99.58	1281.7
83	33.68	26.18	162.35	35.47	50.10	84.11	6.52	18.61	17.52	17.08	0	341.48	406.66	36.71	94.82	1277.4
84	34.67	26.71	168.19	35.10	51.54	84.12	6.64	18.92	17.26	16.07	0	343.39	394.64	36.41	89.69	1268.7
85	35.61	27.15	173.38	34.50	52.83	83.61	6.74	19.21	16.90	15.06	0	344.37	381.39	36.04	84.26	1255.9
86	36.50	27.48	177.78	33.67	53.93	82.59	6.81	19.49	16.45	14.06	0	344.39	367.03	35.60	78.60	1238.9
87	37.31	27.68	181.24	32.64	54.83	81.00	6.85	19.73	15.92	13.08	0	343.45	351.67	35.10	72.79	1217.8
88	37.91	27.57	183.63	31.40	54.73	76.55	6.74	19.62	15.31	12.12	0	341.52	335.46	34.52	66.89	1187.9
89	38.40	27.30	184.83	29.99	54.32	71.76	6.59	19.46	14.62	11.19	0	338.63	318.55	33.89	60.99	1154.2
90	38.84	26.86	185.40	28.43	53.60	66.73	6.42	19.26	13.87	10.28	0	334.98	301.08	33.20	55.16	1117.6
91	39.28	26.24	185.96	26.74	52.57	61.55	6.21	19.02	13.07	9.41	0	330.79	283.21	32.46	49.48	1079.3
92	39.72	25.45	186.53	24.96	51.24	56.29	5.99	18.73	12.23	8.58	0	326.09	265.12	31.66	44.01	1039.9
93	40.17	24.50	187.10	23.10	49.63	51.05	5.74	18.41	11.36	7.78	0	320.91	246.94	30.83	38.80	999.7
94	40.62	23.49	187.68	21.29	47.92	46.10	5.49	18.07	10.51	7.04	0	315.59	229.44	29.98	34.05	960.7
95	41.08	22.52	188.25	19.63	46.27	41.63	5.26	17.74	9.72	6.38	0	310.45	213.17	29.16	29.88	924.6
96	41.08	21.60	188.25	18.09	44.68	37.59	5.03	17.42	8.99	5.77	0	306.36	198.06	28.36	26.21	891.5
97	41.08	20.71	188.25	16.68	43.14	33.95	4.81	17.10	8.32	5.23	0	302.43	184.02	27.59	22.98	860.7
98	41.08	19.86	188.25	15.38	41.65	30.65	4.60	16.78	7.69	4.73	0	298.64	170.97	26.83	20.15	832.2
99	41.08	19.04	188.25	14.17	40.22	27.68	4.40	16.47	7.12	4.28	0	294.98	158.85	26.10	17.66	805.6
100	41.08	18.26	188.25	13.07	38.83	25.00	4.21	16.17	6.58	3.88	0	291.46	147.59	25.38	15.47	781.0
101	41.08	17.51	188.25	12.04	37.49	22.57	4.03	15.87	6.09	3.51	0	288.06	137.13	24.69	13.55	758.1

Table 15. NS female cancer mortality rates per 100,000 for 2018, 2019, 2021.

age	BFO	stomach	colon	liver	bladder	lungs	esophagus	oral cavity	brain	thyroid	skin	remainder	breast	ovaries	uterus	total solid	CHD	stroke
0	0.65	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.31	0.00	0	0.55	0.00	0.01	0.02	0.9	0.00	5.11
1	0.61	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.36	0.00	0	0.51	0.00	0.01	0.02	0.9	0.00	1.24
2	0.57	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.42	0.00	0	0.48	0.00	0.01	0.02	1.0	0.00	0.46
3	0.54	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.50	0.00	0	0.47	0.00	0.01	0.02	1.0	0.00	0.24
4	0.52	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.59	0.00	0	0.46	0.00	0.01	0.03	1.1	0.00	0.17
5	0.49	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.68	0.00	0	0.46	0.00	0.02	0.03	1.2	0.00	0.15
6	0.48	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.76	0.00	0	0.47	0.00	0.02	0.04	1.3	0.00	0.15
7	0.47	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.80	0.00	0	0.48	0.00	0.02	0.04	1.4	0.00	0.15
8	0.46	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.80	0.00	0	0.49	0.00	0.02	0.05	1.4	0.01	0.16
9	0.45	0.01	0.00	0.02	0.00	0.01	0.00	0.01	0.76	0.00	0	0.51	0.00	0.03	0.06	1.4	0.01	0.18
10	0.44	0.01	0.01	0.02	0.00	0.01	0.00	0.01	0.70	0.00	0	0.53	0.00	0.03	0.07	1.4	0.01	0.19
11	0.44	0.01	0.01	0.02	0.00	0.01	0.00	0.01	0.63	0.00	0	0.55	0.00	0.03	0.08	1.4	0.01	0.20
12	0.44	0.01	0.01	0.02	0.00	0.01	0.00	0.01	0.57	0.00	0	0.58	0.00	0.04	0.09	1.4	0.02	0.21
13	0.44	0.01	0.01	0.03	0.00	0.01	0.00	0.01	0.53	0.00	0	0.61	0.00	0.04	0.10	1.4	0.02	0.22
14	0.44	0.01	0.02	0.03	0.00	0.02	0.00	0.01	0.50	0.00	0	0.64	0.00	0.05	0.11	1.4	0.03	0.24
15	0.45	0.02	0.02	0.03	0.00	0.02	0.00	0.02	0.47	0.00	0	0.68	0.01	0.06	0.13	1.5	0.04	0.25
16	0.45	0.02	0.02	0.04	0.00	0.02	0.00	0.02	0.46	0.00	0	0.70	0.01	0.07	0.15	1.5	0.05	0.27
17	0.46	0.03	0.03	0.04	0.00	0.02	0.00	0.02	0.45	0.00	0	0.73	0.01	0.08	0.17	1.6	0.06	0.29
18	0.47	0.03	0.04	0.05	0.00	0.03	0.00	0.02	0.44	0.01	0	0.75	0.02	0.09	0.20	1.7	0.08	0.31
19	0.48	0.04	0.05	0.05	0.01	0.03	0.00	0.02	0.44	0.01	0	0.76	0.03	0.10	0.23	1.8	0.10	0.33
20	0.49	0.05	0.06	0.06	0.01	0.03	0.00	0.03	0.45	0.01	0	0.77	0.05	0.11	0.26	1.9	0.12	0.35
21	0.50	0.06	0.08	0.06	0.01	0.04	0.01	0.03	0.46	0.01	0	0.79	0.07	0.13	0.30	2.0	0.15	0.37
22	0.51	0.07	0.10	0.07	0.01	0.04	0.01	0.03	0.47	0.01	0	0.81	0.10	0.15	0.34	2.2	0.18	0.40
23	0.52	0.09	0.12	0.08	0.01	0.04	0.01	0.03	0.48	0.01	0	0.83	0.15	0.17	0.39	2.4	0.22	0.43
24	0.53	0.11	0.16	0.09	0.01	0.05	0.01	0.03	0.50	0.01	0	0.86	0.22	0.19	0.44	2.7	0.27	0.46
25	0.55	0.13	0.19	0.10	0.01	0.05	0.01	0.04	0.52	0.01	0	0.91	0.32	0.22	0.51	3.0	0.32	0.50
26	0.56	0.15	0.24	0.11	0.01	0.06	0.01	0.04	0.55	0.01	0	0.96	0.45	0.25	0.58	3.4	0.38	0.55
27	0.58	0.18	0.30	0.13	0.02	0.06	0.01	0.04	0.58	0.02	0	1.02	0.62	0.28	0.66	3.9	0.46	0.60
28	0.60	0.21	0.36	0.14	0.02	0.07	0.01	0.04	0.61	0.02	0	1.11	0.84	0.32	0.76	4.5	0.54	0.66
29	0.62	0.25	0.44	0.16	0.02	0.08	0.02	0.05	0.65	0.02	0	1.20	1.12	0.37	0.86	5.2	0.64	0.73
30	0.64	0.29	0.53	0.18	0.02	0.09	0.02	0.05	0.69	0.03	0	1.32	1.46	0.42	0.98	6.1	0.74	0.80
31	0.67	0.33	0.63	0.21	0.03	0.10	0.02	0.05	0.73	0.03	0	1.45	1.88	0.48	1.11	7.0	0.87	0.89
32	0.69	0.38	0.75	0.23	0.03	0.12	0.02	0.06	0.79	0.03	0	1.61	2.37	0.55	1.26	8.2	1.01	0.99
33	0.72	0.43	0.88	0.26	0.04	0.14	0.03	0.06	0.85	0.04	0	1.79	2.95	0.63	1.42	9.5	1.16	1.10
34	0.76	0.49	1.04	0.30	0.04	0.16	0.03	0.07	0.91	0.04	0	2.01	3.62	0.71	1.60	11.0	1.34	1.22
35	0.79	0.55	1.21	0.34	0.05	0.18	0.04	0.08	0.98	0.05	0	2.26	4.38	0.81	1.79	12.6	1.53	1.35
36	0.83	0.62	1.40	0.39	0.06	0.21	0.04	0.09	1.06	0.06	0	2.55	5.23	0.92	2.02	14.5	1.79	1.53
37	0.88	0.69	1.62	0.44	0.07	0.26	0.05	0.10	1.15	0.06	0	2.88	6.16	1.05	2.27	16.7	2.09	1.73
38	0.92	0.77	1.86	0.50	0.08	0.32	0.06	0.11	1.25	0.07	0	3.25	7.18	1.19	2.54	19.0	2.43	1.96
39	0.98	0.85	2.13	0.57	0.09	0.39	0.07	0.13	1.36	0.08	0	3.68	8.28	1.35	2.85	21.7	2.82	2.22
40	1.03	0.93	2.43	0.65	0.10	0.48	0.08	0.15	1.48	0.10	0	4.17	9.46	1.52	3.18	24.5	3.27	2.51
41	1.10	1.02	2.75	0.74	0.12	0.59	0.09	0.17	1.62	0.11	0	4.73	10.70	1.72	3.54	27.6	3.77	2.84
42	1.17	1.11	3.10	0.84	0.14	0.72	0.11	0.19	1.76	0.12	0	5.35	12.01	1.95	3.93	31.0	4.33	3.19
43	1.24	1.21	3.48	0.96	0.16	0.88	0.13	0.22	1.92	0.14	0	6.05	13.38	2.20	4.36	34.7	4.96	3.58
44	1.32	1.31	3.89	1.09	0.19	1.07	0.15	0.25	2.10	0.16	0	6.84	14.80	2.48	4.82	38.7	5.66	4.00
45	1.41	1.41	4.33	1.24	0.22	1.28	0.17	0.28	2.29	0.18	0	7.72	16.26	2.78	5.32	43.0	6.51	4.46
46	1.51	1.52	4.80	1.42	0.25	1.52	0.20	0.32	2.49	0.21	0	8.70	17.75	3.13	5.85	47.5	7.51	4.94
47	1.62	1.63	5.30	1.61	0.29	1.80	0.23	0.36	2.71	0.23	0	9.79	19.27	3.51	6.42	52.4	8.64	5.47
48	1.73	1.74	5.84	1.83	0.33	2.11	0.26	0.41	2.95	0.25	0	10.99	20.81	3.93	7.02	57.6	9.89	6.03
49	1.86	1.85	6.41	2.07	0.38	2.46	0.29	0.46	3.21	0.28	0	12.31	22.35	4.39	7.65	63.1	11.29	6.62
50	2.00	1.97	7.01	2.35	0.43	2.86	0.33	0.51	3.49	0.30	0	13.76	23.90	4.89	8.33	69.0	12.83	7.32
51	2.15	2.09	7.65	2.66	0.49	3.30	0.37	0.57	3.78	0.33	0	15.36	25.45	5.45	9.04	75.2	14.54	8.11
52	2.32	2.21	8.32	3.01	0.55	3.79	0.42	0.63	4.10	0.36	0	17.11	27.00	6.06	9.78	81.8	16.43	8.96

Table 15 continued

age	BFO	stomach	colon	liver	bladder	lungs	esophagus	oral cavity	brain	thyroid	skin	remainder	breast	ovaries	uterus	total solid	CHD	stroke
53	2.50	2.33	9.03	3.40	0.62	4.33	0.47	0.70	4.44	0.40	0	19.01	28.54	6.72	10.56	88.7	18.51	9.88
54	2.70	2.46	9.77	3.83	0.70	4.92	0.52	0.77	4.80	0.43	0	21.09	30.09	7.44	11.37	96.0	20.83	10.90
55	2.91	2.59	10.55	4.31	0.79	5.57	0.57	0.84	5.18	0.47	0	23.35	31.63	8.22	12.22	103.8	23.43	12.02
56	3.15	2.72	11.36	4.84	0.88	6.28	0.63	0.92	5.58	0.52	0	25.80	33.18	9.05	13.10	112.0	26.36	13.26
57	3.41	2.86	12.22	5.43	0.99	7.06	0.70	1.00	6.00	0.56	0	28.45	34.74	9.96	14.01	120.7	29.69	14.65
58	3.70	3.01	13.11	6.08	1.11	7.94	0.78	1.09	6.44	0.62	0	31.30	36.32	10.92	14.95	129.9	33.50	16.21
59	4.02	3.17	14.05	6.79	1.25	8.92	0.86	1.19	6.91	0.68	0	34.38	37.94	11.95	15.92	139.8	37.86	17.98
60	4.37	3.34	15.03	7.57	1.40	10.03	0.96	1.30	7.40	0.74	0	37.68	39.60	13.05	16.92	150.3	42.24	19.98
61	4.76	3.53	16.06	8.42	1.57	11.29	1.07	1.42	7.90	0.81	0	41.21	41.33	14.21	17.94	161.6	46.63	22.25
62	5.20	3.73	17.15	9.34	1.77	12.70	1.19	1.55	8.42	0.89	0	44.98	43.15	15.43	18.99	173.6	51.56	24.83
63	5.69	3.95	18.29	10.33	1.99	14.26	1.33	1.69	8.96	0.98	0	48.99	45.06	16.71	20.04	186.4	57.08	27.76
64	6.24	4.19	19.49	11.39	2.24	15.95	1.49	1.84	9.52	1.08	0	53.25	47.09	18.05	21.11	200.0	63.23	31.06
65	6.85	4.45	20.75	12.53	2.52	17.73	1.65	1.99	10.08	1.18	0	57.75	49.24	19.45	22.19	214.4	70.0	34.78
66	7.53	4.73	22.09	13.75	2.83	19.53	1.83	2.15	10.66	1.30	0	62.49	51.52	20.89	23.27	229.4	77.4	38.93
67	8.29	5.03	23.51	15.03	3.16	21.3	2.02	2.30	11.24	1.42	0	67.48	53.94	22.37	24.34	244.9	85.4	43.55
68	9.13	5.34	25.01	16.39	3.53	22.9	2.20	2.45	11.83	1.55	0	72.69	56.50	23.88	25.41	260.9	94.0	48.70
69	10.07	5.67	26.62	17.80	3.92	24.4	2.39	2.60	12.41	1.70	0	78.14	59.21	25.41	26.46	277.3	103.3	54.49
70	11.10	6.03	28.34	19.27	4.35	26.2	2.59	2.76	13.00	1.85	0	83.81	62.09	26.96	27.50	294.5	114.7	61.07
71	12.24	6.41	30.17	20.79	4.82	28.2	2.79	2.91	13.57	2.01	0	89.69	65.14	28.51	28.52	312.7	128.3	68.61
72	13.48	6.81	32.15	22.34	5.33	30.4	3.00	3.08	14.13	2.19	0	95.78	68.38	30.05	29.52	331.5	143.7	77.32
73	14.83	7.25	34.28	23.92	5.89	32.6	3.22	3.25	14.67	2.36	0	102.1	71.82	31.56	30.49	351.1	161.1	87.4
74	16.29	7.72	36.59	25.52	6.51	35.0	3.46	3.45	15.19	2.55	0	108.5	75.46	33.04	31.44	371.4	181.0	99.2
75	17.86	8.22	39.09	27.10	7.19	37.4	3.71	3.65	15.69	2.75	0	115.2	79.34	34.46	32.36	392.5	203.6	112.8
76	19.53	8.75	41.82	28.67	7.93	39.9	3.96	3.88	16.15	2.95	0	122.0	83.45	35.82	33.24	414.2	229.2	128.8
77	21.30	9.33	44.81	30.20	8.75	42.4	4.22	4.12	16.58	3.16	0	128.9	87.81	37.10	34.08	436.5	258.4	147.5
78	23.14	9.94	48.08	31.66	9.64	44.9	4.49	4.38	16.96	3.38	0	135.9	92.45	38.28	34.88	459.5	291.5	169.5
79	25.04	10.60	51.69	33.05	10.62	47.4	4.75	4.67	17.29	3.60	0	143.1	97.38	39.34	35.63	483.1	329.5	195.5
80	26.97	11.31	55.68	34.34	11.69	49.9	5.02	4.99	17.58	3.83	0	150.4	102.62	40.28	36.33	507.4	373.0	226.2
81	28.91	12.06	60.09	35.51	12.88	52.4	5.29	5.35	17.81	4.07	0	157.7	108.19	41.08	36.98	532.5	423.1	262.9
82	30.83	12.87	65.01	36.54	14.19	54.9	5.55	5.76	17.98	4.32	0	165.1	114.11	41.73	37.57	558.4	481.0	306.8
83	32.67	13.74	70.51	37.41	15.64	57.5	5.82	6.22	18.09	4.58	0	172.6	120.4	42.22	38.11	585.3	548.1	359.5
84	34.40	14.68	76.67	38.11	17.24	59.9	6.09	6.73	18.13	4.84	0	180.1	127.1	42.54	38.59	613.1	623.5	421.4
85	35.97	15.68	83.60	38.62	19.03	62.4	6.35	7.31	18.11	5.11	0	187.6	134.2	42.68	39.01	642.1	711.6	496.6
86	37.33	16.76	91.43	38.92	21.01	64.7	6.62	7.94	18.02	5.40	0	195.2	141.8	42.63	39.38	672.4	814.9	588.2
87	38.42	17.90	100.3	39.01	23.21	67.0	6.87	8.62	17.87	5.69	0	202.9	149.9	42.40	39.68	704.0	936.4	700.4
88	39.09	19.02	110.4	38.88	25.30	67.0	6.99	9.18	17.64	5.99	0	210.6	158.5	41.99	39.91	733.7	1072.4	837.5
89	39.39	20.19	121.9	38.53	27.55	66.7	7.08	9.74	17.36	6.30	0	218.3	167.6	41.40	40.07	764.7	1232.5	1007.5
90	39.50	21.41	134.9	37.96	29.98	66.0	7.15	10.29	17.00	6.63	0	226.2	177.3	40.63	40.17	797.3	1419.0	1215.6
91	39.61	22.69	149.3	37.17	32.61	65.0	7.20	10.79	16.59	6.97	0	234.1	187.7	39.69	40.21	831.3	1633.7	1466.8
92	39.72	24.03	165.2	36.18	35.43	63.5	7.23	11.24	16.12	7.32	0	242.1	198.7	38.58	40.19	867.0	1880.8	1769.8
93	39.83	25.43	182.8	34.99	38.48	61.7	7.23	11.61	15.60	7.69	0	250.2	210.5	37.34	40.12	904.6	2165.4	2135.4
94	39.94	26.89	202.3	33.74	41.78	59.7	7.23	11.92	15.06	8.08	0	258.6	223.0	36.04	40.01	945.0	2493.0	2576.6
95	40.05	28.44	223.9	32.54	45.35	57.8	7.22	12.25	14.54	8.49	0	267.4	236.3	34.79	39.90	989.3	2870.2	3109.0
96	40.05	30.07	223.9	31.37	49.24	56.0	7.21	12.59	14.03	8.92	0	269.8	250.3	33.59	39.81	1007.0	2870.2	3109.0
97	40.05	31.80	223.9	30.25	53.45	54.2	7.21	12.94	13.55	9.37	0	272.3	265.1	32.42	39.71	1026.2	2870.2	3109.0
98	40.05	33.63	223.9	29.17	58.03	52.5	7.20	13.29	13.08	9.84	0	274.9	280.9	31.30	39.62	1047.1	2870.2	3109.0
99	40.05	35.56	223.9	28.12	63.00	50.8	7.20	13.66	12.63	10.34	0	277.6	297.6	30.21	39.53	1069.6	2870.2	3109.0
100	40.05	37.61	223.9	27.12	68.39	49.2	7.19	14.04	12.19	10.86	0	280.3	315.2	29.16	39.44	1093.9	2870.2	3109.0
101	40.05	39.77	223.9	26.15	74.2	47.6	7.19	14.42	11.77	11.41	0	283.1	334.0	28.15	39.35	1120.1	2870.2	3109.0

Table 16. 2019 average male survival and hazard functions.

Age: a	Survival: S(a)	Hazard: m(a)		Age: a	Survival: S(a)	Hazard: m(a)
0	1	0		51	0.9171	4.8789E-03
1	0.9939	6.0989E-03		52	0.9123	5.2981E-03
2	0.9935	4.1504E-04		53	0.9070	5.8062E-03
3	0.9933	2.5687E-04		54	0.9012	6.4051E-03
4	0.9931	1.9318E-04		55	0.8948	7.0588E-03
5	0.9929	1.5316E-04		56	0.8880	7.7169E-03
6	0.9928	1.4855E-04		57	0.8806	8.3731E-03
7	0.9926	1.3660E-04		58	0.8726	9.0646E-03
8	0.9925	1.2586E-04		59	0.8641	9.8156E-03
9	0.9924	1.1347E-04		60	0.8550	1.0631E-02
10	0.9923	1.0110E-04		61	0.8452	1.1511E-02
11	0.9922	9.5150E-05		62	0.8347	1.2419E-02
12	0.9921	1.0595E-04		63	0.8237	1.3331E-02
13	0.9919	1.4541E-04		64	0.8121	1.4231E-02
14	0.9917	2.2055E-04		65	0.7998	1.5147E-02
15	0.9914	3.2393E-04		66	0.7870	1.6133E-02
16	0.9910	4.3822E-04		67	0.7735	1.7303E-02
17	0.9904	5.5464E-04		68	0.7593	1.8519E-02
18	0.9897	6.7909E-04		69	0.7445	1.9796E-02
19	0.9889	8.0898E-04		70	0.7289	2.1137E-02
20	0.9880	9.4089E-04		71	0.7126	2.2556E-02
21	0.9870	1.0780E-03		72	0.6956	2.4221E-02
22	0.9858	1.2118E-03		73	0.6778	2.5885E-02
23	0.9845	1.3249E-03		74	0.6587	2.8664E-02
24	0.9831	1.4076E-03		75	0.6384	3.1179E-02
25	0.9816	1.4662E-03		76	0.6168	3.4479E-02
26	0.9801	1.5152E-03		77	0.5939	3.7783E-02
27	0.9786	1.5650E-03		78	0.5695	4.2024E-02
28	0.9770	1.6148E-03		79	0.5437	4.6358E-02
29	0.9754	1.6701E-03		80	0.5165	5.1242E-02
30	0.9737	1.7317E-03		81	0.4882	5.6497E-02
31	0.9720	1.7954E-03		82	0.4585	6.2630E-02
32	0.9702	1.8596E-03		83	0.4276	6.9849E-02
33	0.9683	1.9279E-03		84	0.3955	7.7902E-02
34	0.9664	1.9997E-03		85	0.3625	8.7188E-02
35	0.9644	2.0738E-03		86	0.3286	9.8258E-02
36	0.9623	2.1563E-03		87	0.2944	1.0977E-01
37	0.9601	2.2437E-03		88	0.2602	1.2366E-01
38	0.9579	2.3261E-03		89	0.2264	1.3904E-01
39	0.9556	2.4019E-03		90	0.1937	1.5601E-01
40	0.9532	2.4792E-03		91	0.1627	1.7465E-01
41	0.9508	2.5719E-03		92	0.1338	1.9503E-01
42	0.9482	2.6889E-03		93	0.1077	2.1721E-01
43	0.9455	2.8278E-03		94	0.0846	2.4120E-01
44	0.9427	2.9874E-03		95	0.0648	2.6701E-01
45	0.9397	3.1667E-03		96	0.0483	2.9459E-01
46	0.9366	3.3706E-03		97	0.0349	3.2388E-01
47	0.9332	3.6027E-03		98	0.0245	3.5475E-01
48	0.9296	3.8638E-03		99	0.0166	3.8707E-01
49	0.9258	4.1623E-03		100	0.0109	4.2064E-01
50	0.9216	4.5070E-03		101	0.0000	1

Table 17. 2019 average female survival and hazard functions.

Age: a	Survival: S(a)	Hazard: m(a)		Age: a	Survival: S(a)	Hazard: m(a)
0	1	0		51	0.9533	2.9681E-03
1	0.9950	5.0577E-03		52	0.9502	3.2223E-03
2	0.9946	3.4150E-04		53	0.9469	3.5255E-03
3	0.9944	2.0928E-04		54	0.9432	3.8767E-03
4	0.9942	1.6589E-04		55	0.9392	4.2554E-03
5	0.9941	1.3658E-04		56	0.9349	4.6335E-03
6	0.9940	1.2490E-04		57	0.9302	5.0128E-03
7	0.9939	1.1164E-04		58	0.9252	5.4194E-03
8	0.9938	1.0237E-04		59	0.9197	5.8703E-03
9	0.9937	9.6311E-05		60	0.9139	6.3664E-03
10	0.9936	9.3495E-05		61	0.9076	6.9151E-03
11	0.9935	9.4787E-05		62	0.9008	7.4829E-03
12	0.9934	1.0176E-04		63	0.8936	8.0359E-03
13	0.9933	1.1631E-04		64	0.8860	8.5561E-03
14	0.9931	1.3948E-04		65	0.8780	9.0737E-03
15	0.9930	1.6976E-04		66	0.8696	9.6187E-03
16	0.9928	2.0431E-04		67	0.8607	1.0289E-02
17	0.9925	2.4093E-04		68	0.8512	1.1091E-02
18	0.9922	2.7959E-04		69	0.8410	1.2091E-02
19	0.9919	3.1938E-04		70	0.8299	1.3275E-02
20	0.9916	3.6006E-04		71	0.8179	1.4590E-02
21	0.9912	4.0390E-04		72	0.8048	1.6085E-02
22	0.9907	4.4911E-04		73	0.7908	1.7535E-02
23	0.9902	4.9015E-04		74	0.7755	1.9622E-02
24	0.9897	5.2411E-04		75	0.7590	2.1426E-02
25	0.9892	5.5298E-04		76	0.7412	2.3830E-02
26	0.9886	5.7941E-04		77	0.7220	2.6259E-02
27	0.9880	6.0856E-04		78	0.7010	2.9431E-02
28	0.9874	6.4435E-04		79	0.6784	3.2751E-02
29	0.9867	6.9071E-04		80	0.6540	3.6606E-02
30	0.9859	7.4665E-04		81	0.6279	4.0867E-02
31	0.9851	8.0804E-04		82	0.5999	4.5602E-02
32	0.9843	8.7038E-04		83	0.5696	5.1747E-02
33	0.9834	9.3306E-04		84	0.5372	5.8592E-02
34	0.9824	9.9274E-04		85	0.5032	6.5291E-02
35	0.9814	1.0497E-03		86	0.4675	7.3728E-02
36	0.9803	1.1122E-03		87	0.4300	8.3656E-02
37	0.9791	1.1790E-03		88	0.3911	9.4787E-02
38	0.9779	1.2405E-03		89	0.3513	1.0723E-01
39	0.9766	1.2959E-03		90	0.3112	1.2110E-01
40	0.9753	1.3515E-03		91	0.2715	1.3650E-01
41	0.9739	1.4147E-03		92	0.2329	1.5352E-01
42	0.9725	1.4943E-03		93	0.1960	1.7227E-01
43	0.9709	1.5940E-03		94	0.1617	1.9282E-01
44	0.9693	1.7151E-03		95	0.1304	2.1521E-01
45	0.9675	1.8530E-03		96	0.1026	2.3949E-01
46	0.9655	2.0075E-03		97	0.0787	2.6565E-01
47	0.9634	2.1745E-03		98	0.0586	2.9365E-01
48	0.9612	2.3502E-03		99	0.0424	3.2342E-01
49	0.9587	2.5373E-03		100	0.0298	3.5485E-01
50	0.9561	2.7444E-03		101	0	1

Table 18. 2019 NS male survival and hazard functions.

Age: a	Survival: S(a)	Hazard: m(a)		Age: a	Survival: S(a)	Hazard: m(a)
0	1	0		51	0.9357	3.4499E-03
1	0.9939	6.0989E-03		52	0.9322	3.7214E-03
2	0.9935	4.1504E-04		53	0.9284	4.0461E-03
3	0.9933	2.5687E-04		54	0.9243	4.4243E-03
4	0.9931	1.9318E-04		55	0.9199	4.8312E-03
5	0.9929	1.5316E-04		56	0.9151	5.2336E-03
6	0.9928	1.4855E-04		57	0.9099	5.6305E-03
7	0.9926	1.3659E-04		58	0.9044	6.0500E-03
8	0.9925	1.2586E-04		59	0.8986	6.5090E-03
9	0.9924	1.1346E-04		60	0.8923	7.0235E-03
10	0.9923	1.0109E-04		61	0.8855	7.5919E-03
11	0.9922	9.5118E-05		62	0.8783	8.1819E-03
12	0.9921	1.0586E-04		63	0.8706	8.7785E-03
13	0.9919	1.4513E-04		64	0.8625	9.3736E-03
14	0.9917	2.1966E-04		65	0.8539	9.9866E-03
15	0.9914	3.2142E-04		66	0.8449	1.0655E-02
16	0.9910	4.3220E-04		67	0.8353	1.1455E-02
17	0.9904	5.4207E-04		68	0.8251	1.2294E-02
18	0.9898	6.5536E-04		69	0.8143	1.3177E-02
19	0.9890	7.6805E-04		70	0.8028	1.4214E-02
20	0.9882	8.7581E-04		71	0.7905	1.5370E-02
21	0.9872	9.8117E-04		72	0.7774	1.6709E-02
22	0.9861	1.0768E-03		73	0.7635	1.8063E-02
23	0.9850	1.1488E-03		74	0.7482	2.0221E-02
24	0.9838	1.1917E-03		75	0.7318	2.2227E-02
25	0.9826	1.2137E-03		76	0.7138	2.4834E-02
26	0.9814	1.2288E-03		77	0.6945	2.7494E-02
27	0.9802	1.2456E-03		78	0.6733	3.0898E-02
28	0.9790	1.2636E-03		79	0.6505	3.4443E-02
29	0.9777	1.2866E-03		80	0.6260	3.8480E-02
30	0.9764	1.3148E-03		81	0.5997	4.2892E-02
31	0.9751	1.3439E-03		82	0.5716	4.8081E-02
32	0.9738	1.3719E-03		83	0.5415	5.3931E-02
33	0.9724	1.4005E-03		84	0.5098	6.0462E-02
34	0.9710	1.4293E-03		85	0.4762	6.8054E-02
35	0.9696	1.4581E-03		86	0.4409	7.7167E-02
36	0.9681	1.5109E-03		87	0.4045	8.6205E-02
37	0.9666	1.5686E-03		88	0.3670	9.7113E-02
38	0.9651	1.6253E-03		89	0.3291	1.0919E-01
39	0.9634	1.6799E-03		90	0.2911	1.2252E-01
40	0.9618	1.7382E-03		91	0.2538	1.3716E-01
41	0.9600	1.8099E-03		92	0.2178	1.5317E-01
42	0.9582	1.9013E-03		93	0.1836	1.7059E-01
43	0.9563	2.0108E-03		94	0.1519	1.8943E-01
44	0.9542	2.1371E-03		95	0.1232	2.0969E-01
45	0.9521	2.2716E-03		96	0.0977	2.3136E-01
46	0.9498	2.4185E-03		97	0.0758	2.5436E-01
47	0.9473	2.5838E-03		98	0.0574	2.7861E-01
48	0.9447	2.7664E-03		99	0.0423	3.0399E-01
49	0.9419	2.9715E-03		100	0.0304	3.3035E-01
50	0.9389	3.2043E-03		101	0.0139	7.8535E-01

Table 19. 2019 NS female survival and hazard functions.

Age: a	Survival: S(a)	Hazard: m(a)		Age: a	Survival: S(a)	Hazard: m(a)
0	1	0		51	0.9587	2.4041E-03
1	0.9950	5.0577E-03		52	0.9562	2.5784E-03
2	0.9946	3.4149E-04		53	0.9535	2.7844E-03
3	0.9944	2.0928E-04		54	0.9507	3.0204E-03
4	0.9942	1.6588E-04		55	0.9476	3.2701E-03
5	0.9941	1.3658E-04		56	0.9442	3.5132E-03
6	0.9940	1.2489E-04		57	0.9407	3.7537E-03
7	0.9939	1.1164E-04		58	0.9369	4.0140E-03
8	0.9938	1.0237E-04		59	0.9329	4.3086E-03
9	0.9937	9.6309E-05		60	0.9286	4.6489E-03
10	0.9936	9.3489E-05		61	0.9239	5.0418E-03
11	0.9935	9.4771E-05		62	0.9189	5.4582E-03
12	0.9934	1.0172E-04		63	0.9135	5.8751E-03
13	0.9933	1.1621E-04		64	0.9078	6.2762E-03
14	0.9931	1.3923E-04		65	0.9017	6.6784E-03
15	0.9930	1.6918E-04		66	0.8954	7.0979E-03
16	0.9928	2.0310E-04		67	0.8886	7.5999E-03
17	0.9925	2.3860E-04		68	0.8813	8.1827E-03
18	0.9923	2.7548E-04		69	0.8735	8.8958E-03
19	0.9919	3.1262E-04		70	0.8650	9.7964E-03
20	0.9916	3.4966E-04		71	0.8557	1.0843E-02
21	0.9912	3.8876E-04		72	0.8454	1.2044E-02
22	0.9908	4.2813E-04		73	0.8343	1.3240E-02
23	0.9903	4.6267E-04		74	0.8219	1.4948E-02
24	0.9898	4.8995E-04		75	0.8085	1.6472E-02
25	0.9893	5.1214E-04		76	0.7937	1.8489E-02
26	0.9888	5.3192E-04		77	0.7776	2.0558E-02
27	0.9883	5.5406E-04		78	0.7597	2.3246E-02
28	0.9877	5.8202E-04		79	0.7401	2.6092E-02
29	0.9871	6.1918E-04		80	0.7187	2.9414E-02
30	0.9864	6.6443E-04		81	0.6953	3.3118E-02
31	0.9857	7.1394E-04		82	0.6698	3.7273E-02
32	0.9850	7.6359E-04		83	0.6419	4.2657E-02
33	0.9842	8.1276E-04		84	0.6114	4.8589E-02
34	0.9833	8.5865E-04		85	0.5790	5.4488E-02
35	0.9824	9.0167E-04		86	0.5442	6.1939E-02
36	0.9815	9.5408E-04		87	0.5070	7.0761E-02
37	0.9805	1.0105E-03		88	0.4680	8.0177E-02
38	0.9795	1.0631E-03		89	0.4274	9.0703E-02
39	0.9784	1.1110E-03		90	0.3858	1.0243E-01
40	0.9772	1.1594E-03		91	0.3437	1.1546E-01
41	0.9761	1.2147E-03		92	0.3019	1.2986E-01
42	0.9748	1.2840E-03		93	0.2609	1.4572E-01
43	0.9735	1.3706E-03		94	0.2217	1.6310E-01
44	0.9720	1.4753E-03		95	0.1848	1.8204E-01
45	0.9705	1.5875E-03		96	0.1509	2.0258E-01
46	0.9688	1.7068E-03		97	0.1205	2.2470E-01
47	0.9671	1.8336E-03		98	0.0940	2.4839E-01
48	0.9652	1.9643E-03		99	0.0715	2.7357E-01
49	0.9631	2.1003E-03		100	0.0530	3.0015E-01
50	0.9610	2.2481E-03		101	0.0227	8.4586E-01

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