Attributable mortality to secondhand tobacco smoke exposure in the 27 Brazilian federal units in 2019

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ABSTRACT

***Objectives**:* To estimate the mortality attributable to secondhand tobacco smoke (SHS) exposure among the population aged 35 years and older in Brazil and its 27 federal units in 2019.

Study Design: Attributable mortality analysis.

Methods: A prevalence-dependent method was applied. Mortality attributable to SHS exposure was estimated under two scenarios. In Scenario 1, attributable mortality from three causes (ischemic heart disease, lung cancer, and stroke) was calculated using the relative risks (RRs) reported by the Surgeon General. In Scenario 2, attributable mortality from eight causes (ischemic heart disease, lung cancer, stroke, COPD, type 2 diabetes mellitus, asthma, lower respiratory tract infections, and breast cancer) was calculated using RRs derived from a recent meta-analysis.

Results: Scenario 1: in 2019, SHS exposure caused 10,604 deaths in Brazil, 5,451 of which were due to ischemic heart disease, 830 to lung cancer and 4,323 to stroke. The attributable mortality rate due to SHS exposure varied across federal units, ranging from 5.6 deaths per 100,000 inhabitants in Amazonas to 16.1 in Piauí. Scenario 2: exposure to SHS caused 20,292 deaths, 5,258 of which were due to ischemic heart disease. In Scenario 2, mortality attributable to SHS exposure from lung cancer increased, while mortality from ischemic heart disease and stroke decreased compared to Scenario 1.

Conclusions: In Brazil, exposure to SHS is estimated to cause between 30 and 60 deaths per day. The mortality rates varied across federal units. Differences in the risk sources and the selection of health outcomes significantly influence mortality estimates. These findings underscore the importance of strengthening the enforcement of tobacco control policies by health authorities in Brazil.

Keywords**:** Secondhand tobacco smoke; Attributable mortality; Lung cancer; ischemic heart disease, stroke.

What is already known on this topic: SHS exposure increases the risk of death from diseases such as ischemic heart disease, lung cancer and stroke. To date, five studies have estimated the attributable mortality to SHS exposure in Brazil. However, none have provided estimates disaggregated by federal units or incorporated the most recent mortality risks.

What this study adds: This study estimates the number of deaths attributable to SHS exposure using two sources of risk: the Surgeon General's reports and a meta-analysis conducted by Flor et al. Based on the risks estimates from the Surgeon General's reports, SHS exposure accounted for 10,604 deaths in Brazil. In contrast, applying the relative risks from the meta-analysis by Flor et al. and expanding the number of health outcomes yielded an estimate of 20,292 SHS-attributable deaths. Moreover, the burden of attributable mortality varied across federal units.

How this study might affect research, practice or policy:

The results indicate that the mortality burden attributed to SHS exposure varies across Brazil's federal units. These differences should be considered by policymakers when designing tobacco control measures tailored to the needs of each federal unit. Furthermore, the use of the most recent evidence yields higher estimates of mortality attributable to SHS exposure.

INTRODUCTION

Secondhand tobacco smoke (SHS) represents a significant global threat to public health. According to the World Health Organization (WHO), SHS causes more than 1.6 million deaths annually among non-smokers worldwide [1]. U.S. Surgeon General's reports have established a causal relationship between SHS exposure and lung cancer and ischemic heart disease since 2006, and with stroke since 2014 [2,3]. Recent studies have concluded that such exposure also increases the risk of chronic obstructive pulmonary disease (COPD), type 2 diabetes mellitus, breast cancer, lower respiratory infections and asthma [4].

The development of smoke-free policies and the monitoring of the prevalence and the impact of SHS exposure on human health are two key elements in the control of the tobacco epidemic. Over the last 30 years, Brazil has made notable advancements in the implementation of Act 9.294/1996 [5] and its subsequent reforms, Act 12.546 [6] and Decree No. 8.262 [7], which prohibit the use of tobacco-related products in collectively used premises, both public and private, across the country. These legislative advances have positioned Brazil as one of the countries with the most stringent smoke-free policies according to the WHO [8].

According to data from the National Health and Nutrition Survey and the National Health Survey, the prevalence of tobacco use has decreased in Brazil from 33.4% in 1989 to 12.8% in 2019. Likewise, the prevalence of exposure to SHS also decreased from 31.7% in 1989 to 7.9% in 2019 [9–11]. The most recent data, from 2019, indicate that 9.2% of non-smokers are exposed to SHS at home and 8.4% are exposed in enclosed spaces at work [12]. Consequently, in 2019, it was estimated that the prevalence of SHS exposure at home varied across the federal units in Brazil, with figures ranging from 6.4% in Mato Grosso do Sul to 12.2% in Rio Grande do Norte [12].

Regarding the monitoring of SHS exposure impact on health, five studies have estimated the mortality attributable to SHS exposure in Brazil since 2003 [13–17]. However, none of these studies have estimated mortality attributable to SHS exposure at the federal unit level. Disaggregated federal-level attributable mortality data are essential for identifying regional disparities and informing targeted public health interventions. In addition, recent studies have identified additional diseases associated with SHS exposure, which should be incorporated into updated estimates [4].

The objective of this study was to estimate mortality attributable to SHS exposure among the population aged 35 years and older in Brazil and its 27 federal units in 2019, considering two scenarios. The first scenario focused on key diseases traditionally recognized as causally linked to SHS exposure—namely, ischemic heart disease, lung cancer, and stroke—while the second scenario incorporated additional health outcomes based on the most recent evidence [4].

METHOD

Brazil is made up of the following five major regions: North (N), Northeast (NE), Center-West (CW), Southeast (SE) and South (S), which are further divided into 27 federal units (Figure S1 of the supplementary material). In 2019, its population was estimated at 210,147,125 [8].

Calculation procedure

This study estimated mortality attributable to SHS exposure under two scenarios that included causes of death and relative risks (RRs) from two data sources: the Surgeon General reports and a meta-analysis. In both scenarios, we used a prevalence-dependent method based on the calculation of population attributable fractions (PAFs) [19]. The calculation was performed in accordance with the recommendations of the STREAMS-p tool [20].

The PAF of SHS exposure was calculated using the following formula:

$$PAF = \frac{(q + p \text{ x } RR) - 1}{q + p \text{ x } RR},$$

where p is the prevalence of SHS exposure, q = 1-p, and RR is the risk of dying due to causes of death linked to SHS exposure among persons exposed to SHS versus the unexposed.

Attributable mortality (AM) is obtained by multiplying the PAF by observed mortality (OM), such that:

AM= PAF x OM

Data sources

Observed mortality

Observed mortality among the population aged 35 years and older in Brazil's 27 federal units in 2019 was obtained from the Mortality Information System of Brazil's Unified Health System (*Sistema de Información de Mortalidad del Sistema Único de Salud de Brasil/ SIM-SUS*). Data on deaths due to underlying causes, classified according to the International Classification of Diseases, 10th revision (ICD-10), were available. Observed mortality data were extracted for those causes of death for which the Surgeon General reports [2,3] establish a causal relationship with exposure to SHS (Scenario 1) and for the causes established by the meta-analysis published by Flor et al (Scenario 2) [4]. The causes of death included from both sources can be consulted in table S1 of the supplementary material with their ICD 10 header diagnosis codes.

Prevalence of SHS exposure

SHS exposure prevalence among the population aged 35 years and older was calculated by sex for each of Brazil's federal units, based on microdata drawn from the 2019 National Health Survey, conducted by the Ministry of Health in collaboration with the Brazilian Geography and Statistics Institute (*Instituto Brasileño de Geografía y Estadística/IBGE*), on the population aged 15 years and older.

Self-reported prevalence of exposure to SHS was calculated based on responses to two questions. The first question was, "How often does someone smoke inside your home?", with the response options being, "1. Daily; 2. Weekly; 3. Monthly; or 4. Less than monthly,". The second question was, "Taking all your work tasks into consideration, over the last 30 days has anyone smoked in an enclosed space where you work?", with the response options being, "1. Yes; 2. No". A person exposed to SHS was defined as anyone whose answer to the first question was "Daily", "Weekly", "Monthly" or "Less than monthly", or who answered affirmatively to the second question.

Relative risks

For the first scenario, the RRs were obtained from Surgeon General's reports published in 2006 and 2014 [2,3]. These risks were extracted for ischemic heart disease (1.27, CI95% 1.19-1.36), lung cancer (1.16, CI95% 1.03-1.30), and stroke (1.25, CI95% 1.12-1.38). For the second scenario, the RRs were obtained from the meta-analysis published by Flor et al [4]. These risks were extracted for ischemic heart disease (1.26, CI95% 1.20-1.32), lung cancer (1.37, CI95% 1.30-1.45), stroke (1.16, CI95% 1.11-1.22), COPD (1,44, CI95%1.21-1.71), type 2 diabetes mellitus (1.16, CI95% 1.09-1.24), asthma (1.21, CI95% 1.16-1.26), lower respiratory tract infections (1.34, CI95% 1.23-1.45) and breast cancer (1.22, CI95% 1.13-1.31).

Data-analysis

Two analyses were performed based on two scenarios. In both scenarios, the same observed mortality and prevalence data were used, while the RRs and the number of causes of death differed. The mortality attributed to SHS exposure and crude attributable mortality rates were estimated for each Brazilian federal unit by sex. The attributable mortality estimates are shown accompanied by their 95% confidence intervals (95%CIs), which were calculated by applying a naïve Bootstrap method and Efron's percentile method [21]. In addition, a comparison of the estimations in both scenarios was conducted. In the results section, the federal units are presented with the initials of their respective regions in brackets. These abbreviations are also shown on the maps. Estimates were calculated with the Stata 17 statistics software program and spatial representation was performed using the QGIS 3.10 program.

RESULTS

Scenario 1

Exposure to SHS caused 10,604 deaths in the population aged 35 years and older. This figure represents 7.3% of all deaths due to ischemic heart disease, lung cancer and stroke occurring in Brazil in 2019. Of this total, 5,451 deaths were due to ischemic heart disease, 830 to lung cancer and 4,323 to stroke. Fifty-seven percent of all attributable mortality occurred in men (6,101 deaths) (Table 1).

Ischemic heart disease was the leading cause of death among men, accounting for 54.4% of total attributable mortality, and among women, accounting for 47.4%. The second leading cause of death was stroke, accounting for 37.6% and 45.1%, respectively, followed by lung cancer, accounting for 8.1% and 7.5% (Table 1).

The crude mortality rate attributable to SHS exposure among men ranged from 7.6 deaths/100,000 inhabitants in Mato Grosso (MT) and Amazonas (AM) to 18.9 deaths in Piauí (PI). Among women, this rate ranged from 3.5 in Amazonas to 13.6 in Paraíba (PB) (Figure 1). These rates also varied by cause of death and sex across the federal units. Among men, the mortality rate for ischaemic heart disease ranged from 3.6 deaths/ 100,000 inhabitants in Amazonas to 10.7 deaths in Rio Grande do Norte (RN); the rate for lung cancer ranged from 0.5 in Roraima (RR), Alagoas (AL), and Bahia (BA) to 2.2 in Rio Grande do Sul (RS); and the rate for stroke ranged from 2.9 in Mato Grosso to 8.4 in Piauí. Among women, the crude mortality rates were 1.2 for ischemic heart disease in Amazonas and 6.2 in Rio Grande do Norte; 0.3 for lung cancer in Amazonas and Mato Grosso, and 1.4 in Rio Grande do Sul; and 2.0 for stroke in Amazonas and Rondônia (RO), and 7.2 in Piauí (Table 1, Figures S2, S3 and S4 of the supplementary material).

Scenario 2

When the causes of death and RR derived from the meta-analysis were considered, it was estimated that exposure to SHS caused 20,292 deaths. Of this total, 5,258 deaths were due to ischemic heart disease, 4,731 to lower respiratory tract infections, 3,490 to COPD, 2,811 to stroke, 1,850 to lung cancer, 1,406 to type 2 diabetes mellitus, 664 to breast cancer and 81 to asthma. Fifty-four percent of deaths occurred in men (10,883 deaths). The leading cause of death was ischemic heart disease in both men and women, accounting for 29.4% and 21.9% of deaths, respectively (Table 2).

Regarding crude attributable mortality rates in both men and women, the variations were greatest between Amazonas (12.8 and 7.5 deaths/100,000 inhabitants, respectively) and Goiás (GO) and Paraíba (30.3 and 27.2 deaths, respectively). Amazonas and Mato Grosso were identified as the federal units with the lowest mortality rates for most of the causes of death analyzed in this study (Table 2). However, among the federal units with the highest mortality rates by cause of death, greater variability was observed. Rio Grande do Sul, Rio Grande do Norte, Paraíba and Piauí were highlighted as having the highest rates of ischemic heart disease, lung cancer and stroke (Tables S2 and S3 of the supplementary material).

Comparison of both scenarios

Applying RR from the Surgeon General's reports (Scenario 1), it was estimated that there would be more deaths from lung cancer and fewer from ischemic heart disease and stroke attributable to SHS exposure. Therefore, according to the total attributable mortality obtained in Scenario 1 (10,604 deaths), there is an increase in mortality of 9.6% for lung cancer and a decrease of 1.8% and 14.3% for ischemic heart disease and stroke, respectively (Table 3).

DISCUSSION

In 2019, at least 10,604 deaths in Brazil were attributable to SHS exposure among the population aged 35 years and older. The inclusion of additional health outcomes and updated risks estimates led to an increase in the number of deaths to 20,292. In both scenarios, ischemic heart disease represented the leading cause of SHS-attributable mortality. Attributable mortality rates varied across federal units, with Amazonas and Mato Grosso exhibiting the lowest rates.

Even though there have been previous estimations of attributable mortality to SHS exposure in Brazil, this is the first time it has been estimated at the federal unit level.

The earliest known estimate of mortality attributable to SHS in Brazil dates back to 2003, when 2,655 deaths were attributed to SHS exposure due to ischemic heart disease, lung cancer and stroke among individuals aged 35 years and over [13]. The population included in this first estimation were residents in urban clusters, never smokers, and exposed to SHS at home. In our study, we estimated that at least 10,000 deaths were attributable to SHS exposure due to ischemic heart disease, lung cancer and stroke regardless of the RR source used. This suggests that the mortality due to these causes of death appears to have tripled over a period of 16 years. However, direct comparison between the two studies is complicated. This is because the RRs used in our study differed from those used in the 2003 estimate and because our estimation refers to the whole country, whereas the previous study focused on urban clusters and covered 82.3% of the country's total population in 2003 [18].

Studies conducted in 2011 [14], 2015 [15] and 2020 [16] estimated annual deaths attributable to SHS exposure at approximately 17,000 deaths. However, these studies analyzed deaths attributable to SHS exposure from more causes than those included in either of the two analyses performed in this study, included a range of age groups, and considered the impact on childhood mortality.

A study conducted in 2012 [17] using the Surgeon General's RR for lung cancer, estimated that 431 lung cancer deaths were attributable to SHS exposure among individuals aged 20 years and older. Despite the differences in the age groups considered, the total number of lung cancer deaths attributable to SHS exposure doubled over the six-year period between 2012 and 2019. This increase may partly explained by improvements in the quality and coverage of Brazil's Death Registry in recent years, rated as high by the WHO since 2017 [22].

The results of this study show regional variations in the estimates of mortality attributable to SHS exposure, regardless of the RR source. Among the analyzed scenarios, the federal units with the highest mortality rates attributable to SHS exposure were Rio Grande do Norte, Piauí, and Rio Grande do Sul, while the federal units with the lowest rates were Amazonas and Mato Grosso. Similar variations were observed in a previous study on mortality attributable to tobacco use [23]. These differences could be explained by variations in observed mortality rates for the analyzed causes, the prevalence of tobacco use and SHS exposure or the socioeconomic status of the federal units.

Rio Grande do Norte, Piauí, and Paraíba have the highest SHS-attributable mortality due to cardiovascular diseases (i.e ischemic heart disease and stroke). These federal units are located in Brazil's Northeast Region, the least developed area of the country, accounting for 47.9% of national poverty [24]. They also have some of the lowest sociodemographic indices (SDI), which assess territorial development based on income, health, and education [25,26]. Consequently, populations in these regions have limited access to health services, resulting in poorer control of risk factors for cardiovascular diseases, including tobacco use, and higher mortality from ischemic heart disease and stroke. Mortality registry data support this, showing an increase in deaths from both diseases in the northern regions since 1996 [27]. Additionally, these federal units had in 2019 the highest prevalence of household exposure to SHS [12].

Rio Grande do Sul has the highest mortality rate due to lung cancer attributable to SHS exposure in both men and women. This can be explained by several factors. First, Rio Grande do Sul is the second federal unit with the highest prevalence of tobacco use (15.8%), and it experienced the smallest decrease in prevalence between 2013 and 2019 [18]. In addition, Rio Grande do Sul is Brazil’s leading tobacco producer, accounting for 41% of total national production [28]. Rio Grande do Sul is the federal unit with the highest prevalence of SHS exposure and biomass or firewood burning [29]. These risk factors are closely related to lung cancer and could explain why Rio Grande do Sul had the highest lung cancer observed and attributed mortality rate in Brazil in 2019 [30].

In contrast, Amazonas and Mato Grosso have the lowest mortality rates attributable to SHS exposure, particularly for ischemic heart disease, lung cancer, and stroke. Unlike the previously mentioned federal units, Amazonas and Mato Grosso have a high SDI. The SDI in Amazonas improved from low to high between 2010 and 2021, while Mato Grosso's has remained high since 2012 [25]. Higher SDI levels are associated with better control of disease risk factors, contributing to lower mortality [31]. A study analyzing historical cardiovascular disease mortality rates from 2000 to 2017 in Brazil reported declines in both Amazonas and Mato Grosso [32]. In addition, the prevalence of tobacco use and SHS exposure, especially in Amazonas, is among the lowest in the country [12].

This study compared estimates of SHS attributable mortality under two scenarios. The Scenario 1 included the three causes of death causally related with SHS exposure with the highest level of evidence (Level 1) according to the 2006 and 2014 Surgeon

General's reports [2,3]. RRs were also derived from these reports. However, a recently published meta-analysis concluded that SHS exposure increased the risk of developing other diseases, such as COPD, asthma, type 2 diabetes mellitus, breast cancer and lower respiratory tract infections [4], though the evidence that supported the association with these diseases was described as weak or very weak. Including these causes of death (Scenario 2) doubles the burden of attributable mortality to SHS exposure, which is estimated at over 20,000 deaths per year. In addition, when focusing on the specific causes of death analyzed in both scenarios (i.e., ischemic heart disease, lung cancer, and stroke), some differences arise. The attributable mortality burden decreased for ischemic heart disease and stroke, while it increased for lung cancer.

This study has limitations relating to the method of estimation and data sources used. The calculation process did not account for the induction period between SHS exposure and death, resulting in both indicators being concurrent in time. When it comes to the RRs applied, it should be noted that these were not sourced from studies conducted in Brazil. To date, however, they constitute the best evidence available.

This study also has advantages, the most important being the calculation of attributable mortality to SHS exposure by applying representative prevalence data by sex at the federal unit level. In addition, the same calculation process and the same data sources were used for estimating attributable mortality in the 27 federal units, allowing for comparison of results. The register from which the observed mortality data were drawn is of high quality. Thus, in 2019 only 3.6% of deaths among inhabitants aged 35 years and older were coded as ICD-10 R99, "Other ill-defined and unspecified causes of mortality", a so-called 'garbage code'. This study has estimated the mortality attributable to SHS exposure, taking into account the most recent available evidence. Moreover, we followed recommendations targeted at improving the quality of the estimations in the attribution of mortality to a risk factor included in the STREAMS-p tool [20].

CONCLUSIONS

In Brazil, exposure to SHS caused 10,604 deaths in 2019 due to ischemic heart disease, lung cancer, and stroke. However, this mortality increases to 20,292 deaths when additional causes of death and the most recent RRs are incorporated in the analysis. Mortality attributable to SHS exposure varied across federal units in both scenarios evaluated, with Amazonas and Mato Grosso consistently exhibiting the lowest rates, while Rio Grande do Sul, Rio Grande do Norte, Piauí, and Paraíba consistently displayed the highest, regardless of the scenario considered.

The results of this study highlight the need for the Brazilian health authorities to ensure country-wide compliance with smoking control laws. Public health measures should consider the characteristics of the different settings in which passive exposure to SHS may occur, as well as the differing social and cultural realities present in Brazil. Furthermore, there are still other tobacco control policies that remain to be implemented, and that could reduce smoking and, by extension, exposure to SHS. Among such measures are increased taxation and further restrictions on points of sale of tobacco products.

AUTHOR STATEMENTS

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Table 1. Attributable mortality (AM) and crude attributable mortality rates to secondhand tobacco smoke exposure by sex across the 27 federal units, based on Surgeon General's relative risks (Scenario 1). AM accompanied by 95% confidence intervals (95% CI) and rates per 100,000 inhabitants.

Federal units	Total		Men		Women	
	AM (95%CI)	**Crude rate**	**AM (95%CI)**	**Crude rate**	**AM (95%CI)**	**Crude rate**
Acre	29 (26 - 33)	10.2	18 (16 - 21)	12.8	11 (9 - 13)	7.7
Alagoas	155 (138 - 171)	11.2	80 (68 - 92)	12.5	75 (64 - 85)	10.1
Amapá	19 (16 - 23)	7.0	12 (10 - 15)	9.0	7 (5 - 9)	5.0
Amazonas	80 (71 - 89)	5.6	54 (47 - 63)	7.6	26 (21 - 30)	3.5
Bahia	562 (501 - 625)	8.1	306 (260 - 358)	9.2	256 (217 - 298)	7.1
Ceará	508 (471 - 549)	13.1	274 (243 - 304)	15.1	234 (209 - 257)	11.3
Distrito Federal	87 (76 - 99)	6.1	55 (46 - 65)	8.7	32 (26 - 38)	4.1
Espírito Santo	210 (186 - 232)	10.8	130 (111 - 149)	13.8	80 (68 - 91)	8.0
Goiás	390 (351 - 427)	12.4	241 (209 - 273)	15.8	148 (128 - 168)	9.2
Maranhão	318 (293 - 345)	12.2	185 (164 - 207)	14.8	133 (118 - 148)	9.8
Mato Grosso	95 (82 - 109)	6.4	57 (46 - 69)	7.6	37 (30 - 45)	5.1
Mato Grosso do Sul	160 (144 - 176)	13.0	101 (88 - 113)	16.8	59 (51 - 68)	9.4
Minas Gerais	1044 (961 - 1121)	10.0	605 (539 - 670)	12.0	439 (394 - 486)	8.1
Pará	282 (253 - 313)	9.0	165 (142 - 190)	10.5	117 (101 - 136)	7.4
Paraíba	276 (252 - 302)	15.3	144 (126 - 163)	17.3	132 (116 - 147)	13.6
Paraná	530 (476 - 584)	9.5	319 (274 - 362)	12.0	212 (182 - 242)	7.3
Pernambuco	562 (511 - 612)	13.3	312 (270 - 352)	16.0	250 (222 - 278)	11.0
Piauí	223 (201 - 249)	16.1	123 (106 - 140)	18.9	100 (85 - 116)	13.6
Rio de Janeiro	915 (843 - 988)	10.6	502 (444 - 559)	12.6	412 (369 - 455)	8.9
Rio Grande do Norte	217 (196 - 237)	13.8	127 (111 - 143)	17.1	90 (78 - 102)	10.9
Rio Grande do Sul	796 (730 - 862)	13.4	417 (365 - 469)	14.9	379 (334 - 426)	12.1
Rondônia	46 (40 - 53)	6.1	30 (24 - 35)	7.7	16 (13 - 20)	4.4
Roraima	16 (14 - 18)	9.0	10 (8- 12)	11.1	6 (5 - 7)	6.7
Santa Catarina	297 (267 - 326)	8.8	168 (145 - 188)	10.5	130 (113 - 147)	7.3
São Paulo	2622 (2393 - 2837)	11.5	1568 (1391 - 1576)	14.5	1054 (930 - 1175)	8.8
Sergipe	86 (77 - 95)	8.9	47 (41 - 55)	10.4	39 (34 - 45)	7.6
Tocantins	79 (71 - 88)	12.7	50 (43 - 58)	15.9	29 (24 - 33)	9.3

Table 2. Attributable mortality (AM) and crude attributable mortality rates to secondhand tobacco smoke exposure by sex across the 27 federal units, based on Flor's relative risks (Scenario 2). AM accompanied by 95% confidence intervals (95% CI) and rates per 100,000 inhabitants.

Federal units	Total		Men		Women	
	AM (95%CI)	Crude rate	AM (95%CI)	Crude rate	AM (95%CI)	Crude rate
Acre	58 (51 - 65)	20.0	37 (32 - 43)	26.3	20 (17 - 24)	13.9
Alagoas	269 (241 - 297)	19.5	129 (110 - 148)	20.2	140 (120 - 159)	19.0
Amapá	38 (32 - 45)	14.0	23 (17 - 28)	16.3	16 (12 - 20)	11.6
Amazonas	146 (129 - 162)	10.1	92 (78 - 106)	12.8	54 (45 - 64)	7.5
Bahia	971 (865 - 1080)	14.0	493 (419 - 576)	14.8	479 (406 - 556)	13.2
Ceará	946 (876 - 1023)	24.4	458 (406 - 509)	25.2	488 (437 - 536)	23.6
Distrito Federal	151 (132 - 171)	10.6	88 (73 - 104)	13.9	64 (52 - 75)	8.0
Espírito Santo	367 (326 - 405)	18.9	218 (187 - 248)	23.1	149 (127 - 171)	15.0
Goiás	810 (732 - 885)	25.8	463 (401 - 522)	30.3	347 (301 - 392)	21.5
Maranhão	487 (448 - 526)	18.7	265 (235 - 296)	21.2	222 (197 - 247)	16.3
Mato Grosso	188 (164 - 215)	12.7	106 (86 - 128)	14.1	82 (66 - 99)	11.2
Mato Grosso do Sul	292 (263 - 322)	23.7	175 (153 - 197)	29.0	117 (101 - 134)	18.6
Minas Gerais	2287 (2110 - 2456)	21.9	1239 (1107 - 1370)	24.5	1048 (941 - 1161)	19.4
Pará	515 (464 - 570)	16.3	278 (239 - 321)	17.7	236 (203 - 274)	15.0
Paraíba	514 (468 - 561)	28.5	250 (219 - 282)	30.0	263 (231 - 295)	27.2
Paraná	1065 (957 - 1169)	19.1	589 (508 - 668)	22.1	476 (409 - 544)	16.4
Pernambuco	951 (867 - 1033)	22.5	486 (422 - 549)	25.0	464 (412 - 516)	20.4
Piauí	382 (346 - 425)	27.5	193 (167 - 220)	29.8	189 (160 - 218)	25.5
Rio de Janeiro	1771 (1635 - 1909)	20.5	896 (792 - 995)	22.4	876 (783 - 966)	18.9
Rio Grande do Norte	386 (349 - 421)	24.6	207 (181 - 234)	27.9	179 (156 - 202)	21.6
Rio Grande do Sul	1622 (1492 - 1751)	27.4	807 (708 - 907)	28.8	814 (720 - 915)	26.0
Rondônia	95 (82 - 109)	12.6	58 (47 - 69)	15.0	38 (30 - 47)	10.1
Roraima	28 (25 - 32)	15.8	16 (13 - 19)	17.2	13 (10 - 15)	14.4
Santa Catarina	607 (547 - 665)	18.1	320 (276 - 359)	20.1	287 (250 - 325)	16.2
São Paulo	5047 (4615 - 5454)	22.1	2834 (2517 - 3171)	26.2	2213 (1954 - 2463)	18.5
Sergipe	162 (146 - 179)	16.7	81 (70 - 94)	17.8	81 (69 - 93)	15.7
Tocantis	136 (121 - 151)	21.7	81 (70 - 94)	25.6	55 (46 - 63)	17.6

Table 3. Impact of alternative scenarios on the global estimate of attributable mortality.

Considerations of Scenario 1	**Considerations of Scenario 2**	**AM obtained in Scenario 1**	**AM obtained in Scenario 2**	**Effect on overall AM obtained in Scenario 1**
Risk of ischemic heart disease sourced from the SG's report	Risk of ischemic heart disease sourced from Flor et al.	5,451	5,258	Decrease of 1.8%
Risk of lung cancer sourced from the SG's report	Risk of lung cancer sourced from Flor et al.	830	1,850	Increase of 9.6%
Risk of stroke sourced from the SG's report	Risk of stroke sourced from Flor et al.	4,323	2,811	Decrease of 14.3%
No evidence of association with type 2 DM	Evidence of association between SHS and type 2 DM. Risk of type 2 DM sourced from Flor et al.	-	1,406	Increase of 13.3%
No evidence of association with asthma	Evidence of association between SHS and asthma. Risk of asthma sourced from Flor et al.	-	81	Increase of 0.8%
No evidence of association with breast cancer	Evidence of association between SHS and breast cancer. Risk of breast cancer sourced from Flor et al.	-	664	Increase of 6.3%
No evidence of association with lower respiratory tract infections	Evidence of association between SHS and lower respiratory tract infections. Risk of lower respiratory tract infections sourced from Flor et al.	-	4,731	Increase of 44.6%

SG: Surgeon General; COPD: chronic obstructive pulmonary disease; DM: diabetes mellitus; SHS: secondhand smoke; AM: attributable mortality.

Figures

Figure 1. Crude mortality rates attributable to secondhand tobacco smoke exposure from ischemic heart disease, lung cancer, and stroke. Rates per 100,000 inhabitants by sex and federal unit: 2019.