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Global, Regional, and National Burden of Lower Respiratory Infections Attributable to Smoking from 1990 to 2021, and Projections Until 2030

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ABSTRACT

Background: Lower respiratory infections (LRIs) are a significant global health issue, and smoking is a notable risk factor.

Methods: Data on deaths and disability-adjusted life years (DALYs) were extracted from the Global Burden of Disease (GBD) 2021. The estimated annual percentage changes (EAPCs) were used to assess trends. Decomposition analysis was performed to evaluate the effects of population growth, aging, and epidemiological changes. Bayesian age-period-cohort analysis was used to generate projections.

Findings: In 2021, the age-standardized death and DALY rates of smoking-attributable LRIs were 2.32 (95% uncertainty interval (UI): 1.8 to 2.83) and 52.04 (95% UI: 40.58 to 62.91) per 100,000 population. The number of deaths were 193,484 (95% UI: 150,393 to 236,120) and DALYs reached 4,455,405 (95% UI: 3,472,541 to 5,382,343), significantly influenced by population growth and aging, particularly in regions with a middle sociodemographic index (SDI). South Asia recorded the highest numbers, while the highest rates were observed in Southern Sub-Saharan Africa. The high SDI regions experienced the most significant decreases, notably in Finland and Ireland, whereas the low to middle SDI regions bore a significantly high burden. The number of deaths and DALYs peaked in the 70-74 and 60-64 age groups, with rates increasing with age. Men carried a disproportionately higher disease burden than women. Projections indicate declines in death and DALYs by 2030 to 153,868 (95% CI: 87,473 to 220,262) and 3,361,019 (95% CI: 1,908,951 to 4,813,087) respectively, with rates expected to decrease to 1.37 (95% CI: 0.8 to 1.95) per 100,000 for deaths and 30.8 (95% CI: 17.92 to 43.68) per 100,000 for DALYs.

Conclusions: Despite declines in smoking-attributable LRIs, smoking continues to pose a substantial risk, especially in lower SDI regions and older males. These disparities underscore the critical need to prioritize efficacious and targeted smoking cessation strategies to enhance LRI management.

Keywords: Lower Respiratory Infections; Smoking; Global Burden; Epidemiology; Deaths; Disability-Adjusted Life Years

Abbreviations: DALYS: Disability-Adjusted Life Years; EAPC: Estimated Annual Percentage Changes; SDI: Social-Demographic Index; GBD: Global Burden of Disease; ASRs: Age-Standardized Rates; CI: Confidence Interval; GAPPD: Global Action Plan for Pneumonia and Diarrhea; LRIS: Lower Respiratory Infections; UI: Uncertainty Interval; YLDS: Years Lived with Disability; YLLS: Years of Life Lost

Introduction

Lower respiratory infections (LRIs), as defined by the Global Burden of Disease Study (GBD), comprise clinician-diagnosed pneumonia or bronchiolitis, posing a significant global health threat with an annual toll exceeding 2 million deaths. [1] High-risk individuals often encounter challenges in accessing clean cooking fuel, adequate sanitation, and optimal temperatures. [2] Despite advancements in combating LRIs, resulting in a decline in LRI incidence and mortality worldwide, particularly among children under 5 years old, there is a lack of emphasis on assessing modifiable risk factors. [1,2] Smoking is a well-established causative factor for LRIs, contributing to over 20% of incident cases and deaths from respiratory infections. [2,3] Smok-

ing has imposed a significant global health burden, resulting in over 200 million deaths worldwide in the past three decades, with more than half of smokers succumbing to smoking-related illnesses. [4] It contains over 250 chemical components that are toxic or carcinogenic and can damage nearly all organs of the human body. [5] In the respiratory tract, smoking can harm alveolar epithelial cells, trigger the release of inflammatory mediators, impact immune responses, reduce cough reflex sensitivity, and lead to ciliary dysfunction, compromising pathogen clearance. [5,6] Kark et al. found that smokers are more likely to contract influenza than non-smokers and experience more severe symptoms [7].

A review of 27 studies revealed that current smokers double their likelihood of contracting community-acquired pneumonia. [8] Furthermore, smoking can weaken the protective effect of vaccines, increase the pathogen load after infection, and worsen tissue lesions. [9] During the COVID-19 pandemic, smokers exhibited increased odds of COVID-19 diagnosis and were 50% more likely to have severe symptoms and complications such as pneumonia. [10] Despite a decline in smoking prevalence in recent years, it remains a predominant risk factor for deaths associated with respiratory infections, particularly among adult males. [4] Smoking accounts for around one-third of fatalities from LRIs in males aged 50–69 years. [2] Promoting smoking cessation and providing education are the most pragmatic and cost-effective preventive strategies to mitigate tobacco-induced disease progression. [3,11] Understanding the evolving landscape of smoking-attributable LRIs is crucial for efficient allocation of public health resources and clinical decision-making. This study systematically analyzed the global, regional, and national burden of smoking-attributable LRIs using data from GBD 2021, a comprehensive global initiative providing estimates of various diseases, injuries, and risk factors. The aim was to provide insights into the development of policies, allocation of resources, and enhancement of clinical practices.

Materials and Methods

Data Source

Data on deaths and disability-adjusted life years (DALYs) of smoking-attributable LRIs were obtained from the GBD 2021 result tool. [12] The GBD study is a global initiative offering estimates of various diseases and injuries among diverse regions and demographics. In the GBD study, LRIs was defined as clinician-diagnosed pneumonia or bronchiolitis. Smoking is characterized by the use of any smoked tobacco product, whether present or previous, either daily or sporadically.

The mortality data for LRIs were obtained from vital registrations, verbal autopsies, and surveillance. The incidence and prevalence data for LRIs were sourced from systematic literature reviews, population-based surveys, claims data, and inpatient records. The years of life lost (YLLs) were calculated by multiplying the estimated mortality in each age group by the remaining life expectancy. Years of disability (YLDs) were computed by multiplying the prevalence of each severity category by the disability weight. Disability-adjusted life years (DALYs) were determined as the sum of YLLs and YLDs, which is a widely recognized composite indicator of disease burden. Attributable burden refers to the potential decrease in the existing disease burden that could have occurred if past population exposure had transitioned to an alternative or hypothetical risk exposure distribution. The burden of smoking attributable-LRIs was determined by multiplying population attributable fractions with the corresponding burden of LRIs based on sex, age, year, and location. [13] More details about the GBD study can be found in the **supplemental content** (Supplemental Methods).

Descriptive Analysis

Percentage changes were calculated to assess the trends in the absolute numbers of smoking-attributable LRI deaths and DALYs between 1990 and 2021. The formula used was as follows: Percentage change = (number2021 – number1990)/number1990. The estimated annual percentage change (EAPC) was employed to analyze trends in age-standardized rates (ASRs). [14] The EAPC and its 95% CI were derived using a linear regression model: EAPC = (exp(β) - 1) × 100, where β represents the regression coefficient of the year independent variable. An EAPC exceeding zero with a 95% CI signifies a rising trend, whereas an EAPC below zero with a 95% CI denotes a declining trend. A world map was generated to illustrate EAPCs on a national scale. These analyses were conducted using R version 4.4.0. The text in this study was polished and significantly improved using Stork's Writing Assistant (https://www.storkapp.me/writeassistant/). The text and figures have been further improved by American Journal Experts (AJE) (https://china.aje.com/cn/home/). The infographic was generated using Figdraw (https://www.figdraw.com/static/index.html#/).

Decomposition Analysis

Applying Das Gupta's decomposition analysis, this study aimed to determine the specific contributions of population growth, aging, and epidemiological changes to the fluctuations in deaths and DALYs numbers observed between 1990 and 2021 [15].

$$Number\ of\ deaths_y = \left(\sum_i a_{i,y} * p_y * e_{i,y}\right) * 100{,}00$$

where i represents the age group, $a_{i,y}$ denotes the proportion of the total population in age group i in year y, p_y signifies the total population in year y, and $e_{i,y}$ indicates the age-standardized death rate in year y. Specifically, epidemiological changes involve shifts in the distribution and determinants of health conditions in populations, which are influenced by factors such as environmental conditions, genetics, socioeconomic status, and policies. These changes can be quantified as follows,

$$effect = \left[\frac{a_{1990} * p_{1990} + a_{2021} * p_{2021}}{3} + \frac{a_{1990} * p_{2021} + a_{2021} * p_{1990}}{6} \right] * \left(e_{2021} - e_{1990} \right)$$

Projections of Future Burden

The Bayesian age-period-cohort (BAPC) model was applied to project the future burden of smoking-attributable LRIs until 2030, integrating Integrated Nested Laplace Approximations for robust trend forecasting. [16] The probabilistic forecasts from the BAPC model demonstrated good calibration and precision, indicating high predictive accuracy in capturing temporal patterns and dynamics, which facilitates the anticipation of the evolving epidemiological landscape of the burden of smoking-attributable LRIs. Deaths and DALYs were segmented into five-year age-group intervals, and population data up to 2030 were aggregated to produce forecasts.

Ethics Statement

This study involved a secondary analysis of the GBD 2021, with no inclusion of animal or human studies, or potentially identifiable human images or data.

Results

Global Deaths and DALYs Of LRIs Attributable to Smoking

In 2021, smoking was responsible for 193,484 deaths (95% UI: 150,393 to 236,120), indicating a 22.89% increase from 1990 levels. The age-standardized death rate decreased from 4.44 (95% UI: 3.51 to 5.43) per 100,000 population in 1990 to 2.32 (95% UI: 1.8 to 2.83) per 100,000 population in 2021, with an EAPC of -2.062 (95% CI: -2.179 to -1.945). DALYs reached 4,455,405 (95% UI: 3,472,541 to 5,382,343) in 2021, with a 13.95% increase from 1990. The age-standardized DALY rate decreased from 97.81 (95% UI: 78.27 to 118.26) in 1990 to 52.04 (95% UI: 40.58 to 62.91) in 2021, with an EAPC of -2.02 (95% CI: -2.157 to -1.884) (Table 1).

Table 1: The deaths and disability-adjusted life years of lower respiratory infections attributable to smoking in 1990 and 2021, and the temporal trends from 1990 to 2021.

	Deaths						DALYs					
	Deaths number			Age-standardized deaths rate			DALYs number			Age-standardized DALYs rate		
	1990 (95%UI)	2021 (95%UI)	Percent change %	1990 (95%UI)	2021 (95%UI)	EAPC	1990 (95%UI)	2021 (95%UI)	Percent Change %	1990 (95%UI)	2021 (95%UI)	EAPC
Global	157445 (125118 to 191410)	193484 (150393 to 236120)	22.89	4.44 (3.51 to 5.43)	2.32 (1.8 to 2.83)	-2.062 (-2.179 to -1.945)	3910085 (3145250 to 4711670)	4455405 (3472541 to 5382343)	13.95	97.81 (78.27 to 118.26)	52.04 (40.58 to 62.91)	-2.02 (-2.157 to -1.884)
Sex												
Male	128049 (102355 to 154906)	162963 (127084 to 197942)	27.27	8.55 (6.76 to 10.44)	4.46 (3.48 to 5.44)	-2.071 (-2.18 to -1.961)	3277105 (2645063 to 3924172)	3822733 (2989222 to 4566511)	16.65	179.68 (144.18 to 216.65)	95.88 (74.85 to 114.96)	-2.025 (-2.16 to -1.889)
Female	29396 (22021 to 37336)	30521 (22501 to 40476)	3.83	1.53 (1.14 to 1.96)	0.66 (0.48 to 0.87)	-2.641 (-2.804 to -2.479)	632979 (482064 to 789019)	632672 (480758 to 825429)	0	30.39 (23.18 to 38.16)	13.86 (10.55 to 18.03)	-2.387 (-2.521 to -2.254)
SDI region												
High SDI	45726 (35606 to 56756)	32595 (24779 to 41364)	-28.72	4.16 (3.23 to 5.16)	1.44 (1.11 to 1.81)	-3.306 (-3.508 to -3.103)	890081 (706022 to 1082959)	595243 (462496 to 744339)	-33.12	81.86 (65 to 99.56)	30.6 (23.92 to 38.1)	-3.023 (-3.229 to -2.817)
High-middle SDI	25534 (20566 to 30804)	36584 (28557 to 45194)	43.28	2.87 (2.29 to 3.5)	1.93 (1.51 to 2.38)	-1.339 (-1.745 to -0.932)	674016 (548846 to 800835)	873215 (697912 to 1059586)	29.55	68.15 (55.35 to 81.45)	47.15 (37.68 to 57.09)	-1.382 (-1.967 to -0.793)

Middle SDI	43738 (35245 to 52789)	59954 (46453 to 73317)	37.08	5.14 (4.08 to 6.26)	2.5 (1.91 to 3.07)	-2.335 (-2.419 to -2.252)	1169681 (949620 to 1388535)	1356699 (1060884 to 1642451)	15.99	110.38 (89.2 to 132.48)	51.47 (40.2 to 62.55)	-2.455 (-2.535 to -2.375)
Low-middle SDI	30032 (23262 to 36874)	48498 (36706 to 60905)	61.48	5.62 (4.29 to 6.96)	3.79 (2.87 to 4.8)	-1.007 (-1.118 to -0.897)	815444 (639610 to 997008)	1175603 (896221 to 1465422)	44.17	128.44 (99.73 to 157.3)	81.21 (61.76 to 101.35)	-1.274 (-1.358 to -1.189)
Low SDI	12263 (9315 to 15684)	15675 (11836 to 19604)	27.82	6.03 (4.57 to 7.77)	3.39 (2.55 to 4.28)	-1.821 (-1.944 to -1.697)	356758 (272296 to 457267)	450187 (342534 to 559476)	26.19	145.95 (111.11 to 186.62)	80.18 (60.78 to 99.77)	-1.973 (-2.078 to -1.868)
GBD region												
Andean Latin America	896 (668 to 1141)	1584 (1130 to 2204)	76.73	4.73 (3.49 to 6.12)	2.75 (1.97 to 3.84)	-1.606 (-1.78 to -1.432)	21841 (16324 to 27641)	35493 (25591 to 49760)	62.5	102.11 (76.61 to 129.44)	58.89 (42.36 to 82.62)	-1.647 (-1.816 to -1.479)
Australasia	291 (223 to 372)	220 (155 to 301)	-24.55	1.29 (0.99 to 1.65)	0.38 (0.27 to 0.51)	-3.3 (-3.801 to -2.797)	6235 (4837 to 7800)	3926 (2907 to 5131)	-37.04	27.24 (21.19 to 34.09)	7.98 (6.05 to 10.2)	-3.314 (-3.805 to -2.821)
Caribbean	875 (661 to 1102)	1223 (918 to 1585)	39.78	3.65 (2.73 to 4.65)	2.24 (1.69 to 2.91)	-1.838 (-2.171 to -1.503)	20718 (15839 to 26037)	27231 (20725 to 34873)	31.44	79.32 (60.74 to 99.34)	50.69 (38.54 to 64.82)	-1.753 (-2.09 to -1.415)
Central Asia	909 (730 to 1094)	1601 (1256 to 1958)	76.14	1.85 (1.48 to 2.24)	1.9 (1.48 to 2.32)	0.143 (-0.258 to 0.546)	31993 (25919 to 38306)	51842 (40985 to 62951)	62.04	61.65 (49.8 to 73.87)	55.71 (43.89 to 67.72)	-0.448 (-0.952 to 0.059)
Central Europe	4400 (3507 to 5276)	4534 (3471 to 5662)	3.04	3.07 (2.45 to 3.69)	2.21 (1.7 to 2.75)	-1.033 (-1.333 to -0.732)	127386 (102909 to 150187)	117549 (91497 to 144501)	-7.72	87.59 (70.84 to 103.08)	63.49 (49.69 to 77.46)	-1.032 (-1.338 to -0.724)
Central Latin America	2602 (2030 to 3223)	3276 (2454 to 4158)	25.92	3.46 (2.66 to 4.3)	1.32 (0.99 to 1.68)	-3.049 (-3.482 to -2.614)	68012 (53932 to 83326)	87079 (66142 to 109604)	28.03	75.9 (59.72 to 93.33)	33.69 (25.56 to 42.54)	-2.592 (-3.064 to -2.118)
Central Sub-Saharan Africa	1460 (982 to 2169)	2536 (1752 to 3641)	73.74	6.5 (4.4 to 9.59)	4.34 (3.05 to 6.11)	-1.207 (-1.418 to -0.994)	46795 (31318 to 69482)	84690 (57951 to 122115)	80.98	176.23 (118.33 to 260.11)	120.37 (83.22 to 172.75)	-1.135 (-1.324 to -0.946)
East Asia	33883 (25733 to 42240)	39004 (28705 to 50426)	15.11	5.77 (4.37 to 7.18)	2.14 (1.58 to 2.77)	-3.523 (-3.654 to -3.391)	817133 (625543 to 1014854)	704506 (527405 to 912419)	-13.78	104.92 (80.1 to 130.56)	35.5 (26.46 to 45.86)	-3.819 (-3.975 to -3.661)
Eastern Europe	3780 (3106 to 4424)	7877 (6282 to 9492)	108.36	1.4 (1.15 to 1.64)	2.61 (2.08 to 3.14)	1.026 (-0.552 to 2.629)	139041 (114690 to 161978)	285240 (227775 to 341790)	105.15	52.55 (43.43 to 61.23)	99.83 (79.5 to 119.83)	0.938 (-0.715 to 2.619)
Eastern Sub-Saharan Africa	5846 (4436 to 7436)	6446 (4955 to 8042)	10.26	8.67 (6.56 to 11)	4.01 (3.07 to 5.02)	-2.716 (-2.856 to -2.577)	171067 (130297 to 217032)	195052 (150033 to 243240)	14.02	209.22 (159.02 to 265.23)	98.36 (75.59 to 122.65)	-2.65 (-2.776 to -2.523)
High-income Asia Pacific	13524 (10667 to 16490)	10276 (7459 to 13543)	-24.01	7.48 (5.83 to 9.21)	1.75 (1.31 to 2.24)	-4.341 (-4.54 to -4.142)	247041 (198127 to 296810)	150763 (114069 to 191726)	-38.97	127.92 (101.75 to 154.5)	31.13 (24.08 to 39.03)	-4.19 (-4.403 to -3.977)

High-income North America	12845 (9795 to 16312)	7092 (5240 to 9238)	-44.79	3.58 (2.74 to 4.54)	1.1 (0.82 to 1.41)	-3.548 (-3.895 to -3.2)	273223 (212471 to 337209)	158195 (119640 to 200945)	-42.1	79.78 (62.13 to 98.07)	27.4 (20.92 to 34.67)	-3.111 (-3.499 to -2.721)
North Africa and Middle East	5103 (3963 to 6381)	9328 (7016 to 11893)	82.78	3.35 (2.57 to 4.22)	2.27 (1.7 to 2.9)	-0.846 (-0.971 to -0.722)	144801 (113087 to 178370)	247196 (187533 to 313151)	70.71	79.05 (61.55 to 98.36)	50.47 (38.21 to 64.04)	-1.056 (-1.167 to -0.944)
Oceania	164 (117 to 213)	262 (192 to 363)	59.35	5.49 (4 to 7.06)	3.29 (2.4 to 4.58)	-1.498 (-1.597 to -1.398)	5537 (3979 to 7190)	8974 (6625 to 12448)	62.06	151.65 (108.58 to 196.17)	93.9 (69.04 to 130.33)	-1.383 (-1.487 to -1.28)
South Asia	25108 (19113 to 31194)	41704 (30622 to 53858)	66.1	5.25 (3.88 to 6.6)	3.29 (2.42 to 4.26)	-1.323 (-1.469 to -1.177)	666884 (514091 to 824717)	940981 (687882 to 1207908)	41.1	114.87 (87.71 to 142.45)	65.57 (48.14 to 84.25)	-1.686 (-1.784 to -1.587)
Southeast Asia	13196 (10327 to 16709)	25239 (19763 to 31141)	91.27	5.78 (4.48 to 7.37)	4.41 (3.46 to 5.46)	-0.401 (-0.593 to -0.209)	366750 (288914 to 463367)	611584 (477894 to 755051)	66.76	133.83 (105.01 to 169.32)	93.18 (72.82 to 115.35)	-0.759 (-0.913 to -0.605)
Southern Latin America	1438 (1120 to 1778)	2911 (2144 to 3740)	102.51	3.15 (2.44 to 3.91)	3.36 (2.49 to 4.3)	1.418 (1.067 to 1.771)	41083 (32173 to 49977)	72932 (55270 to 90800)	77.52	88.07 (69 to 107.17)	87.57 (66.58 to 108.62)	1.185 (0.853 to 1.519)
Southern Sub-Saharan Africa	3383 (2628 to 4197)	4114 (3176 to 5175)	21.58	12.02 (9.31 to 15.08)	6.6 (5.11 to 8.4)	-1.509 (-2.023 to -0.992)	115203 (90959 to 140767)	139474 (107798 to 174413)	21.07	348.71 (273.49 to 429.12)	200.88 (155.32 to 251.9)	-1.325 (-1.873 to -0.774)
Tropical Latin America	6076 (4802 to 7411)	8285 (6084 to 10783)	36.35	7.14 (5.53 to 8.81)	3.28 (2.4 to 4.27)	-1.905 (-2.331 to -1.477)	174373 (139887 to 208232)	196955 (147421 to 254529)	12.95	173.15 (138.47 to 208.2)	75.7 (56.64 to 97.9)	-2.252 (-2.632 to -1.871)
Western Europe	18437 (14228 to 22995)	11053 (8153 to 14205)	-40.05	3.17 (2.44 to 3.96)	1.03 (0.77 to 1.31)	-3.701 (-4.07 to -3.331)	328213 (258509 to 400974)	182030 (137436 to 229301)	-44.54	59.04 (46.71 to 71.91)	20.55 (15.68 to 25.64)	-3.482 (-3.836 to -3.127)
Western Sub-Saharan Africa	3229 (2417 to 4133)	4920 (3524 to 6297)	52.37	3.83 (2.87 to 4.87)	2.5 (1.81 to 3.21)	-1.283 (-1.468 to -1.099)	96756 (71885 to 124925)	153714 (109770 to 198627)	58.87	98.53 (73.77 to 125.95)	64.52 (46.21 to 82.86)	-1.298 (-1.501 to -1.095)

Abbreviations: DALYs, disability-adjusted life years; EAPC, estimated annual percentage changes; SDI, social-demographic index; GBD, global burden of disease.

Regional Deaths and DALYs of LRIs Attributable to Smoking

In 2021, South Asia had the highest number of deaths and DALYs related to smoking-attributable LRIs at 41,704 (95% UI: 30,622 to 53,858) and 940,981 (95%UI: 687,882 to 1,207,908) respectively, followed by East Asia and Southeast Asia. The age-standardized death and DALY rates were most pronounced in Southern Sub-Saharan Africa at 6.6 (95%UI: 5.11 to 8.4) and 200.88 (95%UI: 155.32 to 251.9) in 2021, and lowest in Australasia at 0.38 (95%UI: 0.27 to 0.51) and 7.98 (95%UI: 6.05 to 10.2) respectively. Eastern Europe exhibited the highest rise in death and DALY numbers compared with 1990, whereas High-income North America and Western Europe witnessed the most significant decline.

Between 1990 and 2021, age-standardized death and DALY rates decreased across most regions, except for Southern Latin America, Eastern Europe, and Central Asia. The most notable reduction in these rates occurred in High-income Asia Pacific, showing EAPCs of -4.341 (95% CI: -4.54 to -4.142) and -4.19 (95% CI: -4.403 to -3.977) for death and DALY rates, respectively (Table 1). Males exhibited higher ASRs across all regions, particularly in Central Sub-Saharan Africa, Eastern Europe, and Southern Sub-Saharan Africa (Supplementary Figures 1 & 2).

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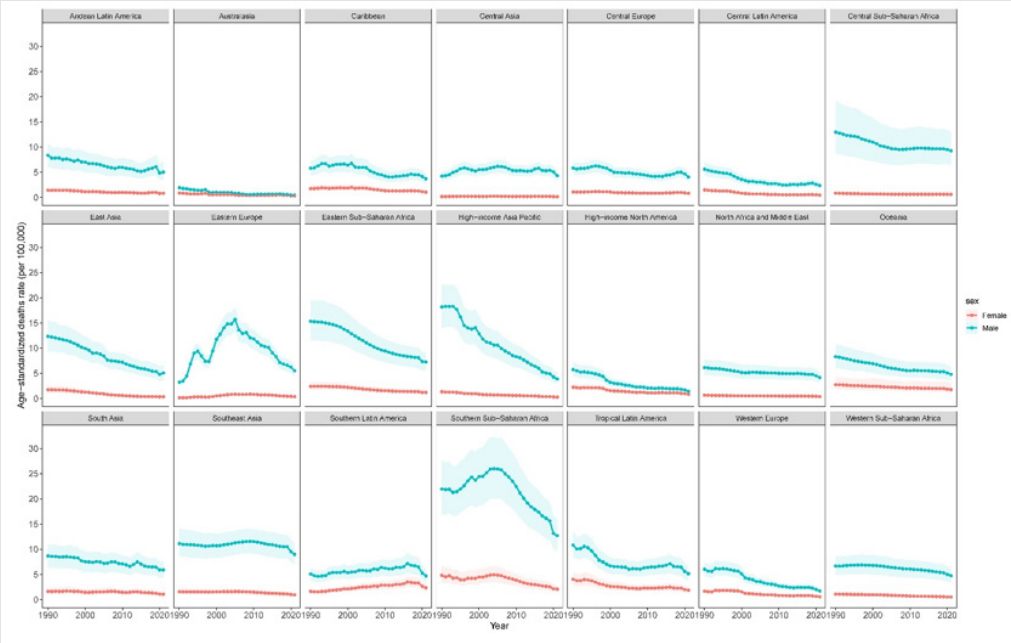
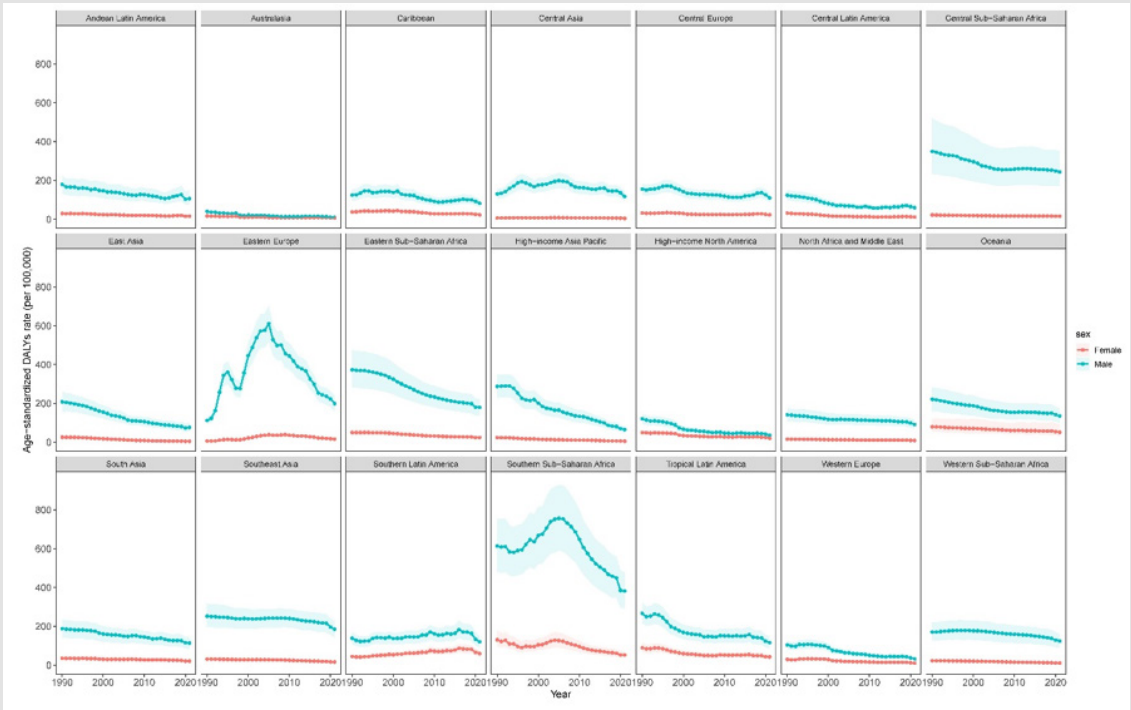


Supplementary Figure 1: Age-standardized deaths rate of smoking-attributable LRIs in 21 regions by sex, 1990–2021.



Supplementary Figure 2: Age-standardized DALYs rate of smoking-attributable LRIs in 21 regions by sex, 1990–2021.

National Deaths and DALYs of LRIs Attributable to Smoking

In 2021, the highest number of deaths occurred in China (36,644, 95% UI: 26,889 to 47,789), India (34,342, 95% UI: 24,983 to 44,324), and Brazil (8,108, 95% UI: 5,951 to 10,559), and the highest number of DALYs was observed in India (769,283, 95%UI: 564,173 to 986,258), China (659,409, 95%UI: 491,315 to 861,139), and the Russian Federation (204,249, 95%UI: 162,465 to 247,559). The age-standardized death rate was highest in Zimbabwe (16.59, 95% UI: 11.29 to 23.02) and lowest in Finland (0.34, 95% UI: 0.25 to 0.43), while the age-standardized DALY rate was highest in Lesotho (466.69, 95%UI: 317.99 to 648.51) and lowest in San Marino (6.61, 95% UI: 3.59 to 10.62) in 2021 (Supplementary Tables 1 and 2). Over the 32-year period, twenty-three countries showed an increasing trend in the age-standardized death rate while eight countries exhibited an increasing trend in age-standardized DALY rate. Finland (deaths: EAPC=-7.986, 95% CI: -8.79 to -7.175; DALYs: EAPC=-7.088, 95%CI: -7.707 to -6.464) and Ireland (deaths: EAPC=-7.01, 95% CI: -7.611 to -6.404; DALYs: EAPC=-6.821, 95%CI: -7.407 to -6.231) demonstrated the largest decrease in age-standardized death and DALY rates from 1990 to 2021 (Figure 1).

Supplementary Table 1: National deaths numbers and age-standardized rates of smoking-attributable LRIs in 1990 and 2021, and temporal trends from 1990 to 2021.

	Deaths Number			Age-standardized deaths Rate		
	1990 (95%UI)	2021(95%UI)	Percent change, %	1990	2021	EAPC
Afghanistan	182 (118 to 257)	212 (138 to 302)	16.13	2.96 (1.94 to 4.22)	2.21 (1.41 to 3.1)	-0.439 (-0.873 to -0.003)
Albania	131 (99 to 165)	97 (68 to 131)	-26.34	7.56 (5.66 to 9.56)	2.42 (1.71 to 3.3)	-3.287 (-3.804 to -2.767)
Algeria	321 (226 to 443)	553 (377 to 758)	72.07	4.43 (2.99 to 6.19)	2.32 (1.52 to 3.22)	-1.495 (-1.687 to -1.303)
American Samoa	1 (1 to 1)	1 (1 to 2)	46.97	4.22 (3.07 to 5.63)	3.11 (2.19 to 4.24)	-1.133 (-1.284 to -0.983)
Andorra	1 (1 to 1)	1 (1 to 2)	16.03	1.84 (1.15 to 2.63)	0.64 (0.38 to 0.95)	-2.672 (-2.992 to -2.35)
Angola	384 (264 to 536)	790 (537 to 1081)	105.98	9.99 (6.85 to 13.98)	6.72 (4.56 to 9.29)	-1.198 (-1.416 to -0.979)
Antigua and Barbuda	1 (1 to 2)	1 (1 to 2)	24.74	2.08 (1.48 to 2.8)	1.44 (1.02 to 1.95)	-1.23 (-1.485 to -0.975)
Argentina	847 (651 to 1058)	2602 (1922 to 3373)	207.29	2.66 (2.03 to 3.37)	4.68 (3.47 to 6.03)	3.166 (2.639 to 3.696)
Armenia	44 (36 to 53)	131 (99 to 163)	195.5	1.58 (1.27 to 1.91)	3.04 (2.3 to 3.78)	2.001 (1.343 to 2.663)
Australia	196 (150 to 249)	165 (114 to 228)	-15.65	1.03 (0.79 to 1.32)	0.35 (0.25 to 0.46)	-2.959 (-3.414 to -2.502)
Austria	141 (107 to 180)	119 (85 to 160)	-15.58	1.21 (0.92 to 1.53)	0.6 (0.44 to 0.78)	-2.031 (-2.535 to -1.525)
Azerbaijan	109 (84 to 140)	161 (109 to 227)	47.53	2.08 (1.57 to 2.66)	1.65 (1.08 to 2.38)	-0.286 (-0.75 to 0.18)
Bahamas	4 (3 to 5)	5 (4 to 7)	35.64	2.5 (1.81 to 3.35)	1.38 (0.91 to 1.91)	-1.463 (-1.679 to -1.246)
Bahrain	6 (4 to 7)	11 (8 to 16)	101.4	4.48 (3.14 to 6.03)	2.02 (1.35 to 2.81)	-2.288 (-2.73 to -1.843)
Bangladesh	3186 (2398 to 4089)	4392 (3117 to 5922)	37.86	7.35 (5.48 to 9.56)	3.68 (2.62 to 5)	-2.513 (-2.809 to -2.216)
Barbados	6 (4 to 7)	6 (4 to 8)	5.44	1.82 (1.32 to 2.4)	1.14 (0.75 to 1.65)	-1.634 (-2.34 to -0.922)
Belarus	140 (110 to 171)	292 (208 to 385)	108.25	1.14 (0.89 to 1.39)	2.11 (1.51 to 2.79)	0.873 (-0.126 to 1.882)
Belgium	630 (467 to 807)	495 (354 to 672)	-21.4	4.06 (3.03 to 5.19)	1.84 (1.33 to 2.43)	-2.251 (-2.655 to -1.845)
Belize	2 (2 to 3)	6 (4 to 8)	147.42	2.67 (1.94 to 3.44)	2.15 (1.51 to 2.9)	-1.112 (-1.707 to -0.512)
Benin	117 (84 to 160)	123 (79 to 177)	4.68	5.9 (4.24 to 7.98)	2.33 (1.52 to 3.38)	-3.069 (-3.3 to -2.838)
Bermuda	1 (1 to 1)	1 (1 to 2)	35.32	1.35 (0.97 to 1.82)	0.76 (0.53 to 1.08)	-2.06 (-2.278 to -1.841)
Bhutan	4 (2 to 6)	7 (4 to 12)	82.08	1.91 (1.13 to 3.04)	1.26 (0.66 to 2.11)	-1.155 (-1.284 to -1.027)
Bolivia (Plurinational State of)	187 (134 to 255)	223 (149 to 331)	19.01	6.39 (4.55 to 8.69)	2.65 (1.76 to 3.92)	-2.007 (-2.296 to -1.717)
Bosnia and Herzegovina	77 (57 to 101)	70 (47 to 95)	-9.53	2.03 (1.5 to 2.68)	1.15 (0.77 to 1.59)	-1.419 (-1.628 to -1.21)
Botswana	105 (67 to 151)	113 (75 to 160)	8.01	19.05 (12.51 to 27.42)	7.44 (5 to 10.77)	-2.998 (-3.356 to -2.639)
Brazil	5986 (4727 to 7307)	8108 (5951 to 10559)	35.45	7.2 (5.56 to 8.9)	3.28 (2.4 to 4.27)	-1.93 (-2.366 to -1.492)

Brunei Darussalam	8 (6 to 10)	7 (5 to 10)	-7.32	8.77 (6.36 to 11.78)	2.71 (1.84 to 3.74)	-2.639 (-3.008 to -2.268)
Bulgaria	696 (549 to 850)	242 (179 to 306)	-65.29	6.02 (4.71 to 7.38)	2.08 (1.57 to 2.62)	-3.187 (-3.613 to -2.76)
Burkina Faso	192 (133 to 268)	256 (173 to 362)	32.95	4.39 (3.06 to 6.12)	2.59 (1.76 to 3.61)	-1.591 (-1.822 to -1.361)
Burundi	234 (158 to 322)	166 (114 to 236)	-29.26	10.16 (6.88 to 13.91)	3.32 (2.24 to 4.68)	-3.812 (-4.251 to -3.372)
Cabo Verde	6 (4 to 8)	10 (7 to 14)	65.13	2.74 (1.97 to 3.67)	2.12 (1.46 to 2.99)	-1.435 (-1.827 to -1.042)
Cambodia	767 (562 to 979)	1416 (1005 to 1880)	84.56	20.04 (14.61 to 25.69)	13.79 (9.74 to 18.09)	-0.764 (-0.968 to -0.56)
Cameroon	249 (168 to 360)	432 (256 to 661)	73.22	5.49 (3.67 to 7.94)	3.18 (1.93 to 4.82)	-1.688 (-2.025 to -1.351)
Canada	1216 (909 to 1534)	695 (506 to 915)	-42.84	3.83 (2.87 to 4.82)	0.91 (0.67 to 1.19)	-4.446 (-5.031 to -3.857)
Central African Republic	129 (86 to 183)	166 (101 to 247)	29.44	10.88 (7.28 to 15.28)	6.72 (4.21 to 9.89)	-1.589 (-1.766 to -1.41)
Chad	186 (116 to 285)	288 (180 to 430)	55.01	6.84 (4.25 to 10.36)	5.17 (3.28 to 7.65)	-1.109 (-1.35 to -0.867)
Chile	509 (388 to 642)	204 (153 to 257)	-59.9	5 (3.78 to 6.33)	0.83 (0.63 to 1.04)	-5.716 (-6.518 to -4.906)
China	32593 (24682 to 40813)	36644 (26889 to 47789)	12.43	5.84 (4.38 to 7.27)	2.09 (1.54 to 2.72)	-3.697 (-3.838 to -3.556)
Colombia	305 (236 to 392)	384 (276 to 534)	25.8	1.75 (1.35 to 2.26)	0.69 (0.5 to 0.96)	-2.681 (-3.022 to -2.34)
Comoros	15 (9 to 22)	19 (12 to 29)	30.37	8.54 (5.43 to 12.67)	4.52 (2.82 to 6.71)	-2.305 (-2.494 to -2.116)
Congo	75 (48 to 106)	137 (85 to 205)	82.18	7.19 (4.62 to 10.13)	5.33 (3.4 to 7.91)	-0.909 (-1.182 to -0.636)
Cook Islands	1 (1 to 1)	1 (1 to 1)	-3.51	7.92 (5.52 to 10.43)	3.8 (2.59 to 5.32)	-2.514 (-2.688 to -2.34)
Costa Rica	32 (24 to 42)	57 (41 to 75)	74.67	1.92 (1.42 to 2.5)	1.02 (0.74 to 1.34)	-2.087 (-2.607 to -1.563)
Cote d'Ivoire	317 (219 to 433)	488 (314 to 715)	53.77	8.06 (5.62 to 11.12)	4.25 (2.74 to 6.14)	-2.543 (-2.973 to -2.111)
Croatia	160 (124 to 198)	136 (100 to 178)	-15.09	2.93 (2.25 to 3.67)	1.51 (1.14 to 1.95)	-3.435 (-4.253 to -2.611)
Cuba	448 (337 to 578)	733 (531 to 961)	63.56	4.67 (3.49 to 6.15)	3.64 (2.64 to 4.76)	-1.541 (-2.06 to -1.02)
Cyprus	19 (14 to 25)	16 (11 to 22)	-13.72	3.8 (2.68 to 5.19)	0.83 (0.59 to 1.13)	-4.425 (-4.657 to -4.193)
Czechia	384 (296 to 486)	472 (335 to 620)	22.91	2.87 (2.22 to 3.6)	2.27 (1.63 to 2.94)	-0.781 (-1.124 to -0.438)
Democratic People's Republic of Korea	467 (327 to 614)	649 (458 to 892)	38.89	3.54 (2.39 to 4.72)	2.12 (1.49 to 2.93)	-1.405 (-1.516 to -1.295)
Democratic Republic of the Congo	828 (473 to 1402)	1380 (847 to 2201)	66.61	5.32 (3.04 to 8.96)	3.41 (2.12 to 5.45)	-1.314 (-1.511 to -1.117)
Denmark	468 (358 to 588)	306 (220 to 402)	-34.58	5.46 (4.19 to 6.84)	2.26 (1.64 to 2.95)	-2.636 (-3.016 to -2.254)
Djibouti	14 (10 to 20)	43 (27 to 67)	203.18	11.74 (8.04 to 16.48)	7.85 (5.14 to 11.6)	-1.287 (-1.41 to -1.163)
Dominica	1 (1 to 2)	1 (1 to 1)	-18.3	2.02 (1.45 to 2.67)	1.18 (0.83 to 1.68)	-1.291 (-1.517 to -1.064)
Dominican Republic	96 (69 to 129)	186 (124 to 280)	94.32	3.42 (2.39 to 4.71)	1.92 (1.27 to 2.89)	-0.817 (-1.282 to -0.35)
Ecuador	213 (163 to 278)	216 (145 to 293)	1.75	4.52 (3.41 to 5.94)	1.39 (0.93 to 1.88)	-3.002 (-3.318 to -2.685)
Egypt	1325 (1017 to 1646)	2601 (1908 to 3521)	96.3	5.48 (4.09 to 6.97)	5.08 (3.64 to 6.74)	0.537 (0.253 to 0.822)
El Salvador	45 (32 to 60)	80 (53 to 115)	78.16	1.48 (1.04 to 1.98)	1.3 (0.86 to 1.86)	-0.067 (-0.364 to 0.231)
Equatorial Guinea	17 (11 to 25)	21 (13 to 33)	28.84	8.44 (5.54 to 12.93)	4.03 (2.5 to 6.07)	-2.572 (-3.047 to -2.094)
Eritrea	121 (57 to 229)	148 (66 to 289)	22.34	8.42 (4.01 to 16.15)	4.4 (2.04 to 8.44)	-2.198 (-2.314 to -2.081)
Estonia	33 (27 to 41)	29 (23 to 37)	-12.32	1.74 (1.39 to 2.11)	1.36 (1.06 to 1.71)	-2.352 (-3.426 to -1.266)
Eswatini	23 (15 to 31)	29 (18 to 42)	26.38	8.38 (5.75 to 11.79)	4.78 (2.98 to 6.94)	-1.032 (-1.637 to -0.424)
Ethiopia	1162 (755 to 1661)	677 (466 to 956)	-41.72	5.61 (3.67 to 8.01)	1.6 (1.07 to 2.27)	-3.964 (-4.277 to -3.65)
Fiji	18 (13 to 23)	16 (11 to 23)	-6.11	4.44 (3.26 to 5.83)	2.08 (1.44 to 2.87)	-2.412 (-2.594 to -2.229)

Finland	204 (149 to 264)	40 (29 to 52)	-80.15	2.87 (2.1 to 3.72)	0.34 (0.25 to 0.43)	-7.986 (-8.79 to -7.175)
France	2320 (1734 to 3008)	1239 (871 to 1680)	-46.6	2.66 (1.99 to 3.44)	0.75 (0.54 to 0.98)	-4.004 (-4.283 to -3.724)
Gabon	28 (18 to 40)	42 (25 to 62)	49.96	4.9 (3.27 to 7.05)	3.86 (2.38 to 5.76)	-0.731 (-0.825 to -0.638)
Gambia	43 (29 to 58)	60 (39 to 87)	41.65	11.87 (8.25 to 16.26)	5.89 (3.81 to 8.45)	-2.31 (-2.473 to -2.146)
Georgia	105 (82 to 126)	245 (189 to 306)	133.77	1.73 (1.34 to 2.08)	4.26 (3.27 to 5.3)	4.072 (2.847 to 5.311)
Germany	2811 (2115 to 3557)	1928 (1418 to 2550)	-31.41	2.17 (1.64 to 2.73)	0.93 (0.7 to 1.2)	-1.846 (-2.043 to -1.647)
Ghana	272 (183 to 389)	719 (474 to 1018)	164.17	5.08 (3.42 to 7.24)	4.8 (3.15 to 6.82)	0.889 (0.579 to 1.2)
Greece	416 (315 to 519)	711 (504 to 970)	71.05	2.91 (2.2 to 3.63)	2.33 (1.73 to 3.08)	-0.12 (-0.434 to 0.195)
Greenland	2 (2 to 3)	1 (1 to 2)	-41.76	8.01 (5.69 to 10.62)	2.26 (1.6 to 3.06)	-3.488 (-3.684 to -3.293)
Grenada	2 (2 to 3)	2 (1 to 2)	-21.77	2.99 (2.21 to 3.95)	1.48 (1.05 to 2.05)	-2.347 (-2.896 to -1.796)
Guam	2 (1 to 2)	2 (2 to 3)	36.01	1.93 (1.41 to 2.62)	1.1 (0.8 to 1.49)	-1.297 (-1.646 to -0.946)
Guatemala	348 (261 to 458)	309 (216 to 420)	-11.15	11.92 (8.88 to 15.79)	2.95 (2.04 to 4.08)	-4.935 (-5.275 to -4.595)
Guinea	204 (131 to 296)	311 (201 to 460)	52.32	6.51 (4.15 to 9.37)	5.63 (3.61 to 8.31)	-0.245 (-0.472 to -0.018)
Guinea-Bissau	22 (15 to 30)	36 (24 to 52)	64.27	5.2 (3.51 to 7.15)	4.25 (2.83 to 6.12)	0 (-0.24 to 0.24)
Guyana	13 (9 to 17)	13 (9 to 19)	3.84	3.29 (2.38 to 4.37)	2.06 (1.37 to 2.99)	-1.453 (-1.787 to -1.118)
Haiti	101 (59 to 157)	102 (55 to 163)	0.45	3.1 (1.82 to 4.85)	1.4 (0.78 to 2.27)	-2.103 (-2.32 to -1.886)
Honduras	49 (35 to 64)	128 (87 to 174)	162.2	2.45 (1.75 to 3.25)	2.2 (1.5 to 3.02)	0.268 (0.035 to 0.501)
Hungary	210 (164 to 256)	142 (109 to 186)	-32.11	1.53 (1.21 to 1.86)	0.83 (0.64 to 1.06)	-2.138 (-2.644 to -1.629)
Iceland	15 (10 to 21)	8 (6 to 12)	-46.39	4.97 (3.43 to 6.87)	1.25 (0.88 to 1.73)	-4.699 (-5.088 to -4.307)
India	19370 (14345 to 24608)	34342 (24983 to 44324)	77.3	5.14 (3.76 to 6.59)	3.33 (2.42 to 4.34)	-1.132 (-1.319 to -0.944)
Indonesia	3187 (2215 to 4461)	5477 (3959 to 7249)	71.85	3.69 (2.48 to 5.12)	2.97 (2.15 to 3.93)	-0.486 (-0.706 to -0.267)
Iran (Islamic Republic of)	389 (296 to 495)	865 (639 to 1104)	122.69	1.62 (1.21 to 2.07)	1.15 (0.83 to 1.49)	-0.576 (-0.748 to -0.405)
Iraq	199 (147 to 271)	327 (224 to 455)	64.28	2.53 (1.85 to 3.47)	1.58 (1.07 to 2.17)	-1.732 (-1.846 to -1.617)
Ireland	434 (335 to 549)	119 (82 to 160)	-72.67	11.47 (8.83 to 14.77)	1.4 (0.97 to 1.89)	-7.01 (-7.611 to -6.404)
Israel	89 (66 to 118)	107 (76 to 147)	19.98	2.07 (1.47 to 2.81)	0.8 (0.58 to 1.08)	-1.82 (-2.27 to -1.368)
Italy	1161 (879 to 1474)	902 (630 to 1196)	-22.25	1.38 (1.05 to 1.76)	0.54 (0.39 to 0.69)	-2.613 (-3.178 to -2.044)
Jamaica	27 (20 to 36)	27 (17 to 39)	-2.61	1.51 (1.11 to 1.97)	0.84 (0.55 to 1.23)	-2.113 (-2.696 to -1.525)
Japan	12320 (9651 to 15065)	7949 (5762 to 10764)	-35.48	7.78 (6.04 to 9.57)	1.69 (1.28 to 2.19)	-4.611 (-4.852 to -4.368)
Jordan	48 (35 to 61)	117 (85 to 153)	145.36	4.31 (3.12 to 5.65)	1.9 (1.33 to 2.55)	-2.552 (-2.735 to -2.369)
Kazakhstan	236 (182 to 290)	528 (402 to 666)	124.13	1.72 (1.32 to 2.12)	2.72 (2.06 to 3.43)	1.419 (0.559 to 2.287)
Kenya	514 (349 to 707)	867 (575 to 1169)	68.85	7.07 (4.82 to 9.76)	4.08 (2.7 to 5.56)	-1.909 (-2.117 to -1.701)
Kiribati	2 (2 to 3)	5 (3 to 6)	83.87	6.67 (4.85 to 8.75)	6.39 (4.63 to 8.53)	-0.335 (-0.573 to -0.097)
Kuwait	17 (13 to 21)	81 (55 to 108)	379.36	2.79 (2.02 to 3.55)	3.35 (2.24 to 4.57)	1.943 (1.398 to 2.492)
Kyrgyzstan	71 (56 to 88)	91 (66 to 119)	27.77	2.35 (1.84 to 2.95)	1.67 (1.22 to 2.22)	-1.253 (-1.737 to -0.768)
Lao People's Democratic Republic	224 (153 to 308)	277 (194 to 371)	24.12	12.07 (8.28 to 16.39)	7.54 (5.28 to 10.07)	-1.214 (-1.301 to -1.126)
Latvia	61 (49 to 72)	52 (40 to 65)	-13.95	1.83 (1.46 to 2.18)	1.78 (1.36 to 2.22)	-1.168 (-2.105 to -0.223)
Lebanon	76 (52 to 112)	345 (238 to 478)	356.04	3.97 (2.75 to 5.94)	5.25 (3.66 to 7.22)	2.121 (1.391 to 2.856)
Lesotho	95 (64 to 131)	181 (123 to 252)	90.55	11.8 (7.97 to 16.41)	15.95 (10.96 to 22.02)	2.178 (1.628 to 2.731)
Liberia	40 (28 to 54)	53 (35 to 76)	34.35	3.5 (2.46 to 4.76)	2.18 (1.43 to 3.06)	-1.746 (-1.952 to -1.539)

Libya	44 (31 to 62)	102 (71 to 140)	131.57	2.45 (1.71 to 3.46)	2.01 (1.37 to 2.76)	0.343 (0.083 to 0.604)
Lithuania	44 (36 to 55)	79 (60 to 99)	77.23	1.05 (0.85 to 1.31)	1.77 (1.37 to 2.19)	1.202 (0.191 to 2.223)
Luxembourg	11 (8 to 15)	8 (6 to 11)	-27.89	2.16 (1.52 to 2.92)	0.71 (0.5 to 0.99)	-3.211 (-3.615 to -2.805)
Madagascar	422 (314 to 553)	347 (229 to 489)	-17.71	8.87 (6.61 to 11.84)	3.02 (1.98 to 4.26)	-3.501 (-3.753 to -3.248)
Malawi	358 (241 to 487)	563 (400 to 795)	57.17	11.31 (7.72 to 15.18)	8.19 (5.8 to 11.55)	-1.154 (-1.408 to -0.9)
Malaysia	773 (578 to 993)	2332 (1726 to 2980)	201.5	8.74 (6.38 to 11.38)	9.1 (6.7 to 11.7)	0.687 (0.315 to 1.06)
Maldives	5 (3 to 6)	6 (4 to 8)	35.45	7.49 (5.37 to 9.87)	2.21 (1.54 to 3)	-3.807 (-3.95 to -3.663)
Mali	124 (85 to 166)	270 (172 to 382)	117.95	3.53 (2.4 to 4.75)	3.49 (2.23 to 5.07)	0.736 (0.504 to 0.968)
Malta	12 (9 to 15)	10 (7 to 14)	-18.21	2.94 (2.12 to 3.9)	0.97 (0.68 to 1.33)	-3.926 (-4.391 to -3.459)
Marshall Islands	1 (1 to 1)	2 (1 to 3)	72.71	5.78 (3.94 to 8)	4.86 (3.29 to 6.85)	-0.406 (-0.484 to -0.328)
Mauritania	56 (40 to 77)	58 (38 to 80)	2.26	5.49 (3.87 to 7.51)	2.61 (1.71 to 3.66)	-2.441 (-2.617 to -2.264)
Mauritius	44 (36 to 54)	50 (38 to 62)	12.45	6.89 (5.43 to 8.58)	2.87 (2.18 to 3.6)	-2.607 (-3.425 to -1.782)
Mexico	1488 (1143 to 1851)	1861 (1355 to 2453)	25.09	4.31 (3.23 to 5.47)	1.5 (1.09 to 1.99)	-3.428 (-4.048 to -2.803)
Micronesia (Federated States of)	5 (3 to 6)	5 (4 to 7)	7.97	9.03 (6.46 to 12.09)	6.5 (4.63 to 8.96)	-1.075 (-1.178 to -0.972)
Monaco	2 (1 to 3)	2 (1 to 3)	-14.37	2.73 (1.83 to 3.85)	1.59 (1.09 to 2.29)	-1.166 (-1.39 to -0.942)
Mongolia	33 (23 to 44)	49 (34 to 64)	46.19	3.03 (2.12 to 3.98)	1.75 (1.24 to 2.28)	-1.709 (-1.953 to -1.464)
Montenegro	9 (7 to 12)	11 (8 to 14)	13.01	1.53 (1.11 to 2.01)	1.17 (0.83 to 1.58)	-0.493 (-0.782 to -0.204)
Morocco	257 (180 to 353)	327 (221 to 451)	27.17	1.87 (1.3 to 2.58)	0.98 (0.66 to 1.34)	-1.764 (-1.912 to -1.616)
Mozambique	347 (250 to 462)	590 (408 to 817)	70.07	6.64 (4.75 to 8.94)	5.45 (3.77 to 7.52)	0.086 (-0.144 to 0.316)
Myanmar	2423 (1708 to 3305)	1714 (1196 to 2321)	-29.28	12.29 (8.73 to 16.67)	4.06 (2.82 to 5.5)	-3.576 (-3.7 to -3.452)
Namibia	90 (60 to 132)	108 (71 to 155)	19.44	16.74 (11.19 to 25.04)	8.57 (5.63 to 12.36)	-2.085 (-2.493 to -1.675)
Nauru	1 (0 to 1)	0 (0 to 1)	-5.64	10.28 (7.08 to 13.8)	7.5 (4.99 to 10.2)	-1.109 (-1.323 to -0.895)
Nepal	644 (432 to 952)	725 (448 to 1095)	12.51	8.62 (5.76 to 12.83)	3.87 (2.4 to 5.91)	-2.561 (-2.721 to -2.402)
Netherlands	636 (468 to 819)	562 (396 to 757)	-11.62	3.16 (2.32 to 4.06)	1.43 (1.02 to 1.91)	-3.053 (-3.742 to -2.36)
New Zealand	96 (71 to 127)	55 (37 to 79)	-42.7	2.62 (1.93 to 3.46)	0.59 (0.4 to 0.84)	-3.812 (-5.216 to -2.387)
Nicaragua	27 (20 to 36)	39 (27 to 53)	43.27	1.83 (1.35 to 2.51)	0.79 (0.55 to 1.1)	-1.703 (-2.083 to -1.322)
Niger	90 (63 to 122)	171 (113 to 244)	89.21	3.63 (2.5 to 5.07)	2.56 (1.68 to 3.68)	-1.076 (-1.208 to -0.943)
Nigeria	879 (601 to 1266)	1021 (654 to 1498)	16.24	2.15 (1.47 to 3.05)	1.11 (0.74 to 1.64)	-2.208 (-2.483 to -1.933)
Niue	0 (0 to 0)	0 (0 to 0)	-25.47	4.3 (2.97 to 6.04)	3.28 (2.22 to 4.67)	-1.104 (-1.176 to -1.033)
North Macedonia	28 (21 to 37)	26 (18 to 35)	-8.37	1.59 (1.16 to 2.09)	0.88 (0.62 to 1.19)	-1.541 (-2.011 to -1.069)
Northern Mariana Islands	1 (1 to 1)	1 (1 to 2)	32.67	4.61 (3.23 to 6.32)	2.51 (1.82 to 3.33)	-1.803 (-1.975 to -1.632)
Norway	392 (277 to 521)	120 (78 to 173)	-69.44	5.14 (3.67 to 6.78)	0.98 (0.65 to 1.39)	-5.398 (-5.735 to -5.06)
Oman	21 (15 to 29)	26 (18 to 36)	22.07	3.19 (2.22 to 4.41)	1.53 (1.02 to 2.16)	-1.317 (-1.701 to -0.931)
Pakistan	1905 (1201 to 2832)	2239 (1231 to 3666)	17.53	3.86 (2.39 to 5.78)	2.2 (1.22 to 3.59)	-1.961 (-2.298 to -1.623)
Palau	0 (0 to 1)	1 (0 to 1)	47.22	4.51 (3.2 to 6.46)	3.18 (2.22 to 4.41)	-1.068 (-1.151 to -0.984)
Palestine	38 (27 to 50)	62 (44 to 81)	63.1	5.09 (3.68 to 6.82)	2.97 (2.09 to 4.01)	-1.519 (-1.744 to -1.295)
Panama	28 (21 to 37)	32 (21 to 46)	13.22	2.01 (1.5 to 2.62)	0.71 (0.47 to 1.01)	-2.687 (-3.013 to -2.36)
Papua New Guinea	76 (49 to 112)	138 (88 to 222)	81.78	4.01 (2.66 to 5.96)	2.47 (1.57 to 4)	-1.249 (-1.368 to -1.129)
Paraguay	90 (67 to 119)	177 (113 to 254)	96.14	4.41 (3.24 to 5.84)	3.23 (2.03 to 4.67)	-0.53 (-0.811 to -0.247)
Peru	496 (351 to 652)	1144 (782 to 1657)	130.7	4.39 (3.07 to 5.83)	3.4 (2.33 to 4.91)	-1.019 (-1.294 to -0.742)

Philippines	2674 (2115 to 3360)	6282 (4582 to 8192)	134.94	11.04 (8.26 to 14.23)	8.86 (6.39 to 11.7)	0.452 (0.036 to 0.869)
Poland	1127 (901 to 1367)	1927 (1449 to 2494)	71.07	2.64 (2.11 to 3.21)	2.83 (2.15 to 3.66)	0.792 (0.483 to 1.101)
Portugal	367 (277 to 459)	270 (190 to 366)	-26.28	2.78 (2.12 to 3.53)	1.07 (0.78 to 1.39)	-3.009 (-3.465 to -2.552)
Puerto Rico	103 (72 to 139)	61 (42 to 86)	-40.53	3 (2.08 to 4.07)	0.86 (0.59 to 1.21)	-4 (-4.233 to -3.765)
Qatar	3 (2 to 3)	9 (6 to 12)	237.37	2.55 (1.73 to 3.56)	0.84 (0.54 to 1.18)	-2.502 (-3.18 to -1.818)
Republic of Korea	1054 (802 to 1335)	2133 (1479 to 2903)	102.42	5.12 (3.71 to 6.8)	2.34 (1.62 to 3.18)	-1.487 (-1.841 to -1.133)
Republic of Moldova	123 (99 to 151)	204 (158 to 253)	65.71	2.67 (2.15 to 3.28)	3.76 (2.91 to 4.64)	1.46 (0.621 to 2.306)
Romania	930 (734 to 1124)	959 (709 to 1199)	3.15	3.53 (2.78 to 4.28)	3.04 (2.26 to 3.78)	-1.231 (-1.819 to -0.639)
Russian Federation	2528 (2082 to 2948)	5778 (4559 to 7023)	128.55	1.42 (1.17 to 1.66)	2.74 (2.16 to 3.31)	1.074 (-0.72 to 2.9)
Rwanda	454 (310 to 629)	475 (309 to 695)	4.67	18.97 (13.08 to 26.28)	9.72 (6.28 to 14.7)	-2.926 (-3.242 to -2.608)
Saint Kitts and Nevis	1 (1 to 1)	1 (1 to 1)	-15.06	2.43 (1.72 to 3.24)	1.21 (0.81 to 1.71)	-2.602 (-2.946 to -2.257)
Saint Lucia	2 (2 to 3)	3 (2 to 3)	19.26	2.61 (1.88 to 3.43)	1.08 (0.72 to 1.49)	-3.49 (-3.902 to -3.077)
Saint Vincent and the Grenadines	1 (1 to 1)	2 (1 to 3)	90.47	1.56 (1.14 to 2.04)	1.53 (1.05 to 2.06)	-0.306 (-0.662 to 0.052)
Samoa	6 (4 to 8)	8 (5 to 10)	28.8	7.13 (5.17 to 9.36)	5.43 (3.86 to 7.09)	-0.939 (-1.059 to -0.819)
San Marino	1 (0 to 1)	0 (0 to 1)	-43.45	1.64 (1.14 to 2.26)	0.35 (0.2 to 0.55)	-3.59 (-4.071 to -3.105)
Sao Tome and Principe	2 (2 to 3)	4 (2 to 5)	50.12	3.57 (2.47 to 4.95)	2.88 (1.94 to 4.17)	-0.798 (-1.177 to -0.417)
Saudi Arabia	175 (112 to 252)	496 (341 to 699)	184.02	2.85 (1.82 to 4.25)	2.03 (1.4 to 2.82)	-0.65 (-0.892 to -0.408)
Senegal	142 (99 to 187)	173 (109 to 241)	22.33	4.05 (2.82 to 5.31)	2.04 (1.28 to 2.83)	-2.2 (-2.344 to -2.056)
Serbia	156 (117 to 202)	161 (118 to 217)	3.48	1.55 (1.15 to 2.01)	1.03 (0.76 to 1.37)	-0.825 (-1.111 to -0.539)
Seychelles	8 (6 to 10)	9 (6 to 11)	3.86	14.78 (11.08 to 18.35)	8.18 (5.95 to 10.88)	-1.255 (-1.499 to -1.011)
Sierra Leone	152 (109 to 202)	163 (113 to 224)	7.38	7.4 (5.32 to 9.82)	4.03 (2.79 to 5.52)	-1.682 (-1.888 to -1.476)
Singapore	142 (106 to 186)	187 (134 to 251)	32	7.27 (5.35 to 9.8)	2.21 (1.58 to 2.97)	-3.331 (-3.618 to -3.044)
Slovakia	361 (267 to 470)	187 (134 to 249)	-48.33	6.17 (4.55 to 8.04)	2.03 (1.47 to 2.71)	-2.796 (-3.041 to -2.552)
Slovenia	60 (45 to 75)	38 (27 to 50)	-36.29	2.46 (1.87 to 3.1)	0.96 (0.7 to 1.25)	-2.961 (-3.371 to -2.55)
Solomon Islands	33 (19 to 46)	59 (42 to 80)	79.42	23.96 (14.77 to 32.47)	16.14 (11.49 to 21.77)	-1.156 (-1.346 to -0.966)
Somalia	260 (158 to 397)	412 (259 to 621)	58.14	10.68 (6.68 to 16.25)	6.31 (3.89 to 9.29)	-1.684 (-1.783 to -1.586)
South Africa	2458 (1944 to 3025)	2481 (1880 to 3125)	0.94	11 (8.6 to 13.67)	4.97 (3.77 to 6.27)	-2.15 (-2.653 to -1.645)
South Sudan	210 (137 to 309)	214 (132 to 320)	1.99	8.6 (5.6 to 12.59)	5.87 (3.62 to 8.59)	-1.436 (-1.652 to -1.22)
Spain	1454 (1115 to 1805)	856 (605 to 1137)	-41.13	2.78 (2.12 to 3.47)	0.76 (0.56 to 0.99)	-3.654 (-3.867 to -3.441)
Sri Lanka	439 (325 to 572)	280 (154 to 414)	-36.35	4.74 (3.51 to 6.23)	1.12 (0.62 to 1.66)	-4.355 (-4.579 to -4.131)
Sudan	270 (163 to 413)	326 (195 to 537)	21.04	3.15 (1.87 to 4.85)	1.83 (1.05 to 3.02)	-1.508 (-1.599 to -1.418)
Suriname	9 (7 to 12)	11 (7 to 17)	17.82	3.81 (2.86 to 4.91)	1.78 (1.16 to 2.67)	-2.241 (-2.578 to -1.903)
Sweden	566 (408 to 763)	211 (143 to 291)	-62.62	3.39 (2.46 to 4.54)	0.82 (0.56 to 1.12)	-4.21 (-4.623 to -3.796)
Switzerland	398 (288 to 526)	179 (124 to 245)	-55.02	3.54 (2.57 to 4.65)	0.77 (0.54 to 1.03)	-4.141 (-4.549 to -3.73)
Syrian Arab Republic	155 (112 to 209)	269 (176 to 382)	72.82	3.19 (2.27 to 4.33)	2.51 (1.67 to 3.46)	-0.463 (-0.674 to -0.251)

Taiwan (Province of China)	823 (638 to 1003)	1711 (1265 to 2190)	107.98	6.39 (4.91 to 7.93)	3.82 (2.83 to 4.86)	-0.609 (-0.888 to -0.328)
Tajikistan	121 (91 to 161)	95 (61 to 139)	-21.6	4.32 (3.2 to 5.77)	1.53 (0.97 to 2.26)	-3.715 (-4.141 to -3.287)
Thailand	978 (708 to 1341)	4670 (3215 to 6677)	377.53	3.18 (2.25 to 4.51)	4.36 (3.01 to 6.24)	2.118 (1.647 to 2.591)
Timor-Leste	16 (10 to 23)	46 (30 to 68)	187.33	7.05 (4.39 to 9.9)	6.75 (4.42 to 10.04)	0.476 (0.301 to 0.652)
Togo	136 (94 to 187)	285 (189 to 394)	110.01	11.88 (8.25 to 16.84)	7.45 (4.94 to 10.25)	-1.506 (-1.644 to -1.368)
Tokelau	0 (0 to 0)	0 (0 to 0)	-30.57	5.45 (3.73 to 7.48)	3.36 (2.2 to 4.85)	-1.718 (-1.777 to -1.658)
Tonga	4 (3 to 6)	5 (4 to 7)	21.19	8.85 (6.27 to 11.9)	6.7 (4.57 to 9.22)	-0.967 (-1.13 to -0.803)
Trinidad and Tobago	26 (19 to 33)	20 (13 to 29)	-20.54	3.32 (2.49 to 4.31)	1.08 (0.71 to 1.57)	-3.784 (-4.103 to -3.464)
Tunisia	146 (109 to 197)	279 (185 to 399)	91.02	3.66 (2.67 to 4.92)	2.35 (1.55 to 3.39)	-1.369 (-1.542 to -1.195)
Turkey	1180 (872 to 1512)	1811 (1282 to 2510)	53.47	3.71 (2.71 to 4.88)	2.05 (1.44 to 2.83)	-1.67 (-2.33 to -1.006)
Turkmenistan	56 (45 to 68)	55 (38 to 75)	-0.94	2.66 (2.14 to 3.23)	1.2 (0.83 to 1.6)	-3.298 (-3.83 to -2.763)
Tuvalu	0 (0 to 1)	1 (0 to 1)	3.95	7.33 (5.41 to 9.9)	5.1 (3.6 to 6.93)	-1.082 (-1.166 to -0.997)
Uganda	295 (195 to 419)	443 (294 to 648)	50.09	5.14 (3.35 to 7.36)	3.24 (2.18 to 4.75)	-2.243 (-2.696 to -1.787)
Ukraine	851 (681 to 1019)	1443 (873 to 2139)	69.62	1.31 (1.05 to 1.56)	2.37 (1.44 to 3.52)	0.776 (-0.239 to 1.801)
United Arab Emirates	16 (11 to 23)	43 (28 to 62)	159.46	4.35 (2.91 to 6.16)	2.48 (1.57 to 3.72)	0.243 (-0.448 to 0.938)
United Kingdom	5874 (4513 to 7331)	2832 (2009 to 3845)	-51.79	6.29 (4.82 to 7.86)	1.94 (1.41 to 2.59)	-4.699 (-5.467 to -3.925)
United Republic of Tanzania	1195 (862 to 1539)	1142 (793 to 1600)	-4.42	12.33 (8.94 to 16.01)	4.66 (3.25 to 6.46)	-3.819 (-4.115 to -3.522)
United States of America	11627 (8893 to 14806)	6396 (4735 to 8352)	-44.99	3.57 (2.74 to 4.53)	1.12 (0.84 to 1.44)	-3.469 (-3.796 to -3.141)
United States Virgin Islands	1 (1 to 2)	1 (1 to 1)	-17.38	1.32 (0.86 to 1.96)	0.51 (0.32 to 0.75)	-2.447 (-2.746 to -2.147)
Uruguay	82 (62 to 101)	105 (76 to 135)	28.85	2.15 (1.65 to 2.65)	1.94 (1.43 to 2.46)	-0.126 (-0.495 to 0.244)
Uzbekistan	134 (100 to 168)	247 (182 to 316)	83.71	1.08 (0.8 to 1.35)	0.81 (0.6 to 1.05)	-0.841 (-1.581 to -0.096)
Vanuatu	3 (2 to 5)	5 (4 to 7)	61.54	5.2 (3.72 to 6.89)	3 (2.13 to 4.07)	-1.66 (-1.774 to -1.546)
Venezuela (Bolivarian Republic of)	279 (210 to 357)	386 (254 to 541)	38.49	3 (2.23 to 3.89)	1.32 (0.87 to 1.84)	-2.164 (-2.669 to -1.656)
Viet Nam	1637 (1164 to 2234)	2645 (1861 to 3525)	61.52	4.33 (3.08 to 5.9)	2.87 (2.03 to 3.77)	-1.015 (-1.22 to -0.81)
Yemen	234 (151 to 367)	459 (271 to 733)	96.37	4.98 (3.19 to 7.84)	3.52 (2.02 to 5.69)	-0.954 (-1.014 to -0.893)
Zambia	239 (173 to 320)	331 (220 to 457)	38.63	9.58 (6.92 to 12.95)	5.2 (3.34 to 7.29)	-2.485 (-2.802 to -2.167)
Zimbabwe	614 (455 to 822)	1203 (808 to 1669)	96.05	16.49 (12.13 to 22.66)	16.59 (11.29 to 23.02)	0.668 (0.007 to 1.334)

Abbreviations: EAPC: estimated annual percentage change.

Supplementary Table 2: National DALYs numbers and age-standardized rates of smoking-attributable LRIs in 1990 and 2021, and temporal trends from 1990 to 2021.

	DALYs Number			Age-standardized DALYs Rate		
	1990 (95%UI)	2021(95%UI)	Percent change, %	1990	2021	EAPC
Afghanistan	4671 (3038 to 6642)	6715 (4300 to 9914)	43.77	69.23 (44.87 to 97.22)	53.12 (34.53 to 75.99)	-0.385 (-0.812 to 0.045)
Albania	2845 (2135 to 3573)	1837 (1321 to 2467)	-35.45	142.51 (106.96 to 177.89)	47.19 (34.02 to 62.45)	-3.074 (-3.501 to -2.645)
Algeria	7651 (5498 to 10376)	11886 (8233 to 16136)	55.36	74.19 (52.68 to 100.56)	37.7 (25.99 to 50.87)	-1.806 (-1.918 to -1.693)
American Samoa	35 (26 to 46)	47 (33 to 63)	33.86	119.65 (89.77 to 159.01)	92.36 (64.6 to 125)	-0.935 (-1.073 to -0.796)
Andorra	20 (13 to 29)	19 (11 to 27)	-8.03	36.18 (22.71 to 50.58)	12.2 (7.13 to 17.79)	-2.737 (-3.054 to -2.42)
Angola	12319 (8457 to 17197)	25544 (17337 to 35317)	107.35	263.58 (181.54 to 367.33)	174.54 (118.91 to 237.9)	-1.242 (-1.465 to -1.018)
Antigua and Barbuda	26 (18 to 34)	34 (24 to 44)	32.01	48.29 (34.51 to 62.84)	31.29 (22.6 to 41.41)	-1.434 (-1.677 to -1.19)
Argentina	23451 (18392 to 28749)	64359 (48714 to 80147)	174.44	72.62 (56.84 to 88.86)	119.73 (90.98 to 148.51)	2.937 (2.428 to 3.448)
Armenia	1504 (1224 to 1782)	2943 (2268 to 3623)	95.71	49.88 (40.57 to 59.31)	70.75 (54.41 to 86.86)	0.725 (0.155 to 1.299)
Australia	4542 (3538 to 5661)	3140 (2295 to 4079)	-30.86	23.66 (18.48 to 29.48)	7.78 (5.84 to 10.03)	-3.006 (-3.42 to -2.589)
Austria	3040 (2345 to 3771)	2155 (1617 to 2752)	-29.1	28.22 (21.86 to 34.82)	12.69 (9.73 to 15.96)	-2.446 (-2.931 to -1.959)
Azerbaijan	3828 (2919 to 4925)	4866 (3274 to 6750)	27.12	67.73 (51.72 to 86.65)	43.24 (29.73 to 60.42)	-1.278 (-1.695 to -0.859)
Bahamas	119 (87 to 157)	148 (97 to 203)	24.55	67.58 (48.97 to 89.5)	34.86 (22.98 to 48.03)	-1.737 (-1.938 to -1.534)
Bahrain	154 (113 to 206)	316 (220 to 441)	104.59	86.67 (62.31 to 114.67)	35.95 (24.86 to 49.83)	-2.664 (-3.011 to -2.315)
Bangladesh	85375 (64974 to 107104)	97533 (69432 to 132454)	14.24	171.33 (129.56 to 217)	72.54 (51.69 to 99.04)	-2.938 (-3.148 to -2.728)
Barbados	111 (82 to 145)	107 (70 to 153)	-3.65	38.92 (28.86 to 50.04)	22.05 (14.5 to 31.6)	-2.044 (-2.658 to -1.427)
Belarus	4884 (3811 to 5970)	10554 (7532 to 13974)	116.08	40.87 (31.79 to 50.1)	80.37 (57.52 to 106.04)	0.987 (-0.081 to 2.066)
Belgium	11359 (8744 to 14283)	8099 (5999 to 10512)	-28.7	76.27 (59.06 to 94.86)	35.52 (26.58 to 45.01)	-2.202 (-2.557 to -1.846)
Belize	58 (43 to 73)	160 (118 to 214)	176.61	60.16 (44.49 to 75.97)	49.47 (36.25 to 66.08)	-1.031 (-1.623 to -0.435)
Benin	3289 (2373 to 4440)	3707 (2379 to 5406)	12.73	152.88 (110.33 to 207.57)	61.31 (39.76 to 89.08)	-3.028 (-3.255 to -2.801)
Bermuda	19 (14 to 25)	21 (14 to 29)	8.41	30.18 (22 to 39.59)	16.57 (11.62 to 23.04)	-2.19 (-2.417 to -1.963)
Bhutan	109 (62 to 169)	139 (76 to 229)	27.6	42.46 (24.4 to 66.19)	23.26 (12.7 to 38.01)	-1.817 (-1.962 to -1.671)
Bolivia (Plurinational State of)	5075 (3625 to 6798)	5619 (3773 to 8281)	10.72	150.09 (107.36 to 201.21)	59.88 (40.25 to 88.34)	-2.268 (-2.548 to -1.987)
Bosnia and Herzegovina	2129 (1613 to 2770)	1561 (1025 to 2137)	-26.68	49.61 (37.52 to 64.35)	27.91 (18.22 to 38.37)	-1.387 (-1.622 to -1.151)
Botswana	3331 (2132 to 4868)	3624 (2305 to 5210)	8.79	511.46 (330.01 to 744.86)	197.75 (130.6 to 279.5)	-3.152 (-3.572 to -2.731)
Brazil	172421 (138166 to 206014)	193210 (144545 to 250337)	12.06	175.23 (139.88 to 210.89)	76.01 (56.77 to 98.55)	-2.279 (-2.665 to -1.89)
Brunei Darussalam	194 (145 to 250)	186 (132 to 246)	-4.14	174.21 (129.46 to 227)	53.13 (37.39 to 71.25)	-3.007 (-3.293 to -2.72)

Bulgaria	20516 (16377 to 24827)	7446 (5654 to 9370)	-63.71	177.47 (142.78 to 213.84)	71.08 (54.74 to 88.77)	-2.794 (-3.23 to -2.356)
Burkina Faso	6090 (4152 to 8340)	8440 (5720 to 11859)	38.58	124.92 (85.72 to 172.2)	73.75 (50.14 to 103.79)	-1.595 (-1.837 to -1.352)
Burundi	7095 (4809 to 9787)	5395 (3698 to 7766)	-23.97	271.6 (184.81 to 372.28)	88.14 (60.6 to 125.1)	-3.853 (-4.307 to -3.396)
Cabo Verde	173 (124 to 232)	297 (201 to 424)	71.91	83.21 (59.29 to 111.46)	59.4 (40.71 to 84.54)	-1.505 (-1.762 to -1.246)
Cambodia	20866 (15491 to 26561)	35416 (25082 to 46863)	69.73	447.2 (330.67 to 570.32)	286.14 (204.15 to 378.3)	-1.118 (-1.311 to -0.925)
Cameroon	8015 (5438 to 11594)	14508 (8615 to 22228)	81.01	152.05 (103.49 to 220.53)	89.22 (53.01 to 137.07)	-1.699 (-2.068 to -1.329)
Canada	22503 (17286 to 27722)	12565 (9388 to 16357)	-44.16	70.08 (54.02 to 86.43)	19.21 (14.42 to 24.84)	-3.992 (-4.56 to -3.421)
Central African Republic	4219 (2796 to 5929)	5819 (3429 to 8662)	37.92	304.9 (202.09 to 429.32)	194.44 (118.19 to 286.33)	-1.52 (-1.691 to -1.348)
Chad	5017 (3117 to 7545)	8697 (5436 to 12933)	73.34	167.92 (104.65 to 253.67)	128.56 (80.32 to 191.38)	-1.055 (-1.316 to -0.794)
Chile	15517 (12031 to 19050)	6127 (4752 to 7525)	-60.51	143.19 (110.98 to 177.23)	25.94 (20.21 to 31.75)	-5.268 (-6.155 to -4.373)
China	785196 (596828 to 981461)	659409 (491315 to 861139)	-16.02	105.33 (80.2 to 131.24)	34.52 (25.6 to 44.89)	-3.984 (-4.151 to -3.816)
Colombia	8971 (7043 to 11471)	10272 (7580 to 13980)	14.5	44.74 (34.81 to 56.86)	18.65 (13.76 to 25.41)	-2.495 (-2.836 to -2.154)
Comoros	422 (263 to 626)	509 (322 to 756)	20.51	200.92 (125.91 to 298.47)	98.88 (62.73 to 146.6)	-2.617 (-2.878 to -2.355)
Congo	2294 (1447 to 3316)	4257 (2629 to 6362)	85.62	191.16 (121.26 to 271.46)	131.69 (82.59 to 196.58)	-1.21 (-1.491 to -0.928)
Cook Islands	29 (21 to 39)	24 (16 to 33)	-18.88	213.33 (151.82 to 283.61)	102.98 (69.93 to 143.04)	-2.406 (-2.596 to -2.215)
Costa Rica	774 (593 to 972)	1438 (1059 to 1866)	85.67	41.73 (31.86 to 52.8)	26.1 (19.22 to 33.87)	-1.567 (-2.061 to -1.071)
Cote d'Ivoire	10505 (7298 to 14330)	16064 (10064 to 23642)	52.92	207.9 (144.75 to 284.67)	111.03 (71.56 to 162.56)	-2.492 (-2.92 to -2.063)
Croatia	4006 (3192 to 4827)	2572 (1942 to 3284)	-35.78	68.59 (54.86 to 82.86)	32.99 (25.24 to 41.3)	-3.26 (-3.906 to -2.609)
Cuba	9601 (7447 to 11960)	15299 (11298 to 19757)	59.36	95.55 (74.08 to 120.2)	80.84 (60.05 to 104.39)	-1.393 (-1.943 to -0.841)
Cyprus	367 (278 to 469)	296 (217 to 391)	-19.3	58.42 (43.98 to 76.81)	14.81 (10.94 to 19.46)	-3.968 (-4.169 to -3.766)
Czechia	9850 (7697 to 12008)	10599 (7790 to 13472)	7.61	75.33 (59.29 to 91.1)	57.27 (42.28 to 72.23)	-0.875 (-1.205 to -0.544)
Democratic People's Republic of Korea	12764 (8833 to 17202)	16531 (11796 to 22741)	29.51	78 (54.35 to 103.47)	50.33 (35.96 to 68.77)	-1.216 (-1.321 to -1.11)
Democratic Republic of the Congo	26605 (15336 to 45045)	47043 (28512 to 74265)	76.82	144.42 (83.33 to 243.84)	98.3 (60.47 to 156.63)	-1.119 (-1.291 to -0.947)
Denmark	7347 (5735 to 9061)	4452 (3270 to 5769)	-39.4	90.86 (71.44 to 111.17)	36.13 (26.8 to 46.17)	-2.851 (-3.202 to -2.499)
Djibouti	458 (299 to 655)	1327 (812 to 2076)	189.5	278.23 (187.88 to 394.55)	178.15 (113.57 to 271.53)	-1.486 (-1.634 to -1.337)
Dominica	27 (20 to 36)	25 (17 to 35)	-10.01	47.43 (34.62 to 61.05)	29.83 (20.86 to 42.6)	-1.056 (-1.293 to -0.82)
Dominican Republic	2125 (1542 to 2807)	3793 (2589 to 5584)	78.48	60.21 (43.67 to 79.68)	37.67 (25.7 to 55.58)	-0.604 (-0.979 to -0.228)
Ecuador	4944 (3835 to 6316)	5152 (3480 to 7002)	4.2	91.13 (70.06 to 116.78)	31.22 (21.13 to 42.36)	-2.78 (-3.089 to -2.47)

Egypt	40115 (31304 to 49189)	71855 (52474 to 96916)	79.12	131.9 (101.26 to 164.53)	109.15 (79.92 to 146.06)	0.042 (-0.179 to 0.264)
El Salvador	1343 (978 to 1786)	2347 (1543 to 3325)	74.76	41.19 (29.61 to 55.4)	38.74 (25.43 to 54.95)	0.183 (-0.128 to 0.495)
Equatorial Guinea	526 (334 to 812)	710 (421 to 1101)	34.86	234.82 (151.14 to 361.3)	104.51 (63.77 to 158.38)	-2.872 (-3.391 to -2.35)
Eritrea	4611 (2198 to 8695)	5601 (2379 to 11113)	21.46	269.42 (128.56 to 511.03)	135.14 (60.82 to 263.76)	-2.345 (-2.463 to -2.227)
Estonia	1242 (993 to 1491)	872 (684 to 1088)	-29.83	66.73 (53.35 to 79.73)	45.37 (35.68 to 56.44)	-2.803 (-3.925 to -1.667)
Eswatini	694 (474 to 950)	971 (589 to 1432)	39.87	209.93 (143.18 to 284.46)	135.41 (82.53 to 196.85)	-0.745 (-1.426 to -0.06)
Ethiopia	36654 (23645 to 52635)	19790 (13572 to 27439)	-46.01	155.89 (101.5 to 223.63)	39.2 (26.93 to 54.66)	-4.463 (-4.774 to -4.15)
Fiji	622 (459 to 791)	537 (362 to 756)	-13.68	130.12 (96.06 to 167.18)	60.93 (41.19 to 85.27)	-2.364 (-2.52 to -2.209)
Finland	4463 (3353 to 5596)	864 (645 to 1085)	-80.65	65.29 (49.26 to 81.88)	9.12 (6.96 to 11.37)	-7.088 (-7.707 to -6.464)
France	40723 (31091 to 51265)	20267 (14968 to 26326)	-50.23	50.47 (38.69 to 63.1)	15.5 (11.73 to 19.72)	-3.711 (-3.992 to -3.429)
Gabon	831 (538 to 1210)	1317 (777 to 1967)	58.41	137.58 (89.5 to 200.2)	105.7 (63.68 to 157.09)	-0.821 (-0.922 to -0.72)
Gambia	1350 (920 to 1840)	1930 (1255 to 2790)	42.9	320.91 (221.51 to 437.27)	161.41 (103.64 to 234.82)	-2.306 (-2.495 to -2.117)
Georgia	3623 (2824 to 4331)	6159 (4773 to 7593)	70.01	60.12 (46.91 to 71.94)	115.42 (90.21 to 141.97)	3.002 (1.98 to 4.034)
Germany	55565 (43251 to 68179)	35192 (26909 to 45068)	-36.66	46.08 (35.89 to 56.45)	20.3 (15.56 to 25.39)	-1.832 (-2.014 to -1.649)
Ghana	7637 (5080 to 11001)	20801 (13664 to 29591)	172.35	115.09 (77.52 to 164.06)	110.65 (72.9 to 156.7)	0.979 (0.646 to 1.313)
Greece	7908 (6176 to 9670)	10326 (7747 to 13492)	30.58	55.12 (43.23 to 67.02)	42.1 (32.33 to 52.99)	-0.288 (-0.613 to 0.038)
Greenland	75 (56 to 95)	39 (28 to 51)	-48.27	191.22 (141.93 to 246.74)	55.49 (40.45 to 73.14)	-3.517 (-3.679 to -3.354)
Grenada	54 (39 to 71)	46 (33 to 62)	-14.37	81.81 (60.64 to 108.4)	38.88 (27.75 to 52.48)	-2.394 (-2.818 to -1.968)
Guam	56 (42 to 75)	73 (54 to 97)	28.78	56.13 (41.28 to 75.15)	38.54 (28.63 to 51.53)	-0.781 (-1.096 to -0.466)
Guatemala	9847 (7431 to 12850)	7751 (5356 to 10342)	-21.28	263.98 (197.83 to 348.03)	67.19 (46.35 to 90.06)	-5 (-5.36 to -4.639)
Guinea	5558 (3616 to 8012)	9021 (5858 to 13530)	62.32	160.34 (104.13 to 231.23)	141.59 (91.35 to 211.37)	-0.156 (-0.412 to 0.102)
Guinea-Bissau	708 (473 to 990)	1269 (842 to 1879)	79.34	150.21 (100.47 to 208.54)	125.93 (84.29 to 182.86)	0.087 (-0.148 to 0.324)
Guyana	390 (288 to 514)	422 (278 to 616)	8.38	87.7 (63.58 to 116.12)	60.38 (40.05 to 87.55)	-1.17 (-1.514 to -0.824)
Haiti	3363 (1929 to 5202)	3311 (1748 to 5323)	-1.54	88.49 (51.02 to 137.17)	37.31 (20.19 to 59.71)	-2.386 (-2.614 to -2.158)
Honduras	1439 (1045 to 1908)	3261 (2186 to 4449)	126.64	62 (44.99 to 81.62)	49.42 (33.63 to 66.75)	-0.263 (-0.442 to -0.084)
Hungary	6555 (5223 to 7832)	3859 (2965 to 4928)	-41.13	49.51 (39.52 to 58.92)	25.08 (19.36 to 31.58)	-2.399 (-2.88 to -1.915)
Iceland	247 (184 to 325)	132 (95 to 178)	-46.46	84.51 (63.49 to 110.05)	23.02 (16.73 to 30.65)	-4.423 (-4.798 to -4.046)
India	517035 (392724 to 650373)	769283 (564173 to 986258)	48.79	111.63 (83.29 to 141.24)	66.39 (48.49 to 85.16)	-1.493 (-1.614 to -1.372)
Indonesia	91501 (64562 to 126926)	135153 (98211 to 180387)	47.71	85.91 (60.15 to 120.14)	58.7 (42.77 to 77.48)	-1.129 (-1.324 to -0.933)

Iran (Islamic Republic of)	11881 (9164 to 15080)	23674 (18018 to 29793)	99.26	40.55 (31.14 to 51.46)	27.18 (20.53 to 34.26)	-0.764 (-0.943 to -0.584)
Iraq	5459 (4108 to 7295)	8913 (6161 to 12718)	63.27	62.39 (46.22 to 84.59)	34.59 (23.72 to 48.06)	-2.06 (-2.166 to -1.954)
Ireland	7054 (5544 to 8818)	1821 (1297 to 2345)	-74.19	177.82 (139.44 to 222.67)	23.21 (16.91 to 29.67)	-6.821 (-7.407 to -6.231)
Israel	1727 (1313 to 2184)	1847 (1370 to 2421)	6.98	37.59 (28.37 to 47.98)	15.05 (11.25 to 19.54)	-1.969 (-2.356 to -1.581)
Italy	22253 (17243 to 27241)	14772 (10944 to 18772)	-33.62	27.22 (21.09 to 33.22)	10.88 (8.39 to 13.61)	-2.558 (-3.1 to -2.012)
Jamaica	590 (442 to 752)	632 (418 to 930)	7.14	33.39 (25.05 to 42.24)	20.42 (13.58 to 29.96)	-2.093 (-2.768 to -1.413)
Japan	219004 (175097 to 262973)	114495 (86980 to 148587)	-47.72	132.37 (105.17 to 159.83)	31.03 (24.01 to 39.13)	-4.348 (-4.605 to -4.092)
Jordan	1324 (985 to 1707)	3306 (2422 to 4320)	149.68	91.54 (67.92 to 118.49)	39.89 (29.09 to 52.04)	-2.595 (-2.772 to -2.417)
Kazakhstan	8506 (6592 to 10389)	18026 (13860 to 22658)	111.91	59.31 (45.99 to 72.44)	88.83 (68.16 to 111.52)	1.098 (0.093 to 2.113)
Kenya	13801 (9188 to 18904)	25562 (16802 to 35127)	85.22	157.5 (105.84 to 216.68)	97.95 (64.71 to 132.18)	-1.628 (-1.895 to -1.36)
Kiribati	83 (62 to 110)	153 (109 to 205)	85.78	186.41 (137.98 to 245.18)	174.21 (125.16 to 230)	-0.403 (-0.619 to -0.187)
Kuwait	556 (425 to 691)	1956 (1374 to 2565)	251.58	64.18 (48.42 to 80.53)	60.21 (41.36 to 80.72)	1.061 (0.553 to 1.572)
Kyrgyzstan	2502 (1989 to 3111)	3311 (2397 to 4354)	32.34	78.5 (62.59 to 97.49)	55.27 (40.13 to 72.7)	-1.624 (-2.147 to -1.097)
Lao People's Democratic Republic	6391 (4353 to 8869)	6815 (4749 to 9097)	6.64	290.45 (198.98 to 397.29)	148.93 (104.17 to 198.62)	-1.923 (-1.999 to -1.846)
Latvia	2206 (1784 to 2637)	1729 (1325 to 2154)	-21.62	68.7 (55.55 to 81.8)	65.19 (50.1 to 81.36)	-1.399 (-2.373 to -0.415)
Lebanon	1875 (1304 to 2789)	6130 (4409 to 8141)	226.94	87.04 (60.7 to 128.86)	97.68 (70.5 to 129.04)	1.468 (0.804 to 2.136)
Lesotho	2641 (1805 to 3645)	5995 (4096 to 8308)	126.97	294.41 (198.76 to 407.12)	466.69 (317.99 to 648.51)	2.608 (2.006 to 3.213)
Liberia	1201 (849 to 1641)	1858 (1198 to 2630)	54.67	95.71 (67.6 to 130.52)	62.99 (40.91 to 89.39)	-1.53 (-1.736 to -1.322)
Libya	1182 (853 to 1636)	2999 (2057 to 4068)	153.64	56.25 (40.24 to 78.48)	47.77 (32.86 to 65.14)	0.288 (0.066 to 0.511)
Lithuania	1690 (1362 to 2081)	2454 (1898 to 3038)	45.16	41.09 (32.98 to 50.31)	62.44 (48.56 to 77.02)	0.907 (-0.114 to 1.937)
Luxembourg	237 (172 to 303)	144 (102 to 194)	-39.12	45.44 (33.31 to 58.21)	13.61 (9.73 to 18.1)	-3.678 (-4.059 to -3.296)
Madagascar	13131 (9818 to 16983)	12248 (7923 to 17178)	-6.72	228.68 (170.54 to 297.73)	80.92 (53.48 to 114.23)	-3.386 (-3.613 to -3.158)
Malawi	9536 (6561 to 13023)	16211 (11407 to 22632)	69.99	244.87 (166.97 to 330)	193.95 (136.81 to 272.32)	-0.939 (-1.241 to -0.636)
Malaysia	20436 (15644 to 26122)	58196 (44155 to 73258)	184.77	200.72 (152.11 to 256.66)	200.39 (151.14 to 251.83)	0.507 (0.196 to 0.818)
Maldives	123 (90 to 155)	132 (91 to 177)	7.64	146.37 (106.2 to 185.24)	36.92 (25.63 to 49.57)	-4.446 (-4.641 to -4.25)
Mali	3637 (2531 to 4879)	7664 (4859 to 10975)	110.7	84.76 (58.42 to 113.73)	79.5 (51.19 to 113.18)	0.499 (0.27 to 0.728)
Malta	257 (198 to 323)	181 (132 to 242)	-29.55	61.11 (46.57 to 77.5)	21.47 (15.91 to 27.86)	-3.625 (-4.012 to -3.237)
Marshall Islands	38 (26 to 51)	67 (46 to 96)	76.43	172.37 (118.08 to 235.59)	144.08 (98.67 to 203.59)	-0.491 (-0.549 to -0.433)
Mauritania	1826 (1321 to 2528)	1819 (1169 to 2498)	-0.38	159.91 (115.49 to 221.1)	71.82 (46.67 to 98.6)	-2.607 (-2.782 to -2.433)

Mauritius	1133 (925 to 1382)	1203 (931 to 1492)	6.11	150.87 (122.45 to 183.66)	68.14 (52.57 to 84.38)	-2.466 (-3.262 to -1.663)
Mexico	36505 (28612 to 44300)	50068 (36243 to 65662)	37.15	84.23 (65.45 to 103.43)	37.94 (27.46 to 49.9)	-2.584 (-3.327 to -1.835)
Micronesia (Federated States of)	163 (112 to 220)	175 (121 to 248)	7.37	274.48 (190.91 to 371.42)	196.59 (137.2 to 277.24)	-1.07 (-1.18 to -0.96)
Monaco	36 (24 to 50)	28 (19 to 40)	-22.08	56.4 (38.82 to 76.01)	31.58 (21.74 to 45.53)	-1.339 (-1.548 to -1.13)
Mongolia	1067 (758 to 1408)	1787 (1263 to 2372)	67.54	90.37 (64.12 to 119.22)	57.14 (40.13 to 75.23)	-1.388 (-1.617 to -1.159)
Montenegro	276 (204 to 354)	266 (188 to 357)	-3.61	42.98 (31.7 to 55.39)	29.22 (20.88 to 39.36)	-0.874 (-1.234 to -0.513)
Morocco	7215 (5055 to 9707)	8822 (5875 to 12479)	22.28	46.43 (32.6 to 62.53)	24.34 (16.44 to 34.13)	-1.767 (-1.909 to -1.625)
Mozambique	9764 (6977 to 12903)	18524 (12813 to 25702)	89.72	153.49 (110.61 to 203.22)	139.56 (97.01 to 193.92)	0.484 (0.216 to 0.752)
Myanmar	64954 (45241 to 88626)	40974 (28997 to 55333)	-36.92	275.19 (195.29 to 373.76)	84.75 (59.36 to 113.83)	-3.83 (-3.954 to -3.705)
Namibia	2501 (1638 to 3734)	3043 (1941 to 4538)	21.66	375.58 (252.1 to 554.18)	201.02 (132.45 to 290.6)	-2.103 (-2.531 to -1.673)
Nauru	19 (13 to 25)	18 (12 to 24)	-6.14	302.58 (212.52 to 407.61)	229.73 (154.29 to 309.72)	-0.984 (-1.234 to -0.734)
Nepal	16753 (11285 to 24376)	15354 (9579 to 22689)	-8.35	182.11 (123.67 to 268.39)	71.11 (44.38 to 106.09)	-3.02 (-3.166 to -2.873)
Netherlands	10248 (7899 to 12808)	8118 (5945 to 10571)	-20.78	51.76 (39.96 to 64.5)	22.78 (16.87 to 29.31)	-3.086 (-3.801 to -2.365)
New Zealand	1693 (1285 to 2154)	785 (563 to 1062)	-53.63	44.9 (34.13 to 57.44)	9.24 (6.74 to 12.3)	-4.192 (-5.565 to -2.799)
Nicaragua	755 (562 to 972)	1098 (789 to 1497)	45.46	42.99 (32.11 to 56.17)	20.21 (14.43 to 27.87)	-1.58 (-1.943 to -1.216)
Niger	2858 (1973 to 3952)	5088 (3286 to 7267)	78.04	87.31 (60.79 to 119.53)	55.93 (36.87 to 79.51)	-1.371 (-1.463 to -1.279)
Nigeria	25568 (17481 to 36730)	32364 (20111 to 47514)	26.58	53.08 (36.27 to 77.25)	28.81 (18.36 to 42.11)	-2.062 (-2.366 to -1.757)
Niue	3 (2 to 4)	2 (1 to 3)	-27.14	127.03 (86.25 to 180.56)	91.64 (62.64 to 131.37)	-1.364 (-1.46 to -1.268)
North Macedonia	784 (588 to 1004)	652 (458 to 885)	-16.84	40.43 (30.06 to 51.92)	20.76 (14.6 to 27.89)	-1.893 (-2.251 to -1.534)
Northern Mariana Islands	38 (25 to 54)	40 (29 to 51)	5.22	124.84 (86.97 to 174.64)	69.35 (51.38 to 91.48)	-1.74 (-1.94 to -1.54)
Norway	5948 (4464 to 7670)	1623 (1115 to 2222)	-72.71	83.19 (63.54 to 105.68)	14.97 (10.77 to 19.98)	-5.452 (-5.793 to -5.11)
Oman	629 (437 to 879)	767 (524 to 1071)	21.99	74.89 (51.94 to 104.27)	30.65 (20.63 to 43.06)	-1.92 (-2.237 to -1.603)
Pakistan	47612 (31041 to 69720)	58671 (32507 to 94131)	23.23	84.26 (54.44 to 123.39)	47.26 (26.34 to 76.78)	-2.053 (-2.392 to -1.713)
Palau	15 (10 to 21)	21 (14 to 30)	44.65	125.94 (88.47 to 177.37)	91.06 (62.74 to 126.46)	-0.991 (-1.072 to -0.909)
Palestine	865 (626 to 1165)	1577 (1159 to 2055)	82.33	100.78 (72.75 to 135.33)	59.98 (43.1 to 78.41)	-1.423 (-1.602 to -1.244)
Panama	656 (498 to 841)	708 (473 to 994)	7.96	42.64 (32.22 to 55.02)	15.98 (10.69 to 22.37)	-2.581 (-2.886 to -2.274)
Papua New Guinea	2587 (1671 to 3789)	4846 (3102 to 7796)	87.36	113.83 (74.11 to 168.9)	71.52 (45.88 to 114.87)	-1.196 (-1.321 to -1.071)
Paraguay	1951 (1451 to 2522)	3745 (2429 to 5384)	91.93	86.04 (63.96 to 112.04)	63.65 (41.16 to 91.13)	-0.58 (-0.838 to -0.322)
Peru	11822 (8619 to 15307)	24722 (17015 to 35862)	109.12	93.95 (68.14 to 122.44)	71.8 (49.48 to 104.24)	-1.048 (-1.311 to -0.784)

Philippines	81996 (65882 to 99677)	159708 (116812 to 208028)	94.78	246.83 (196.43 to 307.83)	189.99 (139.35 to 246.52)	-0.013 (-0.306 to 0.28)
Poland	31436 (25617 to 37391)	48459 (37569 to 61987)	54.15	72.78 (59.4 to 86.68)	78.08 (60.53 to 99.11)	0.884 (0.575 to 1.193)
Portugal	8695 (6697 to 10650)	5319 (3886 to 6818)	-38.83	67.33 (52.24 to 82.64)	26.01 (19.33 to 32.64)	-3.112 (-3.576 to -2.645)
Puerto Rico	2475 (1780 to 3279)	1291 (900 to 1810)	-47.83	69.72 (49.87 to 92.85)	22.12 (15.66 to 30.92)	-3.632 (-3.862 to -3.402)
Qatar	91 (64 to 125)	332 (222 to 471)	265.59	54.44 (38.06 to 75.67)	18.38 (11.89 to 26.11)	-2.393 (-2.999 to -1.783)
Republic of Korea	24388 (18869 to 30386)	32516 (23241 to 43001)	33.33	89.98 (68.75 to 113.89)	35.5 (25.44 to 46.64)	-2.04 (-2.389 to -1.69)
Republic of Moldova	4755 (3841 to 5813)	7230 (5636 to 8906)	52.04	102.91 (82.95 to 126.14)	138.5 (107.89 to 169.82)	1.276 (0.395 to 2.164)
Romania	30930 (24656 to 36824)	29000 (21567 to 35703)	-6.24	116 (92.69 to 138.14)	100.57 (74.92 to 123.58)	-1.277 (-1.869 to -0.682)
Russian Federation	92887 (77086 to 107813)	204249 (162465 to 247559)	119.89	52.91 (43.98 to 61.3)	101.87 (81.09 to 122.95)	0.924 (-0.953 to 2.838)
Rwanda	12545 (8453 to 17457)	11813 (7608 to 17083)	-5.83	428.97 (292.87 to 592.7)	191.02 (125.03 to 278.71)	-3.561 (-3.929 to -3.191)
Saint Kitts and Nevis	20 (15 to 27)	19 (13 to 27)	-4.8	57.9 (42.04 to 76.14)	27.2 (18.47 to 38.39)	-2.88 (-3.22 to -2.538)
Saint Lucia	55 (41 to 70)	61 (42 to 83)	11.42	62.61 (47.12 to 80.45)	25.95 (17.76 to 35.42)	-3.345 (-3.717 to -2.971)
Saint Vincent and the Grenadines	29 (21 to 37)	52 (36 to 70)	81.94	39.84 (29.47 to 51.74)	37.59 (26.25 to 50.19)	-0.48 (-0.85 to -0.11)
Samoa	176 (127 to 235)	225 (161 to 298)	28.2	188.54 (137.97 to 252.86)	144.25 (103.12 to 189.51)	-0.907 (-1.064 to -0.749)
San Marino	10 (7 to 14)	5 (3 to 8)	-51.29	30.04 (21.56 to 40.47)	6.61 (3.59 to 10.62)	-3.606 (-4.036 to -3.174)
Sao Tome and Principe	71 (49 to 97)	115 (74 to 174)	61.61	104.58 (72.28 to 142.89)	82.31 (53.96 to 122.36)	-0.918 (-1.306 to -0.529)
Saudi Arabia	5613 (3609 to 8130)	18722 (12354 to 26732)	233.52	74.71 (47.72 to 107.86)	56.47 (39.43 to 78.99)	-0.349 (-0.613 to -0.084)
Senegal	4768 (3405 to 6362)	5813 (3737 to 8176)	21.92	124.41 (87.54 to 163.86)	61.53 (38.98 to 85.72)	-2.25 (-2.381 to -2.119)
Serbia	4531 (3477 to 5779)	3979 (2946 to 5242)	-12.19	41.37 (31.62 to 52.68)	27.8 (20.77 to 36.5)	-0.794 (-1.086 to -0.502)
Seychelles	192 (145 to 236)	204 (152 to 271)	6.35	340.56 (256.9 to 418.38)	175.16 (129.64 to 232.38)	-1.555 (-1.778 to -1.332)
Sierra Leone	4531 (3251 to 6134)	5348 (3696 to 7475)	18.03	202.16 (144.79 to 274.21)	114.84 (79.71 to 158.73)	-1.495 (-1.724 to -1.266)
Singapore	3456 (2634 to 4352)	3565 (2613 to 4624)	3.17	150.54 (113.77 to 194.45)	41.07 (30.04 to 53.25)	-3.628 (-3.958 to -3.297)
Slovakia	9763 (7435 to 12376)	4621 (3403 to 6076)	-52.67	166.99 (127.05 to 211.05)	53.31 (39.31 to 69.64)	-2.893 (-3.114 to -2.672)
Slovenia	1727 (1339 to 2155)	987 (719 to 1273)	-42.87	72.35 (56.16 to 89.66)	29.05 (21.48 to 37.5)	-2.982 (-3.316 to -2.647)
Solomon Islands	1079 (621 to 1496)	2016 (1423 to 2691)	86.72	658.52 (383.23 to 913.67)	460.64 (329.12 to 622.22)	-1.032 (-1.219 to -0.845)
Somalia	8869 (5347 to 13799)	14268 (8835 to 21835)	60.88	281.39 (171.87 to 429.02)	171.77 (106.98 to 258.68)	-1.673 (-1.777 to -1.568)
South Africa	88509 (70541 to 107697)	86110 (65617 to 108409)	-2.71	339.48 (268.76 to 414.22)	156.08 (118.44 to 196.09)	-2.022 (-2.584 to -1.457)
South Sudan	5841 (3825 to 8815)	6522 (4052 to 9641)	11.65	214.15 (139.53 to 314.82)	143.13 (88.74 to 213.73)	-1.553 (-1.824 to -1.282)

Spain	29302 (23169 to 35461)	14808 (10932 to 19132)	-49.46	58.19 (46.56 to 70.34)	16.07 (12.05 to 20.37)	-3.664 (-3.858 to -3.47)
Sri Lanka	12204 (9165 to 15915)	7228 (3958 to 10945)	-40.78	106 (79.02 to 138.08)	27.63 (15.37 to 41.51)	-4.22 (-4.46 to -3.979)
Sudan	7715 (4823 to 11822)	9171 (5328 to 14826)	18.86	75.87 (47.06 to 115.9)	40.75 (24.17 to 66.49)	-1.816 (-1.919 to -1.712)
Suriname	261 (201 to 328)	311 (207 to 451)	19.05	96.33 (74.58 to 122.22)	48.06 (32.02 to 70.42)	-2.101 (-2.424 to -1.777)
Sweden	9322 (6877 to 12115)	3168 (2201 to 4328)	-66.01	61.7 (45.93 to 79.35)	14.35 (10.23 to 19.38)	-4.223 (-4.663 to -3.782)
Switzerland	6371 (4785 to 8146)	2476 (1790 to 3299)	-61.14	60.15 (45.78 to 76.35)	12.62 (9.38 to 16.45)	-4.381 (-4.718 to -4.043)
Syrian Arab Republic	4369 (3099 to 5700)	7068 (4663 to 10000)	61.76	75.41 (53.98 to 99.42)	53.41 (35.95 to 74.71)	-0.776 (-0.953 to -0.599)
Taiwan (Province of China)	19174 (15149 to 22907)	28566 (21650 to 35871)	48.99	125.5 (98.37 to 151.66)	67.76 (51.84 to 84.68)	-0.974 (-1.247 to -0.701)
Tajikistan	3913 (2977 to 5159)	3332 (2162 to 4947)	-14.85	129.04 (97.84 to 170.96)	44.08 (28.7 to 64.96)	-4.008 (-4.406 to -3.609)
Thailand	25464 (18785 to 33696)	98328 (67488 to 141678)	286.14	68.61 (49.96 to 93.16)	94.68 (65.84 to 135.91)	2.032 (1.628 to 2.437)
Timor-Leste	478 (294 to 684)	1048 (682 to 1555)	119.18	151.08 (94.8 to 215.45)	129.73 (84.83 to 190.38)	0.067 (-0.166 to 0.302)
Togo	3951 (2749 to 5360)	8910 (5859 to 12443)	125.51	286.79 (198.72 to 393.64)	193.44 (129.19 to 266.51)	-1.237 (-1.403 to -1.072)
Tokelau	2 (1 to 3)	1 (1 to 2)	-32.34	148.1 (101.39 to 206.77)	93.39 (62.28 to 134.74)	-1.665 (-1.737 to -1.592)
Tonga	108 (78 to 143)	120 (81 to 165)	11.73	194.76 (140.92 to 257.12)	148.78 (100.69 to 203.29)	-0.896 (-1.034 to -0.759)
Trinidad and Tobago	664 (498 to 832)	557 (374 to 798)	-16.08	76.29 (57.59 to 95.88)	29.94 (19.91 to 42.96)	-3.378 (-3.737 to -3.017)
Tunisia	3358 (2522 to 4470)	5838 (3887 to 8537)	73.85	70.3 (52.85 to 94.66)	45.22 (30.22 to 65.16)	-1.34 (-1.476 to -1.204)
Turkey	32208 (24187 to 41117)	41992 (30057 to 58630)	30.38	86.57 (64.01 to 109.98)	44.79 (32 to 61.9)	-1.907 (-2.497 to -1.313)
Turkmenistan	2005 (1615 to 2439)	2112 (1485 to 2834)	5.36	87.54 (70.57 to 105.85)	42.5 (29.82 to 57.25)	-3.088 (-3.669 to -2.504)
Tuvalu	16 (12 to 23)	16 (12 to 22)	-1.12	215.68 (158.07 to 295)	146.65 (106.53 to 198.41)	-1.156 (-1.252 to -1.06)
Uganda	8312 (5423 to 11812)	13174 (8536 to 19622)	58.49	121.15 (79.69 to 172.37)	77.05 (50.97 to 113.33)	-2.295 (-2.774 to -1.813)
Ukraine	31376 (25281 to 37467)	58152 (35238 to 86318)	85.34	49.91 (40.15 to 59.32)	99.86 (60.77 to 147.69)	0.935 (-0.154 to 2.037)
United Arab Emirates	545 (366 to 783)	1476 (977 to 2133)	170.73	89.47 (60.53 to 126.43)	39.2 (25.6 to 56.9)	-0.943 (-1.585 to -0.297)
United Kingdom	95444 (74745 to 117493)	45757 (33794 to 59840)	-52.06	107.16 (84.36 to 131.46)	36.52 (27.38 to 47.01)	-4.46 (-5.236 to -3.678)
United Republic of Tanzania	33365 (24087 to 42686)	33930 (23691 to 47249)	1.69	289.84 (210.12 to 370.39)	114.21 (78.94 to 159.08)	-3.644 (-3.921 to -3.367)
United States of America	250638 (194100 to 310655)	145589 (109883 to 184821)	-41.91	81 (62.8 to 99.93)	28.35 (21.6 to 35.76)	-3.037 (-3.413 to -2.659)
United States Virgin Islands	30 (20 to 43)	19 (12 to 28)	-36.68	32.26 (21.33 to 47.39)	12.44 (8.32 to 18.28)	-2.399 (-2.665 to -2.132)
Uruguay	2114 (1635 to 2552)	2443 (1831 to 3055)	15.57	57.99 (45.18 to 69.89)	51.4 (38.93 to 63.53)	-0.219 (-0.56 to 0.123)
Uzbekistan	5046 (3785 to 6287)	9306 (6876 to 11899)	84.43	38.75 (29.09 to 48.25)	27.72 (20.61 to 35.62)	-1.153 (-1.88 to -0.422)

Vanuatu	117 (81 to 161)	191 (137 to 260)	62.99	146.23 (103.81 to 195.92)	87.81 (62.9 to 118.43)	-1.575 (-1.68 to -1.47)
Venezuela (Bolivarian Republic of)	7723 (5902 to 9729)	10137 (6682 to 14312)	31.26	71.22 (53.91 to 90.39)	33.18 (21.85 to 46.64)	-2.029 (-2.553 to -1.501)
Viet Nam	40480 (28283 to 54507)	66325 (46403 to 88164)	63.85	97.54 (69.16 to 132.02)	64.83 (45.45 to 85.93)	-0.897 (-1.085 to -0.708)
Yemen	7242 (4670 to 11221)	13449 (7871 to 21012)	85.7	127.55 (82.76 to 198.45)	81.69 (48.04 to 129.48)	-1.327 (-1.389 to -1.266)
Zambia	6541 (4758 to 8763)	10010 (6648 to 14127)	53.04	219.71 (159.89 to 291.89)	122.8 (81.03 to 169.76)	-2.458 (-2.813 to -2.103)
Zimbabwe	17527 (12866 to 23296)	39732 (26248 to 55412)	126.69	399.34 (296.01 to 531.81)	463.27 (311.03 to 645.32)	0.96 (0.25 to 1.676)

Abbreviations: DALYs: disability-adjusted life years; EAPC: estimated annual percentage change

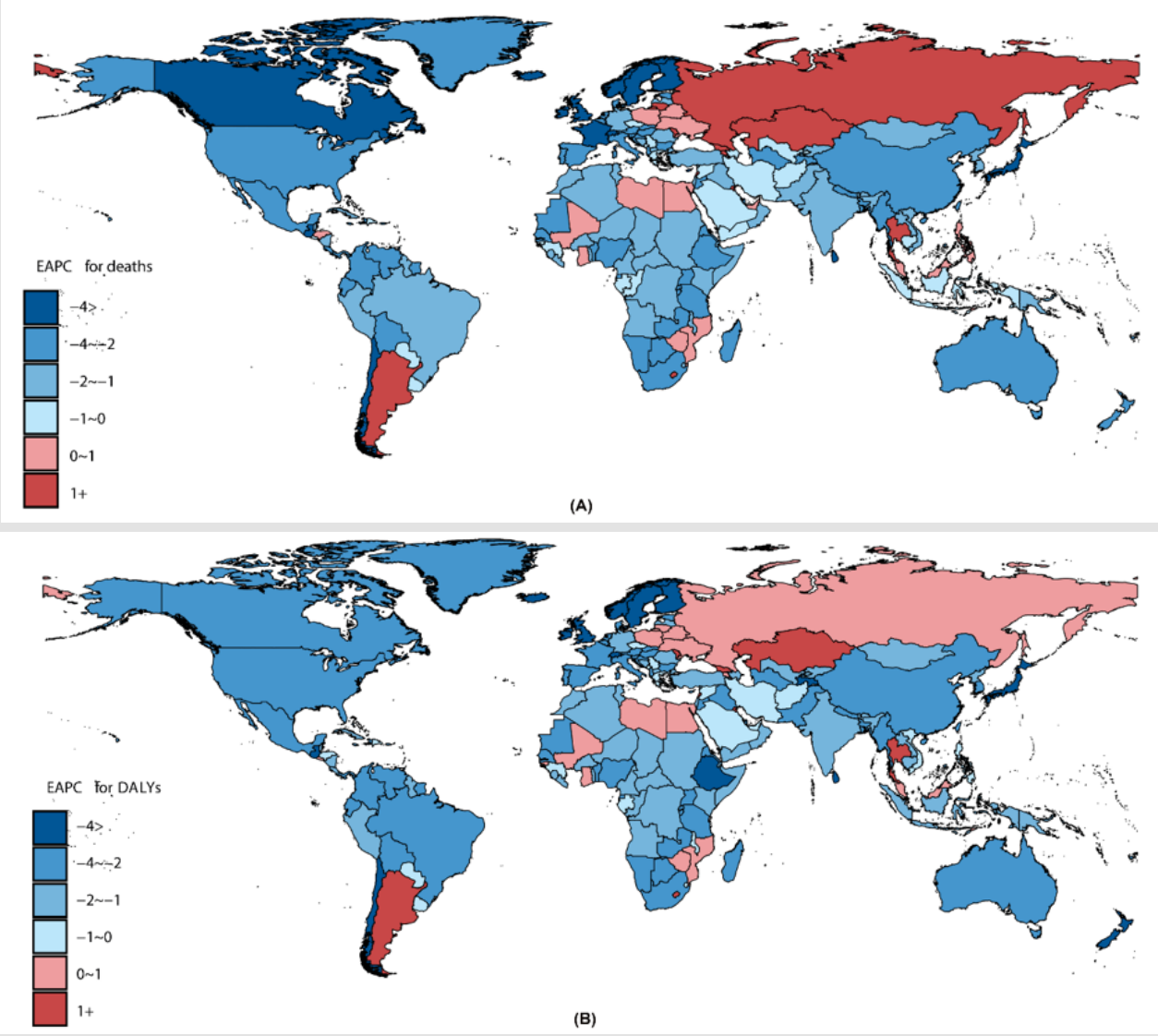


Figure 1: EAPC of smoking-attributable LRIs in the age-standardized death (A) and DALY (B) rates at the national level, 1990–2021. EAPC, estimated annual percentage change; DALYs, disability-adjusted life years.

Deaths and DALYs of LRIs Attributable to Smoking Based on Sociodemographic Index (SDI)

In high SDI regions, the number of deaths decreased to 32,595 (95% UI: 24,779 to 41,364) in 2021, while two plateaus were observed during the periods 1993-1999 and 2001-2018. In the high-middle SDI regions, the number of deaths fluctuated, showing a 43.28% increase compared to 1990. The middle and low-middle SDI regions experienced a significant increase from 1990 to 2021, reaching 59,954 (95% UI: 46,453 to 73,317) and 48,498 (95% UI: 36,706 to 60,904) in 2021, respectively. The low SDI regions consistently exhibited the lowest number of deaths, with a 27.82% increase in 2021 compared with 1990 (Figure 2A). The number of DALYs displayed similar changing patterns as the number of deaths across the five SDI regions, with middle SDI regions having the highest DALYs in 2021 at 1,356,699 (95% UI: 1,060,884 to 1,642,451) (Figure 2C). Age-standardized death and DALY rates decreased across the five SDI regions from 1990 to 2021, with high SDI regions showing the most significant decrease (death: EAPC=-3.306, 95% CI: -3.508 to -3.103; DALYs: EAPC=-3.023, 95% CI: -3.229 to -2.817) (Figures 2B & 2D). Males showed a higher smoking-attributable LRI burden across all SDI regions (Supplementary Figure 3).

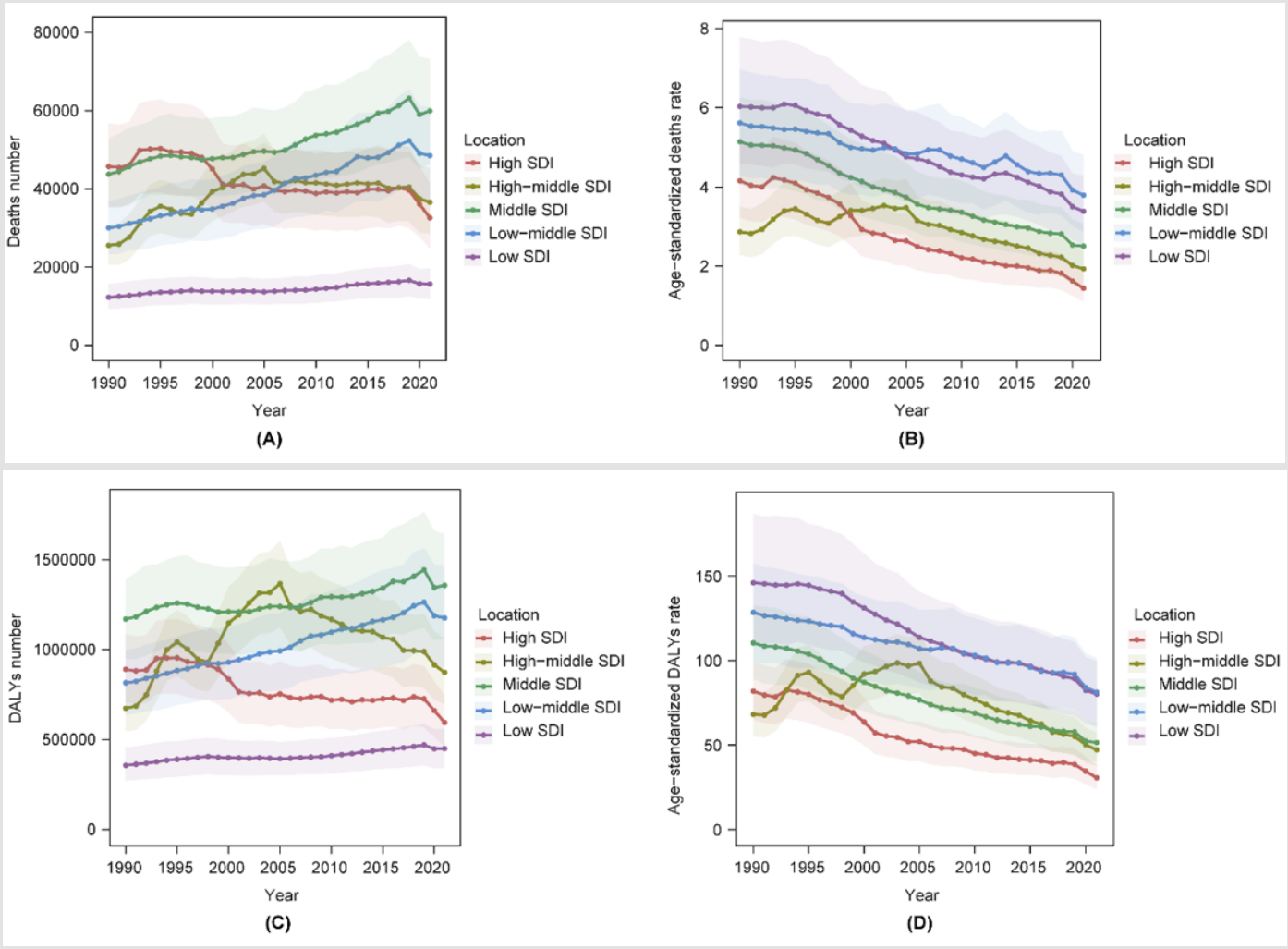


Figure 2: Deaths (A, B) and DALYs (C, D) of smoking-attributable LRIs by SDI regions, 1990–2021. DALYs, disability-adjusted life years; SDI, sociodemographic index.

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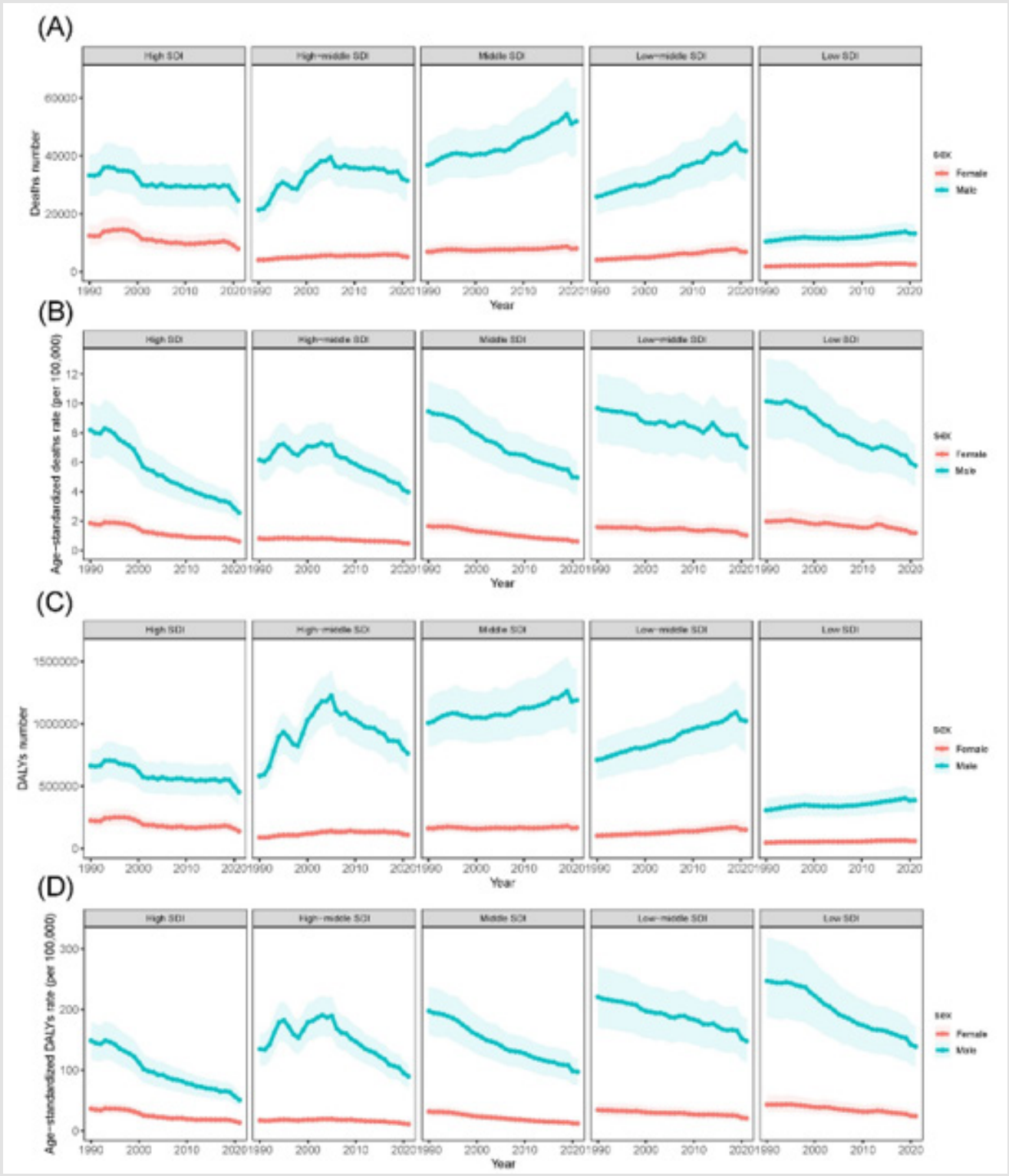

Supplementary Figure 3: Deaths (A, B) and DALYs (C, D) of smoking-attributable LRIs in five SDI regions by sex, 1990–2021.

Deaths and DALYs of LRIs Attributable to Smoking Based on Age

In 2021, the number of deaths increased with age, reaching a peak in the 70-74 age group before declining in both sexes. The age-standardized death rate increased gradually until the 70-74 age group, then sharply increased with advancing age (Figure 3A). DALYs displayed a trend similar to that of deaths, peaking around the 60-64 age group (Figure 3B). The number of deaths and DALYs remained higher in the five-year age groups centered around 70 years from 1990 to 2021, with males consistently recording higher numbers (Figures 3C & 3D).

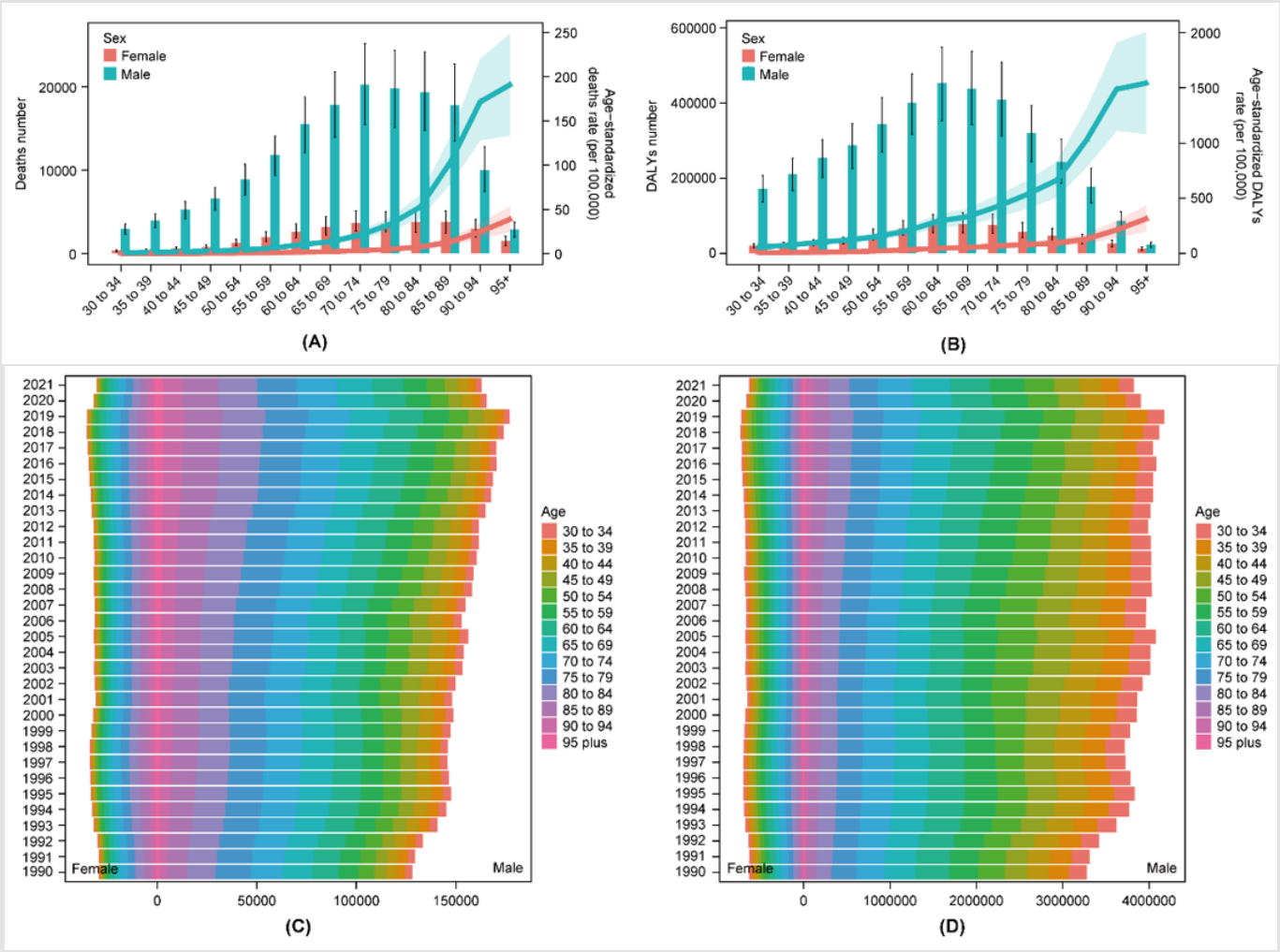

Figure 3: Age and sex distribution of global deaths (A, C) and DALYs (B, D) of smoking-attributable LRIs. DALYs, disability-adjusted life years.

Decomposition Analysis

Between 1990 and 2021, population growth contributed to 119,585 deaths (331.82%) and 2,854,603 DALYs (523.47%), whereas aging contributed to 39,290 deaths (109.02%) and 519,307 DALYs (95.23%). Epidemiological changes led to a decrease of -122,836 deaths (-340.84%) and -2,828,590 DALYs (-518.7%). Population growth had a significant impact in the middle SDI regions, followed by the low-middle SDI regions. The influence of population aging was notable in the middle- and high- SDI regions (Figures 4A & 4B). Regional analysis indicated that population aging had the most pronounced effect in East Asia, High-income Asia Pacific, and South Asia, whereas population growth was the most significant in South Asia, East Asia, and Southeast Asia. Population growth has been identified as the primary driver in many regions, particularly in Eastern Sub-Saharan Africa, and population aging also plays a significant role in Central Europe, Central Latin America, and Tropical Latin America. Although epidemiological changes notably reduced the burden of smoking-attributable LRIs in most regions, they significantly increased the burden in Eastern Europe and Southern Latin America (Figures 4C & 4D).

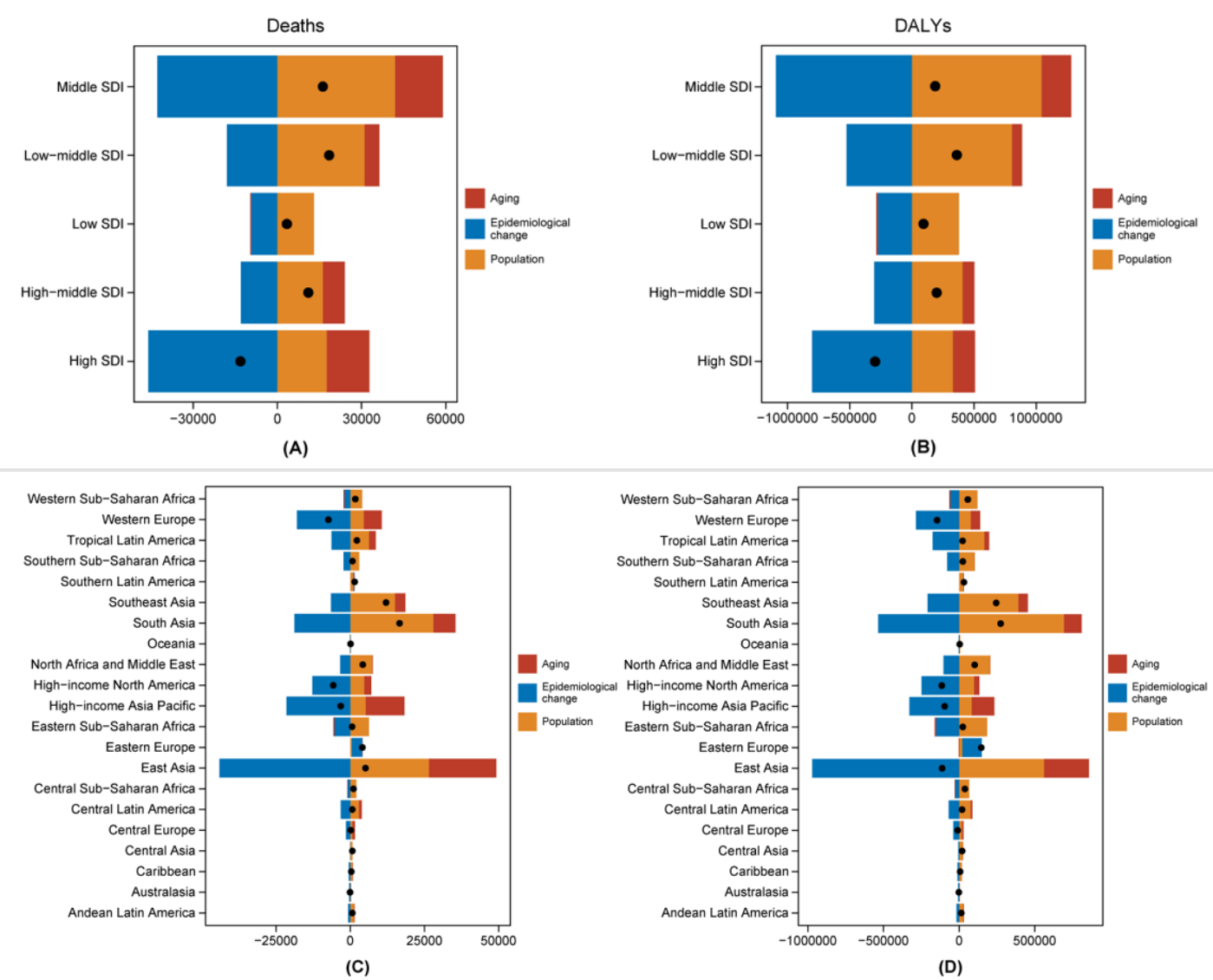

Figure 4: Decomposition of change in the number of deaths and DALYs of smoking-attributable LRIs by SDI (A, B) and region (C, D), 1990–2021. DALYs, disability-adjusted life years; SDI, sociodemographic index.

Projections of Future Burden

The projected number of deaths related to smoking-attributable LRIs is expected to decrease to 139,298 (95%CI: 87,473 to 220,262) in males and 19,625 (95%CI: 7,322 31,927) in females by 2030, while the projected number of DALYs is expected to decrease to 3,076,505 (95%CI: 1,845,159 to 4,307,851) in males and 395,393 (95%CI: 169,374 to 621,412) in females (Figures 5A & 5C). ASRs for smoking-attributable LRIs deaths and DALYs are projected to decrease, with expected rates of 1.37 (95% CI: 0.8 to 1.95) per 100,000 for deaths and 30.8 (95% CI: 17.92 to 43.68) per 100,000 for DALYs in 2030 (Figures 5B & 5D). Age-standardized DALYs rates were projected regionally, showing a decreasing trend in most areas, with relatively stable trend in Andean Latin America and Australasia (Supplementary Figure 4). The confidence intervals for the projections have negative values, which are likely due to insufficient data availability and should be adjusted to zero.

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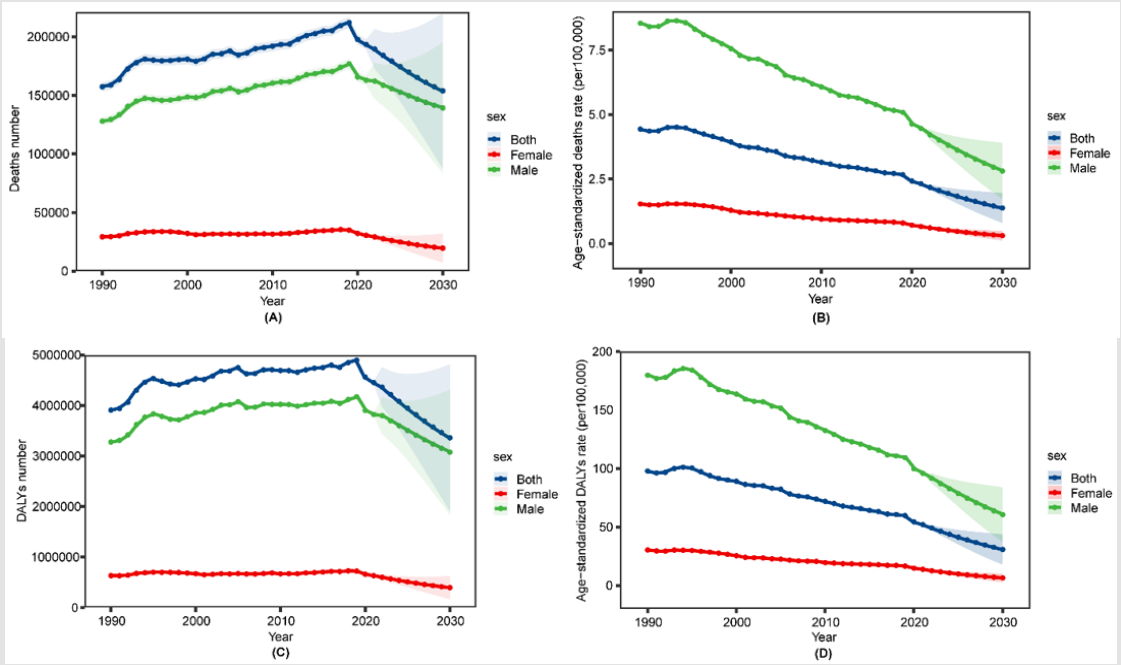
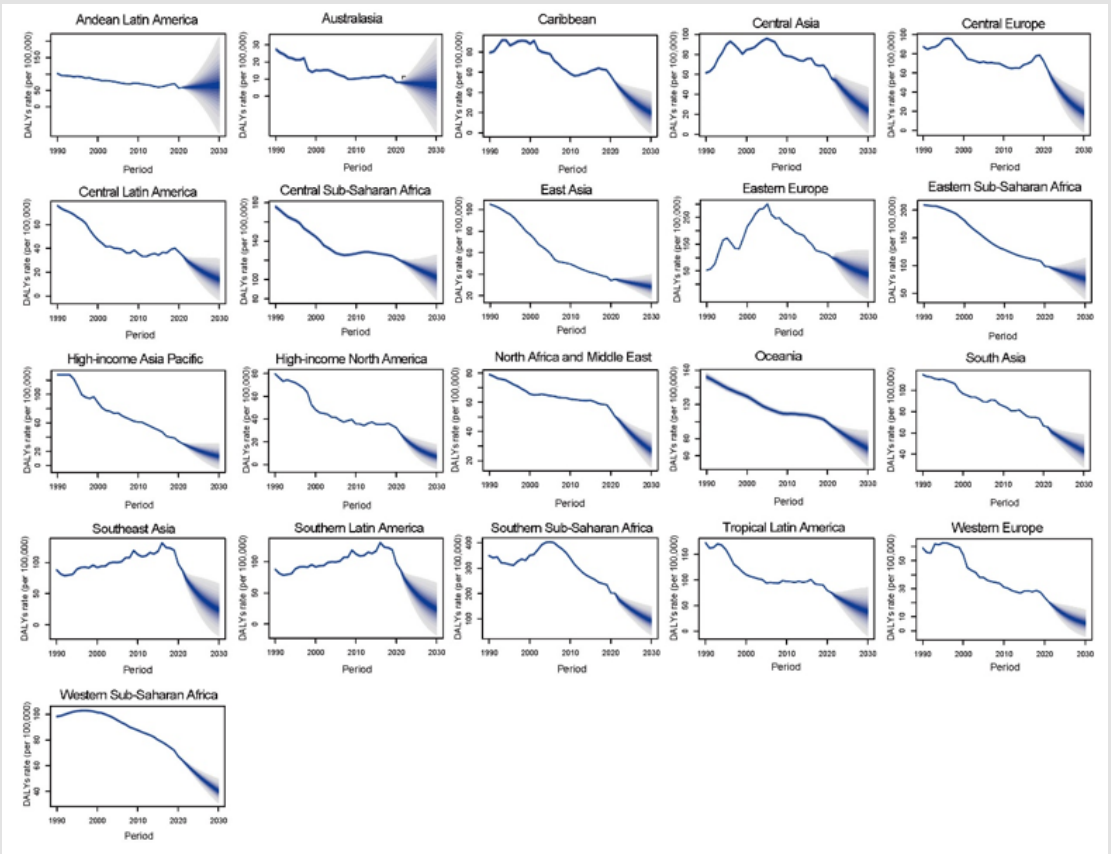


Figure 5: Projections of smoking-attributable LRIs among both sex, males, and females, until 2030. Shaded areas represent 95% confidence intervals. DALYs, disability-adjusted life years.



Supplementary Figure 4: Projection of the age-standardized DALYs rate of smoking-attributable LRIs in 21 regions until 2030.

Discussion

LRIs continue to be a major cause of morbidity and mortality worldwide, and smoking is a significant risk factor. This study analyzed data from GBD 2021 to systematically examine the global, regional, and national burden of smoking-attributable LRIs from 1990 to 2021. Disparities in disease burden were evident across regions, age groups, and genders, with a higher concentration among elderly males in the lower to middle SDI regions. Although there is a projected decrease in the burden of smoking-attributable LRIs, it is imperative to maintain efforts to control smoking to alleviate its impact.

In the last 32 years, there has been a worldwide decrease in age-standardized death and DALY rates of smoking-attributable LRIs. This reduction aligns with the overall decrease in LRIs and smoking prevalence. [1,4] Several global initiatives have been established to address LRIs, such as the Global Action Plan for Pneumonia and Diarrhea (GAPPD), which advocates for interventions targeting the primary risks associated with contracting and succumbing to LRIs. [1] Progress in preventive, diagnostic, and therapeutic tools has contributed to reducing the burden of LRIs, for instance, mRNA-based vaccines, multiplex high-throughput systems, and advances in oxygen therapy and nutritional support. [17,18] Global efforts, such as increased tobacco taxes and implementation of health warnings on tobacco products, have played a significant role in mitigating the smoking burden, particularly following the establishment of the World Health Organization Framework Convention on Tobacco Control in 2005. [19] Despite the gradual decline in smoking-attributable LRI rates, there has been an increase in absolute numbers. This increase aligns with the increase in LRIs among all adult age groups and smokers, driven by population growth and aging, underscoring the pressing need for effective interventions [2,4].

The rates of smoking-attributable LRIs were highest in the low SDI regions. Research has shown that individuals in low-income countries, especially children under 5, bear a disproportionately high burden of LRIs.20 Lower development status is correlated with limited access to medical services and healthcare systems. Factors such as poor nutrition, low vaccination coverage, and high prevalence of HIV infection increase the risk of LRIs in these regions. [20,21] Paradoxically, regions with low SDI exhibit the lowest rates of smoking-related deaths and DALYs, possibly because of the relatively high cost of tobacco products.4 However, smoking prevalence may be underestimated due to reliance on self-reported data, particularly among demographic groups where smoking is stigmatized. [4] In 2021, smoking-attributable LRIs rates were most pronounced in Southern Sub-Saharan Africa. Sustainable socioeconomic development and comprehensive, cross-sectoral interventions, supported by international cooperation, are essential for addressing LRIs in low- SDI regions. [1,2] Furthermore, stringent smoking control measures are imperative in these regions, where over 2.8 billion people are not covered by smoke-free laws [22].

In 2021, the highest absolute numbers of smoking-attributable LRIs were observed in the middle and low-middle SDI regions, demonstrating a notable increase over the past 32 years. Countries with moderate development levels have high smoking rates, potentially due to the increased accessibility of tobacco products and inadequate health awareness. [4] Despite a gradual decline in smoking prevalence since 1990, these countries have seen consistent growth in smokers, leading to a rise in smoking-related diseases.[4] In 2021, South Asia, East Asia, and Southeast Asia have reported the highest absolute numbers of smoking-attributable LRIs, with population growth and aging playing significant roles. South Asia also had the highest number of LRI-related deaths. [1] Common pathogens in LRIs include Streptococcus pneumoniae and Haemophilus influenzae type b, with low vaccine coverage in South Asia. [23] Many residents in South Asia lack access to clean cooking fuels, leading to severe household air pollution, particularly in rural areas, necessitating interventions for a complete transition to clean fuels. [24] Moreover, cottage industries in South Asia produce tobacco products sold at low prices with minimal health warnings, evading tobacco regulations and taxes imposed on factory-made cigarettes. [25] At the national level, China, with the world's largest producer and consumer of tobacco, recorded the highest number of deaths from smoking-attributable LRIs in 2021. [5] Antibiotic resistance is a critical concern in China, complicating treatment strategies for LRIs and leading to unfavorable clinical outcomes. [26] Furthermore, despite an overall decline in tobacco use, smoking prevalence is increasing among rural men born after 1990 in China [27].

The burden of smoking-attributable LRIs decreased most significantly in regions with high SDI. Smoking declines have been largest in high-income regions over the decades, falling by more than 40% in some high-income countries. [28] Due to strict tobacco tax policies, the affordability of cigarettes decreased significantly in 72% of high-income countries between 2008 and 2018—more than 33% of low-income countries and 38% of middle-income countries.4 A simultaneous increase in the consumption of snus, a smokeless tobacco product, in some high SDI regions, may suggest the potential benefits of transitioning to smokeless alternatives. [29] High SDI regions typically have more advanced healthcare services to manage LRIs, including high coverage of vaccines, advanced diagnostic technologies, greater accessibility to high-level antibiotics, and improved supportive care [20].

Moreover, strict antimicrobial stewardship in high SDI regions may reduce the spread of antimicrobial resistance. [30] Over the past 32 years, Finland and Ireland had the highest declines in smoking-attributable LRI burden. They were the first countries in the world to introduce anti-smoking legislation and have very active tobacco control policies, leading to a steady decrease in smoking-related diseases. [31,32] Notably, despite its relatively high development status, Eastern Europe has experienced a growing smoking-attributable LRIs burden over the last three decades. This region has a high prevalence

of smoking, with tobacco contributing to more than 20% of male deaths. [33] Furthermore, seasonal influenza vaccination coverage in this area is particularly inadequate [34].

Older individuals bear a significantly high burden of smoking-attributable LRIs, with rates increasing with advancing age, and numbers peaking at approximately 70 years. Smoking has a dose-dependent impact on LRIs, placing long-term smokers at elevated risk.5 Advanced age is often associated with a compromised immune system, rendering older adults more susceptible to pathogens. Additionally, older adults commonly present with multiple comorbidities during LRIs, necessitating intensive care unit admission and potentially resulting in death. [35] Although progress has been made in reducing LRIs burden in children under five, efforts for adults have been limited, with smoking remaining a significant risk factor. [1,2] Persistent smoking cessation is the most effective preventive measure against smoking-related diseases in the elderly. [36] Studies have also indicated the benefits of pneumococcal conjugate vaccines for unvaccinated older individuals. [37] Additionally, enhancing oxygen delivery systems could further decrease LRI mortality in the elderly [18].

Males demonstrated a higher burden of smoking-attributable LRIs across all age groups than females. Smoking is the primary risk factor for males, contributing to 20.2% of male deaths and 5.8% of female deaths.4 Socially, smoking is often associated with masculinity, while female smokers may encounter increased societal stigma. Females typically smoke for shorter durations and at lower intensities than males. Moreover, alcohol consumption, which is commonly accompanied by smoking, is more prevalent in males, increasing the risk of microbe aspiration and compromising the host immune system, contributing to higher LRI mortality. [38] Even after adjusting for the combined effects of risk factors, LRIs mortality remains high in males, suggesting a potential role of genetics and hormones in the differential regulation of the immune system. [39] Additionally, smoking prevalence has decreased by 27.2% among men since 1990, and by 37.9% among women, leading to a more marked decline in smoking-attributable LRIs burden in females [4].

Despite the burden of smoking-attributable LRIs expected to decrease by 2030, sustained efforts to combat tobacco use are essential for long-term management of LRIs. Reliable messaging and methods to monitor the risks of LRI-related deaths among current, former, and non-smokers are crucial. [5] Governments and health programs should issue definitive statements on the impact of smoking on infectious respiratory diseases to advocate smoking cessation. While the prevalence of smoking is projected to decline with current tobacco policies, achieving a smoking prevalence below 5% in the future will necessitate the implementation of new tobacco control measures. [40] Furthermore, effective management of risk factors such as household air pollution, ambient particulate matter, and alcohol consumption is vital for controlling LRIs. [2] This study has several limitations. First, it dependents on the accuracy of the GBD estimates, which may be constrained in regions with limited healthcare access and incomplete disease surveillance, leading to wide intervals of uncertainty due to data scarcity. Second, the assessment of tobacco exposure may have been underestimated because of the reliance on self-reported data on smoking tobacco use, focusing mainly on traditional tobacco products. Finally, the enforcement of tobacco control measures varies significantly across countries and time periods, posing challenges in establishing associations between study findings and changes in smoking interventions.

Conclusion

This study underscores the ongoing global burden of LRIs attributable to smoking, especially in the low- to middle- SDI regions and among elderly males. It is imperative to implement effective tobacco control interventions to enhance the management of LRIs, with emphasis on integrating smoking cessation strategies into clinical settings.

Conflict of Interest

The authors declare that this research was conducted in the absence of any commercial or financial relationships that could be construed as potential conflict of interest.

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Data Availability Statement

The dataset presented in this study can be found in online repositories, and all data are available on the IHME website (https://vizhub.healthdata.org/gbd-results/).

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