Global, regional, and national burden of stroke and its risk factors, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021

*GBD 2021 Stroke Risk Factor Collaborators**

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Summary

Background Up-to-date estimates of stroke burden and attributable risks and their trends at global, regional, and national levels are essential for evidence-based health care, prevention, and resource allocation planning. We aimed to provide such estimates for the period 1990–2021.

Methods We estimated incidence, prevalence, death, and disability-adjusted life-year (DALY) counts and age-standardised rates per 100 000 people per year for overall stroke, ischaemic stroke, intracerebral haemorrhage, and subarachnoid haemorrhage, for 204 countries and territories from 1990 to 2021. We also calculated burden of stroke attributable to 23 risk factors and six risk clusters (air pollution, tobacco smoking, behavioural, dietary, environmental, and metabolic risks) at the global and regional levels (21 GBD regions and Socio-demographic Index [SDI] quintiles), using the standard GBD methodology. 95% uncertainty intervals (UIs) for each individual future estimate were derived from the 2·5th and 97·5th percentiles of distributions generated from propagating 500 draws through the multistage computational pipeline.

Findings In 2021, stroke was the third most common GBD level 3 cause of death (7·3 million [95% UI 6·6–7·8] deaths; 10·7% [9·8–11·3] of all deaths) after ischaemic heart disease and COVID-19, and the fourth most common cause of DALYs (160·5 million [147·8–171·6] DALYs; 5·6% [5·0–6·1] of all DALYs). In 2021, there were 93·8 million (89·0–99·3) prevalent and 11·9 million (10·7–13·2) incident strokes. We found disparities in stroke burden and risk factors by GBD region, country or territory, and SDI, as well as a stagnation in the reduction of incidence from 2015 onwards, and even some increases in the stroke incidence, death, prevalence, and DALY rates in southeast Asia, east Asia, and Oceania, countries with lower SDI, and people younger than 70 years. Globally, ischaemic stroke constituted 65·3% (62·4–67·7), intracerebral haemorrhage constituted 28·8% (28·3–28·8), and subarachnoid haemorrhage constituted 5·8% (5·7–6·0) of incident strokes. There were substantial increases in DALYs attributable to high BMI (88·2% [53·4–117·7]), high ambient temperature (72·4% [51·1 to 179·5]), high fasting plasma glucose (32·1% [26·7–38·1]), diet high in sugar-sweetened beverages (23·4% [12·7–35·7]), low physical activity (11·3% [1·8–34·9]), high systolic blood pressure (6·7% [2·5–11·6]), lead exposure (6·5% [4·5–11·2]), and diet low in omega-6 polyunsaturated fatty acids (5·3% [0·5–10·5]).

Interpretation Stroke burden has increased from 1990 to 2021, and the contribution of several risk factors has also increased. Effective, accessible, and affordable measures to improve stroke surveillance, prevention (with the emphasis on blood pressure, lifestyle, and environmental factors), acute care, and rehabilitation need to be urgently implemented across all countries to reduce stroke burden.

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Introduction

Evidence from the Global Burden of Disease, Injuries, and Risk Factors Study (GBD) suggests that prevalent cases of total cardiovascular disease (including stroke) nearly doubled from 271 million (95% uncertainty interval [UI] 257–285) in 1990 to 523 million (497–550) in 2019.[1] Moreover, despite a consistent decline in age-standardised cardiovascular disease (including stroke) mortality rates globally in the second half of the 20th century,[1] there has been a subsequent deceleration in the decline and an overall flattening of the decline in the past few years.[1] Since 2010, age-standardised cardiovascular disease (including stroke) mortality rates have even increased in many locations (eg, Mexico, the UK, and the USA),[1,2] and the age-standardised incidence of stroke in individuals younger than 55 years has increased substantially in high-income countries.[3,4] The previous GBD study on stroke burden and risks covered the period 1990–2019, and identified stroke as the second leading cause of death in the world.[5] The most recent GBD stroke burden project[6] has estimated an almost doubling of disability-adjusted life-years (DALYs),

Research in context

Evidence before this study

The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) is the only global epidemiological study that produces comprehensive estimates of global, regional, and country-specific burden due to stroke. To evaluate the availability of evidence, we carried out a structured review of the published scientific literature in MEDLINE, Scopus, Google Scholar, and PubMed for relevant reports published in any language from Jan 1, 1990, to March 1, 2024, using search terms that included "stroke", "cerebral infarction", "isch(a)emic stroke", "intracerebral h(a)emorrage", "h(a)emorrhagic stroke", or "subarachnoid h(a)emorrage", AND "incidence", "prevalence", "mortality", or "epidemiology" or "population attributable fraction (PAF)", "risk factor(s)", "trends", or "disability-adjusted life-year(s) (DALYs)". The most recent GBD report on the burden of stroke and its risk factors covered the period from 1990 to 2019 and found that the annual number of strokes and deaths due to stroke increased substantially, despite large reductions in age-standardised rates, particularly reductions among people aged 70 years or older. The highest age-standardised stroke-related mortality and DALY rates were in the World Bank low-income group, and the fastest growing risk factor for stroke between 1990 and 2019 was high BMI.

Added value of this study

As part of GBD 2021, this study provides the most up-to-date estimates of the burden of overall stroke, ischaemic stroke, intracerebral haemorrhage, and subarachnoid haemorrhage and its risk factors. We found that stroke burden, in terms of absolute numbers, has increased substantially from 1990 to 2021. From 1990 to 2021, there was an increase in the contribution to stroke DALYs from not only high BMI, as in the previous GBD 2019 study, but also high ambient temperature, high fasting plasma glucose, diet high in sugar-sweetened beverages, low physical activity, high systolic blood pressure, and diet low in omega-6 polyunsaturated fatty acids, emphasising the increasing role of environmental factors on the heightened burden from stroke. Stroke burden was highest in low-income and middle-income countries.

Implications of all the available evidence

The findings from this study can help to guide evidence-based health-care planning, prevention, and resource allocation for stroke and its pathological types, including country-specific prioritisation of these measures. Effective, accessible, and affordable measures to improve stroke surveillance, prevention (with the emphasis on elevated blood pressure, lifestyle, and environmental factors), acute care, and rehabilitation to reduce stroke burden need to be urgently implemented across all countries.

deaths, and cost due to stroke from 2020 to 2050.[6] Globally, the age-standardised prevalence of cardiovascular disease (including stroke) risk factors (including hypertension, overweight, and diabetes)[1] are also increasing.[7] There has been a rapid increase in the number of people who died or remained disabled from stroke over the past 30 years,[5] with a trend towards increasing incidence rates in people younger than 55 years, and increased prevalence of major risk factors for stroke (elevated blood pressure, overweight, and diabetes) over the past 10–15 years. These findings necessitate timely updated data on the most recent changes in stroke burden and risks across the globe to inform adequate health-care planning, resource allocation, and priority setting for stroke and to assess the success or failure of measures to reduce stroke burden.

See Online for appendix

The current GBD 2021 study of stroke burden and risks covers the period from 1990 to 2021. It includes analysis of the additional data sources for 2019–21, with corresponding re-calculation of all previous stroke burden and risks estimates, including stroke incidence, prevalence, deaths, and DALYs for total stroke and its three main pathological types (ischaemic stroke, intracerebral haemorrhage, and subarachnoid haemorrhage). It also includes analysis of DALYs due to stroke and stroke pathological type attributable to 23 risk factors and six risk factor clusters at global, regional, and national (204 countries and territories) levels. This manuscript was produced as part of the GBD Collaborator Network and in accordance with the GBD Protocol.

Methods

Overview

Details of the GBD 2021 methods for stroke burden and risk factors estimates remained the same as for the latest GBD estimates and are described elsewhere[8–10] (appendix pp 61–99). Stroke was defined according to the clinical WHO criteria[11] and categorised into three pathological types (ischaemic stroke, intracerebral haemorrhage, and subarachnoid haemorrhage).[12] To simplify the stroke modelling process and to ensure that all major pathological types were estimated correctly, vital registration and surveillance data were used to separately produce independent acute and chronic stroke models for ischaemic stroke, intracerebral haemorrhage, and subarachnoid haemorrhage type (appendix pp 75–76). As in previous GBD stroke burden estimates, we modelled first-ever-in-a-lifetime ischaemic stroke, intracerebral haemorrhage, and subarachnoid haemorrhage from the day of stroke onset to 28 days, and separately modelled survival (prevalence) beyond 28 days.[5]

Cause of Death Ensemble modelling (CODEm) was used to estimate deaths due to overall stroke and stroke pathological types. For non-fatal disease modelling (incidence and prevalence of stroke), we used the DisMod-MR 2.1 tool,[13] a Bayesian modelling software that uses data on various disease parameters and the epidemiological relationships between these parameters.[5] In the GBD study, the incidence rate represents new events in a given year, whereas the death rate represents those that occurred in that year regardless of when the stroke occurred.

We used data from 3736 vital registration sources, 147 verbal autopsy sources, 368 incidence sources, 346 prevalence sources, 229 excess mortality sources, 7753 risk factor exposure sources, and 2733 risk factor relative risk sources. Further details of the data sources used in this analysis are available on the GBD 2021 Sources Tool website.

Stroke incidence, mortality, prevalence, and DALY estimates are presented in absolute numbers and as age-standardised rates per 100 000 population (with 95% UIs) and are stratified by age, sex, 21 GBD regions, and seven GBD super-regions (appendix pp 202–203). Countries and territories were also grouped into quintiles of high, high-middle, middle, low-middle, and low Socio-demographic Index (SDI; a summary indicator of geometric mean of normalised values of a location's lag-distributed income per capita, the average years of schooling in the population aged 15 years or older, and the total fertility rate in females younger than 25 years),[14] on the basis of their 2021 values. Expressed on a scale from 0 to 1, a location with an SDI of 0 would have a theoretical minimum level of development relevant to health, whereas a location with an SDI of 1 would have a theoretical maximum level.

Count data in tables are rounded to the nearest thousand or, when the count is less than 1000, to the nearest 10. Uncertainty was propagated throughout all of these calculations by creating 500 values for each incidence, prevalence, death, or DALY estimate and performing aggregations across causes and locations at the level of each of the 500 values for all intermediate steps in the calculation. The lower and upper bounds of the 95% UI are the 2·5th and 97·5th percentiles.

Attributable burden of stroke due to risk factors

To analyse the attributable burden of stroke and its three pathological types due to 23 risk factors currently available for such analysis in GBD 2021, we calculated population attributable fractions (PAFs) of DALYs (appendix pp 31–43), using the exposure level for each risk factor and theoretical minimum risk exposure level (TMREL) that minimises risk for each individual in the population as the reference variable.[9] We analysed data on the prevalence of exposure to a risk and derived relative risks for any risk–outcome pair for which we found sufficient evidence of a causal relationship.[15] Adjustments for mediation were applied to account for relationships involving risk factors that act indirectly on outcomes via intermediate risks, as described elsewhere.[9] Relative risk data were pooled using meta-regression of cohort, case–control, or intervention studies. From the prevalence and relative risk results, PAFs were estimated relative to the TMREL. The PAF represents a proportion of the stroke DALYs that would be decreased if the exposure to the risk factor in the past had been at the counterfactual level of the TMREL.

The risks included in the analysis were ambient particulate matter pollution; household air pollution from solid fuels; low ambient temperature (daily temperatures below the TMREL); high ambient temperature (daily temperatures above the TMREL); lead exposure; diet high in sodium; diet high in red meat; diet high in processed meat; diet low in fruits; diet low in vegetables; diet low in wholegrains; alcohol use (any alcohol dosage consumption); diet high in sugar-sweetened beverages; diet low in fibre; diet low in omega-6 polyunsaturated fatty acids; low physical activity (only for ischaemic stroke burden); smoking; second-hand smoke; high BMI; high fasting plasma glucose; high systolic blood pressure; high LDL cholesterol (only for ischaemic stroke burden); and kidney dysfunction, as measured by low glomerular filtration rate (not assessed for subarachnoid haemorrhage burden). We set the TMREL to zero for all harmful dietary risk factors with monotonically increasing risk functions (eg, processed meat intake), excluding sodium. For protective risks with monotonically declining risk functions with exposure (eg, fruit intake), we first determined the 85th percentile of exposure in the cohorts or trials used in the meta-regression of each outcome that was associated with the risk. Then, we determined the TMREL by weighting each risk–outcome pair by the relative global magnitude of each outcome.[5]

As with causes, GBD organises risk factors into four levels, from the broadest (level 1: environmental risks, behavioural risks, and metabolic risks) to the most specific (level 4; 23 individual risk factors). The PAFs of risk factor groups took into account mediation between risk factors included in the group, as explained elsewhere.[16] Percentages and number of DALYs are not mutually exclusive. The crude sum of the PAF of the risk factors might exceed 100% because the effects of many of these risk factors are mediated partly or wholly through another risk factor or risk factors.[5] Definitions of risk factors and risk groups and further details of risk factors are in the appendix (pp 31–43). Changes in the modelling of stroke for GBD 2021 are presented in the appendix (pp 44–47). Analyses were also done by cluster of risk factors. The air pollution cluster includes ambient $PM_{2·5}$ pollution and household air pollution. The behavioural risks cluster includes smoking (including second-hand smoking), dietary risks (diet high in sodium, diet high in processed meat diet, high in red meat, diet high in sugar-sweetened beverages, diet low in omega-6 polyunsaturated fatty acids, diet low in

For the **GBD 2021 Sources Tool** see https://ghdx.healthdata.org/gbd-2021/sources

	Incident cases		Deaths		Prevalent cases		DALYs	
	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021
World Bank income level								
Global	11 946 000 (10 772 000 to 13 220 000)	−21·8% (−23·7 to −19·8)	7 253 000 (6 567 000 to 7 808 000)	−39·4% (−44·0 to −34·6)	93 816 000 (89 030 000 to 99 335 000)	−8·5% (−9·7 to −7·3)	160 457 000 (147 781 000 to 171 643 000)	−38·7% (−43·4 to −34·0)
High income	1 994 000 (1 822 000 to 2 173 000)	−41·0% (−43·0 to −39·0)	930 000 (791 000 to 1 002 000)	−62·2% (−64·2 to −61·1)	21 889 000 (21 018 000 to 22 893 000)	−15·6% (−17·3 to −13·8)	16 980 000 (15 364 000 to 18 218 000)	−58·0% (−59·6 to −56·5)
Upper-middle income	5 680 000 (5 053 000 to 6 432 000)	−17·9% (−21·2 to −14·4)	3 557 000 (3 113 000 to 4 005 000)	−43·4% (−50·5 to −35·1)	38 997 000 (36 331 000 to 41 833 000)	−1·6% (−3·6 to 0·5)	73 780 000 (65 305 000 to 82 892 000)	−45·1% (−51·7 to −37·4)
Lower-middle income	3 702 000 (3 374 000 to 4 043 000)	−19·7% (−21·8 to −17·4)	2 410 000 (2 225 000 to 2 592 000)	−26·3% (−32·1 to −18·6)	28 336 000 (26 853 000 to 30 089 000)	−8·9% (−10·0 to −7·7)	60 018 000 (55 442 000 to 64 220 000)	−27·7% (−33·3 to −20·5)
Low income	561 000 (518 000 to 605 000)	−19·6% (−21·8 to −16·9)	349 000 (302 000 to 397 000)	−28·2% (−35·8 to −19·9)	4 520 000 (4 365 000 to 4 673 000)	−13·8% (−15·1 to −12·6)	9 596 000 (8 261 000 to 10 976 000)	−30·6% (−38·5 to −22·2)
SDI level								
High SDI	1 800 000 (1 632 000 to 1 981 000)	−37·3% (−39·0 to −35·4)	798 000 (683 000 to 860 000)	−59·4% (−61·6 to −57·7)	20 249 000 (19 375 000 to 21 279 000)	−13·4% (−15·1 to −11·5)	15 221 000 (13 730 000 to 16 390 000)	−54·5% (−56·6 to −52·5)
High-middle SDI	3 094 000 (2 748 000 to 3 480 000)	−25·6% (−27·7 to −23·3)	1 942 000 (1 726 000 to 2 138 000)	−46·9% (−52·0 to −41·5)	21 406 000 (20 065 000 to 22 783 000)	−8·4% (−10·4 to −6·3)	38 405 000 (34 662 000 to 42 300 000)	−46·7% (−51·9 to −41·3)
Middle SDI	4 215 000 (3 795 000 to 4 707 000)	−14·2% (−17·2 to −10·9)	2 681 000 (2 384 000 to 2 946 000)	−37·2% (−44·0 to −28·6)	30 207 000 (28 379 000 to 32 296 000)	−2·0% (−3·6 to −0·3)	59 875 000 (54 006 000 to 65 175 000)	−39·3% (−45·6 to −31·4)
Low-middle SDI	2 029 000 (1 855 000 to 2 209 000)	−16·8% (−18·9 to −14·4)	1 349 000 (1 240 000 to 1 454 000)	−23·6% (−29·9 to −15·2)	15 293 000 (14 510 000 to 16 186 000)	−6·5% (−7·8 to −5·3)	33 705 000 (30 995 000 to 36 498 000)	−26·4% (−32·5 to −18·7)
Low SDI	799 000 (737 000 to 866 000)	−21·8% (−23·8 to −19·6)	476 000 (425 000 to 528 000)	−26·5% (−33·6 to −18·1)	6 588 000 (6 323 000 to 6 864 000)	−13·6% (−14·9 to −12·4)	13 105 000 (11 572 000 to 14 675 000)	−29·5% (−37·0 to −21·1)
GBD super-regions, regions, and countries and territories								
Central Europe, eastern Europe, and central Asia	1 078 000 (968 000 to 1 198 000)	−28·4% (−30·5 to −26·3)	725 000 (669 000 to 769 000)	−45·7% (−48·2 to −43·0)	6 643 000 (6 249 000 to 7 041 000)	−13·7% (−15·6 to −11·7)	13 875 000 (12 992 000 to 14 683 000)	−43·4% (−46·1 to −40·6)
Central Asia	166 000 (154 000 to 178 000)	−8·8% (−12·1 to −5·4)	84 000 (76 000 to 92 000)	−22·2% (−28·2 to −15·3)	1 119 000 (1 082 000 to 1 160 000)	−11·7% (−13·1 to −10·0)	1 996 000 (1 809 000 to 2 181 000)	−26·8% (−32·5 to −20·1)
Armenia	5000 (4000 to 5000)	−40·7% (−44·2 to −36·7)	3000 (2000 to 3000)	−45·0% (−50·8 to −38·4)	41 000 (39 000 to 42 000)	−16·6% (−19·3 to −13·6)	56 000 (50 000 to 62 000)	−45·3% (−50·8 to −39·0)
Azerbaijan	17 000 (16 000 to 19 000)	6·1% (0·6 to 12·3)	8000 (7000 to 10 000)	−20·4% (−34·1 to −2·6)	110 000 (106 000 to 115 000)	−6·3% (−9·3 to −3·4)	187 000 (153 000 to 226 000)	−27·4% (−40·7 to −10·5)
Georgia	13 000 (12 000 to 14 000)	−16·6% (−21·5 to −11·1)	10 000 (9000 to 11 000)	−17·4% (−26·3 to −7·9)	68 000 (65 000 to 71 000)	−5·7% (−8·3 to −3·0)	184 000 (164 000 to 205 000)	−23·2% (−32·1 to −12·9)
Kazakhstan	37 000 (34 000 to 41 000)	−18·4% (−23·9 to −12·9)	23 000 (20 000 to 26 000)	−10·0% (−21·2 to 3·0)	275 000 (265 000 to 287 000)	−20·1% (−22·9 to −17·2)	509 000 (441 000 to 576 000)	−19·3% (−29·4 to −7·5)
Kyrgyzstan	8000 (7000 to 9000)	−38·2% (−42·1 to −33·6)	4000 (3000 to 5000)	−53·3% (−60·5 to −45·7)	56 000 (54 000 to 58 000)	−31·8% (−34·1 to −29·5)	108 000 (92 000 to 126 000)	−49·2% (−57·4 to −40·9)
Mongolia	6000 (5000 to 6000)	0·5% (−4·1 to 5·4)	3000 (2000 to 3000)	−37·6% (−51·4 to −22·5)	36 000 (35 000 to 37 000)	−0·8% (−3·3 to 1·8)	72 000 (60 000 to 86 000)	−37·4% (−50·4 to −22·3)
Tajikistan	12 000 (11 000 to 13 000)	11·9% (6·0 to 18·6)	6000 (4000 to 7000)	−19·0% (−36·2 to 1·9)	71 000 (68 000 to 74 000)	−8·3% (−11·0 to −5·4)	141 000 (112 000 to 170 000)	−25·8% (−41·2 to −7·3)
Turkmenistan	9000 (9000 to 10 000)	5·9% (−0·5 to 11·6)	6000 (5000 to 7000)	21·6% (−2·7 to 50·7)	70 000 (68 000 to 73 000)	18·5% (14·9 to 22·7)	158 000 (126 000 to 193 000)	21·4% (−3·4 to 49·9)
Uzbekistan	60 000 (55 000 to 65 000)	9·9% (3·9 to 16·5)	22 000 (19 000 to 26 000)	−20·8% (−31·3 to −7·8)	392 000 (377 000 to 407 000)	−3·2% (−6·7 to 1·0)	581 000 (505 000 to 672 000)	−28·0% (−37·7 to −16·4)

(Table 1 continues on next page)

	Incident cases		Deaths		Prevalent cases		DALYs	
	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021
(Continued from previous page)								
Central Europe	302 000 (273 000 to 328 000)	−36·6% (−38·3 to −35·1)	215 000 (196 000 to 230 000)	−55·3% (−58·2 to −52·5)	1 891 000 (1 797 000 to 1 996 000)	−22·8% (−24·5 to −21·3)	3 740 000 (3 455 000 to 3 993 000)	−55·5% (−58·5 to −52·7)
Albania	6000 (6000 to 7000)	−14·0% (−17·5 to −10·7)	6000 (5000 to 7000)	−25·1% (−40·0 to −8·3)	31 000 (30 000 to 33 000)	−15·4% (−17·6 to −12·9)	97 000 (79 000 to 116 000)	−34·6% (−47·6 to −19·8)
Bosnia and Herzegovina	10 000 (9000 to 11 000)	−17·1% (−23·2 to −10·6)	7000 (6000 to 8000)	−32·8% (−46·2 to −18·9)	71 000 (68 000 to 74 000)	−5·2% (−8·6 to −1·4)	127 000 (103 000 to 148 000)	−36·6% (−48·8 to −24·1)
Bulgaria	31 000 (28 000 to 34 000)	−20·9% (−25·3 to −15·9)	28 000 (25 000 to 32 000)	−37·1% (−44·2 to −29·5)	159 000 (146 000 to 173 000)	−11·3% (−16·6 to −6·4)	484 000 (424 000 to 551 000)	−37·8% (−45·4 to −29·0)
Croatia	11 000 (10 000 to 12 000)	−43·1% (−46·0 to −40·6)	7000 (6000 to 8000)	−66·2% (−69·9 to −62·3)	72 000 (70 000 to 75 000)	−20·6% (−25·0 to −16·0)	110 000 (98 000 to 123 000)	−66·9% (−70·3 to −62·9)
Czechia	23 000 (20 000 to 26 000)	−51·8% (−55·6 to −47·7)	10 000 (8000 to 11 000)	−79·2% (−81·4 to −76·8)	184 000 (178 000 to 192 000)	−26·1% (−29·4 to −22·4)	177 000 (156 000 to 197 000)	−76·8% (−79·3 to −74·0)
Hungary	22 000 (20 000 to 25 000)	−51·7% (−54·7 to −48·0)	12 000 (10 000 to 13 000)	−70·7% (−74·5 to −66·9)	162 000 (155 000 to 169 000)	−39·3% (−41·4 to −36·9)	223 000 (195 000 to 251 000)	−69·0% (−72·8 to −65·2)
Montenegro	2000 (2000 to 2000)	−6·6% (−10·4 to −2·5)	2000 (2000 to 2000)	22·6% (2·8 to 43·3)	8000 (7000 to 8000)	−10·7% (−13·1 to −7·9)	32 000 (27 000 to 37 000)	1·3% (−16·1 to 19·9)
North Macedonia	7000 (7000 to 8000)	−8·6% (−14·5 to −2·2)	7000 (5000 to 8000)	−1·8% (−18·1 to 15·4)	40 000 (36 000 to 43 000)	−18·8% (−23·4 to −13·6)	120 000 (98 000 to 142 000)	−20·1% (−34·3 to −6·3)
Poland	72 000 (62 000 to 83 000)	−35·1% (−37·8 to −32·0)	45 000 (40 000 to 49 000)	−65·5% (−68·2 to −62·8)	485 000 (441 000 to 535 000)	−16·8% (−20·1 to −13·6)	800 000 (726 000 to 876 000)	−63·9% (−66·6 to −60·9)
Romania	64 000 (58 000 to 70 000)	−33·4% (−37·5 to −29·0)	53 000 (47 000 to 59 000)	−45·5% (−51·4 to −39·7)	369 000 (351 000 to 387 000)	−17·8% (−21·8 to −13·0)	903 000 (810 000 to 999 000)	−44·8% (−50·6 to −38·6)
Serbia	32 000 (29 000 to 35 000)	−26·9% (−31·5 to −22·3)	28 000 (24 000 to 33 000)	−49·6% (−57·8 to −39·8)	152 000 (141 000 to 165 000)	−25·9% (−30·2 to −21·6)	458 000 (388 000 to 532 000)	−50·2% (−58·1 to −40·9)
Slovakia	13 000 (11 000 to 14 000)	−37·2% (−41·9 to −32·1)	6000 (5000 to 7000)	−54·3% (−62·0 to −44·1)	106 000 (102 000 to 111 000)	−27·0% (−29·2 to −24·6)	127 000 (108 000 to 147 000)	−54·7% (−61·8 to −45·1)
Slovenia	3000 (3000 to 4000)	−56·1% (−59·2 to −52·9)	2000 (2000 to 2000)	−69·5% (−73·2 to −66·2)	24 000 (23 000 to 25 000)	−30·8% (−34·7 to −26·5)	29 000 (25 000 to 32 000)	−71·8% (−74·8 to −68·7)
Eastern Europe	610 000 (536 000 to 693 000)	−27·9% (−30·8 to −25·0)	426 000 (389 000 to 460 000)	−43·3% (−46·8 to −39·5)	3 633 000 (3 342 000 to 3 928 000)	−11·1% (−13·6 to −8·2)	8 139 000 (7 532 000 to 8 761 000)	−39·4% (−43·3 to −35·4)
Belarus	27 000 (24 000 to 30 000)	−24·2% (−29·6 to −19·0)	16 000 (13 000 to 19 000)	−26·7% (−38·1 to −13·8)	177 000 (168 000 to 186 000)	−10·0% (−16·1 to −2·7)	322 000 (270 000 to 376 000)	−28·4% (−39·3 to −15·4)
Estonia	2000 (2000 to 3000)	−58·6% (−62·1 to −54·8)	1000 (1000 to 1000)	−79·0% (−81·6 to −76·7)	18 000 (17 000 to 18 000)	−30·5% (−34·9 to −26·2)	21 000 (18 000 to 23 000)	−76·7% (−79·5 to −74·2)
Latvia	7000 (6000 to 7000)	−38·3% (−42·3 to −34·2)	5000 (4000 to 6000)	−46·9% (−52·4 to −41·3)	39 000 (37 000 to 41 000)	−11·6% (−17·0 to −4·9)	81 000 (72 000 to 90 000)	−48·6% (−53·9 to −43·6)
Lithuania	10 000 (9000 to 11 000)	−28·2% (−34·0 to −22·9)	5000 (4000 to 5000)	−30·2% (−38·3 to −23·3)	50 000 (44 000 to 56 000)	−6·7% (−16·7 to 3·9)	79 000 (70 000 to 87 000)	−35·9% (−43·2 to −29·5)
Moldova	9000 (8000 to 10 000)	−31·9% (−36·5 to −27·0)	5000 (5000 to 6000)	−52·1% (−56·4 to −47·1)	53 000 (50 000 to 55 000)	−9·1% (−12·6 to −5·4)	112 000 (102 000 to 124 000)	−46·8% (−51·7 to −41·3)
Russia	422 000 (368 000 to 481 000)	−27·0% (−30·1 to −23·8)	311 000 (285 000 to 335 000)	−43·9% (−47·5 to −40·5)	2 454 000 (2 247 000 to 2 670 000)	−9·5% (−12·5 to −6·3)	5 892 000 (5 460 000 to 6 339 000)	−40·3% (−44·0 to −36·4)
Ukraine	134 000 (116 000 to 153 000)	−29·7% (−33·8 to −25·4)	82 000 (64 000 to 102 000)	−45·0% (−56·6 to −31·4)	844 000 (763 000 to 925 000)	−13·5% (−18·9 to −8·3)	1 632 000 (1 276 000 to 2 023 000)	−38·6% (−51·6 to −24·1)

(Table 1 continues on next page)

	Incident cases		Deaths		Prevalent cases		DALYs	
	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021
(Continued from previous page)								
High income	1 711 000 (1 563 000 to 1 865 000)	−41·6% (−43·7 to −39·3)	772 000 (643 000 to 838 000)	−62·3% (−64·4 to −61·1)	19 822 000 (19 019 000 to 20 724 000)	−15·9% (−17·6 to −14·0)	13 972 000 (12 517 000 to 15 091 000)	−57·7% (−59·3 to −56·2)
Australasia	36 000 (33 000 to 40 000)	−40·7% (−43·8 to −38·0)	15 000 (12 000 to 16 000)	−63·9% (−66·4 to −61·5)	368 000 (357 000 to 380 000)	−21·5% (−23·2 to −19·8)	250 000 (221 000 to 273 000)	−60·8% (−63·1 to −58·5)
Australia	31 000 (28 000 to 34 000)	−40·6% (−44·2 to −37·0)	12 000 (10 000 to 13 000)	−65·3% (−67·9 to −62·8)	313 000 (305 000 to 322 000)	−21·5% (−23·2 to −19·9)	205 000 (182 000 to 224 000)	−61·6% (−63·9 to −59·2)
New Zealand	6000 (5000 to 6000)	−41·3% (−45·2 to −37·2)	3000 (2000 to 3000)	−55·5% (−58·9 to −52·4)	55 000 (50 000 to 60 000)	−21·9% (−26·6 to −17·2)	45 000 (40 000 to 49 000)	−56·6% (−59·4 to −53·8)
High-income Asia Pacific	408 000 (372 000 to 446 000)	−46·2% (−49·0 to −43·3)	185 000 (147 000 to 207 000)	−71·2% (−73·3 to −69·6)	4 793 000 (4 539 000 to 5 071 000)	−24·1% (−26·0 to −21·6)	3 386 000 (2 955 000 to 3 726 000)	−65·5% (−67·5 to −63·6)
Brunei	510 (460 to 560)	−45·4% (−48·5 to −41·9)	170 (150 to 200)	−51·1% (−58·5 to −40·6)	5000 (5000 to 5000)	−39·6% (−41·1 to −37·9)	5000 (4000 to 6000)	−53·0% (−60·1 to −43·3)
Japan	305 000 (276 000 to 336 000)	−37·7% (−41·7 to −32·8)	147 000 (115 000 to 165 000)	−67·1% (−69·0 to −65·6)	3 607 000 (3 367 000 to 3 852 000)	−14·1% (−16·8 to −10·5)	2 575 000 (2 246 000 to 2 840 000)	−57·6% (−59·6 to −55·8)
Singapore	7000 (6000 to 7000)	−63·1% (−66·0 to −60·2)	1000 (1000 to 1000)	−84·3% (−85·8 to −83·0)	83 000 (80 000 to 86 000)	−48·6% (−50·1 to −46·8)	36 000 (31 000 to 40 000)	−79·6% (−81·3 to −78·0)
South Korea	96 000 (86 000 to 106 000)	−67·1% (−69·0 to −65·2)	37 000 (31 000 to 42 000)	−82·5% (−84·7 to −79·2)	1 097 000 (1 063 000 to 1 135 000)	−51·4% (−52·6 to −50·0)	770 000 (676 000 to 862 000)	−81·5% (−83·2 to −78·9)
High-income North America	466 000 (410 000 to 528 000)	−33·6% (−36·7 to −30·4)	209 000 (177 000 to 225 000)	−34·1% (−37·0 to −32·0)	7 005 000 (6 589 000 to 7 467 000)	−2·6% (−6·1 to 0·9)	4 254 000 (3 847 000 to 4 597 000)	−30·1% (−32·6 to −28·2)
Canada	54 000 (51 000 to 58 000)	−36·8% (−42·1 to −31·1)	17 000 (14 000 to 19 000)	−57·0% (−60·0 to −54·0)	705 000 (691 000 to 720 000)	−10·7% (−13·0 to −8·3)	341 000 (304 000 to 374 000)	−49·3% (−52·4 to −46·3)
Greenland	80 (80 to 90)	−48·2% (−51·2 to −44·9)	40 (30 to 40)	−61·1% (−67·1 to −53·3)	840 (810 to 870)	−39·1% (−41·7 to −36·9)	880 (760 to 1010)	−60·7% (−66·4 to −53·7)
USA	412 000 (358 000 to 470 000)	−33·3% (−36·4 to −30·0)	192 000 (163 000 to 207 000)	−31·3% (−34·3 to −29·1)	6 299 000 (5 889 000 to 6 761 000)	−1·7% (−5·5 to 2·2)	3 912 000 (3 534 000 to 4 228 000)	−27·9% (−30·3 to −25·9)
Southern Latin America	82 000 (76 000 to 89 000)	−42·1% (−44·8 to −39·7)	36 000 (33 000 to 39 000)	−63·1% (−65·0 to −61·1)	799 000 (773 000 to 825 000)	−28·6% (−30·2 to −26·9)	775 000 (726 000 to 825 000)	−62·6% (−64·5 to −60·7)
Argentina	54 000 (49 000 to 58 000)	−42·5% (−45·6 to −39·4)	23 000 (21 000 to 25 000)	−64·3% (−66·4 to −62·3)	518 000 (500 000 to 537 000)	−29·4% (−31·4 to −27·4)	510 000 (479 000 to 543 000)	−63·3% (−65·4 to −61·2)
Chile	23 000 (21 000 to 25 000)	−39·0% (−42·6 to −35·2)	10 000 (9000 to 11 000)	−60·8% (−63·6 to −58·4)	230 000 (222 000 to 238 000)	−21·0% (−23·3 to −18·8)	202 000 (187 000 to 218 000)	−60·6% (−62·9 to −58·3)
Uruguay	6000 (5000 to 6000)	−44·0% (−47·2 to −40·7)	3000 (3000 to 4000)	−54·7% (−57·5 to −52·1)	51 000 (49 000 to 53 000)	−36·7% (−38·4 to −34·6)	62 000 (58 000 to 66 000)	−55·8% (−58·2 to −53·3)
Western Europe	717 000 (664 000 to 771 000)	−43·4% (−45·7 to −41·0)	326 000 (272 000 to 355 000)	−68·3% (−70·2 to −67·0)	6 858 000 (6 651 000 to 7 084 000)	−22·4% (−23·8 to −20·8)	5 307 000 (4 726 000 to 5 734 000)	−65·1% (−66·6 to −63·5)
Andorra	90 (80 to 110)	−28·2% (−32·7 to −24·0)	40 (30 to 50)	−49·5% (−65·2 to −30·4)	930 (890 to 970)	−19·3% (−21·7 to −17·0)	640 (500 to 800)	−48·8% (−63·6 to −31·8)
Austria	17 000 (15 000 to 19 000)	−34·2% (−39·7 to −27·3)	5000 (4000 to 5000)	−75·7% (−77·6 to −74·2)	196 000 (191 000 to 202 000)	−1·1% (−3·5 to 1·2)	94 000 (84 000 to 104 000)	−68·6% (−71·2 to −66·3)
Belgium	17 000 (16 000 to 19 000)	−44·0% (−48·5 to −38·8)	8000 (6000 to 8000)	−67·7% (−70·1 to −65·8)	151 000 (147 000 to 155 000)	−18·1% (−21·8 to −14·3)	127 000 (112 000 to 139 000)	−63·7% (−65·7 to −61·7)
Cyprus	1000 (1000 to 1000)	−48·3% (−52·2 to −44·1)	770 (640 to 900)	−73·1% (−78·1 to −66·9)	10 000 (9000 to 11 000)	−39·2% (−41·4 to −36·5)	12 000 (10 000 to 14 000)	−72·6% (−77·7 to −66·9)

(Table 1 continues on next page)

	Incident cases		Deaths		Prevalent cases		DALYs	
	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021
(Continued from previous page)								
Denmark	8000 (7000 to 9000)	−49·1% (−52·5 to −45·2)	4000 (4000 to 5000)	−58·5% (−61·3 to −56·0)	79 000 (76 000 to 82 000)	−34·9% (−36·9 to −33·0)	70 000 (63 000 to 76 000)	−60·2% (−62·5 to −58·1)
Finland	12 000 (11 000 to 13 000)	−40·3% (−43·5 to −36·6)	5000 (4000 to 5000)	−62·8% (−65·7 to −60·5)	127 000 (123 000 to 130 000)	−21·9% (−23·5 to −20·4)	84 000 (74 000 to 91 000)	−61·2% (−63·4 to −59·1)
France	94 000 (88 000 to 101 000)	−23·1% (−26·7 to −18·8)	43 000 (36 000 to 47 000)	−65·7% (−68·3 to −63·5)	929 000 (907 000 to 954 000)	−3·0% (−6·0 to −0·1)	686 000 (606 000 to 750 000)	−59·8% (−62·2 to −57·1)
Germany	185 000 (168 000 to 202 000)	−38·6% (−42·8 to −34·2)	63 000 (52 000 to 69 000)	−70·1% (−72·3 to −68·2)	1 961 000 (1 908 000 to 2 014 000)	−18·8% (−20·5 to −16·9)	1 167 000 (1 042 000 to 1 283 000)	−64·2% (−66·4 to −61·8)
Greece	27 000 (25 000 to 29 000)	−42·9% (−46·7 to −39·0)	17 000 (15 000 to 19 000)	−66·8% (−68·7 to −65·2)	185 000 (178 000 to 193 000)	−23·2% (−25·8 to −20·4)	247 000 (221 000 to 266 000)	−63·1% (−64·8 to −61·4)
Iceland	400 (360 to 450)	−49·2% (−53·4 to −45·2)	150 (120 to 170)	−63·0% (−66·8 to −59·0)	4000 (4000 to 4000)	−30·2% (−32·2 to −28·4)	3000 (2000 to 3000)	−62·3% (−65·4 to −59·1)
Ireland	4000 (4000 to 5000)	−58·6% (−61·5 to −55·7)	2000 (2000 to 2000)	−73·5% (−76·2 to −71·4)	43 000 (41 000 to 45 000)	−42·3% (−44·1 to −40·1)	32 000 (28 000 to 35 000)	−72·7% (−74·5 to −70·9)
Israel	8000 (7000 to 9000)	−50·8% (−54·1 to −47·3)	3000 (2000 to 3000)	−67·2% (−70·1 to −64·7)	92 000 (89 000 to 95 000)	−29·6% (−31·4 to −27·6)	54 000 (48 000 to 59 000)	−64·5% (−66·7 to −62·2)
Italy	92 000 (84 000 to 102 000)	−52·5% (−56·5 to −47·8)	62 000 (50 000 to 69 000)	−65·0% (−67·4 to −63·3)	727 000 (671 000 to 790 000)	−28·6% (−30·9 to −25·8)	871 000 (744 000 to 948 000)	−64·7% (−66·5 to −63·1)
Luxembourg	610 (560 to 650)	−57·2% (−59·7 to −54·4)	320 (280 to 360)	−79·2% (−81·2 to −77·2)	5000 (5000 to 6000)	−39·9% (−44·1 to −35·6)	5000 (5000 to 6000)	−77·9% (−79·7 to −75·9)
Malta	560 (510 to 620)	−54·9% (−57·7 to −51·9)	270 (220 to 300)	−72·8% (−75·4 to −69·7)	5000 (5000 to 5000)	−34·6% (−37·1 to −32·2)	4000 (4000 to 5000)	−71·1% (−73·6 to −68·3)
Monaco	80 (70 to 90)	−43·3% (−47·1 to −39·3)	50 (40 to 70)	−59·3% (−68·9 to −43·5)	700 (670 to 740)	−26·9% (−29·0 to −24·6)	800 (650 to 960)	−57·6% (−67·0 to −44·1)
Netherlands	26 000 (23 000 to 29 000)	−46·5% (−50·0 to −42·8)	12 000 (10 000 to 14 000)	−54·1% (−57·2 to −51·3)	251 000 (242 000 to 261 000)	−36·2% (−38·0 to −34·6)	199 000 (176 000 to 217 000)	−56·5% (−59·1 to −54·2)
Norway	9000 (8000 to 11 000)	−43·3% (−47·3 to −39·1)	3000 (2000 to 3000)	−68·6% (−70·7 to −67·0)	91 000 (84 000 to 99 000)	−28·7% (−31·7 to −25·4)	50 000 (44 000 to 55 000)	−65·9% (−68·0 to −64·2)
Portugal	18 000 (17 000 to 20 000)	−68·7% (−70·3 to −67·0)	14 000 (12 000 to 15 000)	−80·4% (−81·9 to −79·2)	121 000 (116 000 to 127 000)	−55·3% (−57·9 to −52·4)	204 000 (181 000 to 220 000)	−79·4% (−80·6 to −78·3)
San Marino	50 (50 to 60)	−37·8% (−41·8 to −34·2)	20 (20 to 30)	−68·7% (−77·9 to −57·7)	500 (470 to 520)	−23·5% (−25·5 to −21·5)	360 (270 to 460)	−63·0% (−72·6 to −52·2)
Spain	71 000 (67 000 to 75 000)	−50·0% (−53·9 to −45·3)	32 000 (26 000 to 35 000)	−75·1% (−76·7 to −73·5)	694 000 (679 000 to 711 000)	−19·9% (−24·4 to −14·9)	518 000 (458 000 to 569 000)	−70·3% (−72·1 to −68·6)
Sweden	18 000 (16 000 to 21 000)	−35·9% (−39·6 to −31·6)	7000 (6000 to 8000)	−62·3% (−65·9 to −58·8)	179 000 (165 000 to 194 000)	−16·9% (−22·3 to −11·5)	113 000 (99 000 to 127 000)	−59·5% (−62·8 to −56·3)
Switzerland	10 000 (9 000 to 12 000)	−41·7% (−45·7 to −36·2)	4 000 (3 000 to 5 000)	−70·6% (−73·3 to −68·1)	103 000 (99 000 to 106 000)	−19·5% (−22·3 to −17·1)	67 000 (58 000 to 75 000)	−67·5% (−69·8 to −65·2)
UK	96 000 (87 000 to 106 000)	−43·3% (−46·3 to −40·1)	41 000 (35 000 to 44 000)	−67·3% (−69·0 to −66·2)	895 000 (843 000 to 953 000)	−26·0% (−27·8 to −24·2)	690 000 (630 000 to 740 000)	−64·8% (−66·1 to −63·5)
Latin America and Caribbean	554 000 (503 000 to 611 000)	−39·6% (−41·2 to −37·9)	279 000 (254 000 to 300 000)	−53·6% (−56·6 to −50·5)	5 184 000 (4 916 000 to 5 466 000)	−26·1% (−27·3 to −24·7)	6 414 000 (5 981 000 to 6 862 000)	−53·0% (−56·1 to −49·9)
Andean Latin America	46 000 (42 000 to 50 000)	−33·6% (−35·7 to −31·3)	22 000 (19 000 to 26 000)	−48·0% (−56·5 to −37·7)	496 000 (481 000 to 513 000)	−19·8% (−21·0 to −18·6)	544 000 (460 000 to 644 000)	−49·8% (−58·1 to −40·3)

(Table 1 continues on next page)

	Incident cases		Deaths		Prevalent cases		DALYs	
	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021
(Continued from previous page)								
Bolivia	8000 (7000 to 9000)	−31·8% (−34·3 to −28·6)	5000 (4000 to 7000)	−46·1% (−57·5 to −28·9)	75 000 (72 000 to 78 000)	−25·1% (−26·8 to −23·4)	134 000 (98 000 to 180 000)	−51·0% (−61·9 to −34·1)
Ecuador	14 000 (13 000 to 16 000)	−25·9% (−28·9 to −21·9)	6000 (5000 to 8000)	−44·7% (−54·4 to −33·6)	153 000 (148 000 to 158 000)	−18·4% (−20·3 to −16·5)	146 000 (119 000 to 178 000)	−48·8% (−57·9 to −38·5)
Peru	24 000 (22 000 to 26 000)	−37·8% (−40·6 to −34·6)	11 000 (8000 to 13 000)	−49·6% (−62·0 to −34·1)	269 000 (260 000 to 277 000)	−19·5% (−21·3 to −17·9)	264 000 (212 000 to 327 000)	−49·3% (−60·4 to −35·2)
Caribbean	59 000 (55 000 to 63 000)	−17·1% (−19·2 to −14·9)	39 000 (35 000 to 45 000)	−32·6% (−40·3 to −23·8)	483 000 (467 000 to 500 000)	−9·7% (−11·1 to −8·3)	893 000 (778 000 to 1 027 000)	−30·5% (−38·9 to −20·2)
Antigua and Barbuda	110 (100 to 120)	−26·6% (−30·5 to −22·9)	70 (60 to 70)	−41·2% (−45·5 to −36·6)	920 (890 to 950)	−16·9% (−19·1 to −14·8)	1000 (1000 to 2000)	−45·2% (−49·4 to −40·4)
The Bahamas	400 (370 to 430)	−21·2% (−25·2 to −17·2)	200 (170 to 240)	−38·0% (−49·4 to −25·3)	3700 (3600 to 3800)	−12·4% (−14·8 to −10·1)	5000 (4000 to 6000)	−40·1% (−51·2 to −26·9)
Barbados	500 (460 to 550)	−25·2% (−29·1 to −20·7)	370 (300 to 450)	−38·4% (−50·0 to −26·0)	4200 (4000 to 4400)	−12·8% (−15·5 to −10·0)	7000 (6000 to 8000)	−38·4% (−50·4 to −25·3)
Belize	280 (250 to 300)	−15·2% (−19·7 to −10·4)	140 (130 to 160)	−24·8% (−33·6 to −15·6)	3000 (2000 to 3000)	−8·6% (−11·0 to −6·2)	3000 (3000 to 4000)	−29·2% (−37·7 to −20·7)
Bermuda	90 (80 to 100)	−38·6% (−42·1 to −35·2)	50 (40 to 60)	−59·8% (−65·5 to −51·7)	930 (900 to 960)	−21·3% (−23·1 to −19·3)	820 (710 to 970)	−58·9% (−64·5 to −51·6)
Cuba	17 000 (16 000 to 19 000)	−22·6% (−26·7 to −18·2)	11 000 (10 000 to 13 000)	−30·5% (−38·6 to −22·2)	145 000 (140 000 to 151 000)	−14·3% (−16·6 to −11·8)	212 000 (187 000 to 238 000)	−33·1% (−41·1 to −24·7)
Dominica	80 (70 to 80)	−15·5% (−20·1 to −10·8)	70 (60 to 80)	−26·1% (−35·8 to −15·0)	640 (620 to 660)	−13·1% (−15·2 to −10·8)	1000 (1000 to 2000)	−26·6% (−37·3 to −14·2)
Dominican Republic	14 000 (12 000 to 15 000)	14·3% (9·8 to 19·5)	7000 (6000 to 9000)	−21·4% (−39·3 to 4·9)	111 000 (108 000 to 115 000)	7·7% (5·2 to 10·2)	170 000 (136 000 to 215 000)	−17·8% (−36·1 to 8·9)
Grenada	140 (120 to 150)	−25·6% (−29·8 to −21·7)	90 (70 to 90)	−45·0% (−51·9 to −38·1)	1000 (1000 to 1000)	−19·3% (−22·5 to −15·5)	2000 (2000 to 2000)	−50·6% (−57·0 to −43·9)
Guyana	1000 (1000 to 1000)	−37·5% (−40·2 to −34·8)	760 (600 to 940)	−49·0% (−60·0 to −37·1)	8000 (7000 to 8000)	−26·9% (−29·2 to −24·5)	18 000 (14 000 to 23 000)	−52·6% (−63·6 to −40·4)
Haiti	13 000 (12 000 to 14 000)	−21·2% (−24·2 to −17·6)	11 000 (8000 to 14 000)	−30·2% (−47·0 to −9·9)	89 000 (86 000 to 93 000)	−15·1% (−17·4 to −12·9)	310 000 (233 000 to 409 000)	−33·5% (−49·9 to −13·5)
Jamaica	4000 (3000 to 4000)	−17·6% (−21·8 to −13·2)	3000 (2000 to 4000)	−27·7% (−42·4 to −9·6)	26 000 (25 000 to 27 000)	−12·5% (−15·0 to −10·2)	54 000 (43 000 to 67 000)	−31·4% (−45·3 to −13·1)
Puerto Rico	4000 (4000 to 4000)	−32·6% (−36·1 to −29·3)	2000 (1000 to 2000)	−62·7% (−68·6 to −56·8)	44 000 (42 000 to 45 000)	−11·9% (−14·2 to −9·3)	30 000 (25 000 to 34 000)	−55·2% (−61·6 to −48·7)
Saint Kitts and Nevis	90 (90 to 100)	−41·2% (−44·0 to −38·1)	60 (50 to 70)	−50·4% (−57·1 to −45·0)	730 (710 to 770)	−35·8% (−38·3 to −32·9)	1000 (1000 to 2000)	−53·2% (−60·3 to −46·6)
Saint Lucia	260 (240 to 280)	−40·5% (−44·0 to −37·4)	200 (160 to 230)	−56·1% (−62·9 to −49·0)	2000 (2000 to 2000)	−25·1% (−28·0 to −21·9)	4000 (3000 to 4000)	−55·9% (−62·8 to −48·4)
Saint Vincent and the Grenadines	160 (140 to 170)	−23·8% (−28·1 to −19·2)	110 (100 to 130)	−39·8% (−45·9 to −32·8)	1000 (1000 to 1000)	−20·9% (−23·6 to −18·2)	2000 (2000 to 3000)	−39·6% (−46·4 to −32·2)
Suriname	840 (770 to 900)	−13·0% (−17·0 to −8·9)	550 (430 to 680)	−29·1% (−45·7 to −10·9)	6000 (6000 to 6000)	−12·8% (−15·0 to −10·4)	13 000 (10 000 to 16 000)	−29·0% (−44·7 to −11·3)
Trinidad and Tobago	2000 (2000 to 2000)	−37·9% (−41·1 to −34·6)	1000 (1000 to 2000)	−49·9% (−59·8 to −38·5)	17 000 (17 000 to 18 000)	−25·7% (−27·7 to −23·5)	27 000 (21 000 to 33 000)	−47·8% (−58·2 to −34·7)

(Table 1 continues on next page)

	Incident cases		Deaths		Prevalent cases		DALYs	
	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021
(Continued from previous page)								
Virgin Islands	150 (140 to 170)	−9·3% (−13·9 to −4·4)	60 (50 to 70)	−57·1% (−65·8 to −46·3)	1200 (1200 to 1300)	−7·0% (−9·4 to −4·6)	1200 (1000 to 1500)	−55·3% (−64·6 to −43·1)
Central Latin America	204 000 (186 000 to 223 000)	−34·4% (−36·0 to −32·8)	89 000 (79 000 to 98 000)	−45·6% (−50·6 to −40·1)	2 100 000 (2 006 000 to 2 208 000)	−23·1% (−24·3 to −21·9)	2 051 000 (1 852 000 to 2 284 000)	−43·0% (−48·3 to −37·1)
Colombia	42 000 (38 000 to 46 000)	−44·5% (−47·3 to −41·3)	17 000 (14 000 to 19 000)	−60·5% (−66·7 to −53·9)	429 000 (416 000 to 444 000)	−31·6% (−33·2 to −29·7)	369 000 (312 000 to 432 000)	−59·5% (−65·5 to −53·0)
Costa Rica	4000 (4000 to 5000)	−29·9% (−33·4 to −26·2)	2000 (1000 to 2000)	−41·6% (−47·9 to −35·2)	44 000 (43 000 to 46 000)	−16·9% (−18·9 to −14·8)	32 000 (28 000 to 35 000)	−40·3% (−46·4 to −34·5)
El Salvador	5000 (4000 to 5000)	−34·7% (−37·6 to −31·7)	2000 (2000 to 3000)	−46·7% (−57·4 to −34·6)	45 000 (43 000 to 47 000)	−25·2% (−26·8 to −23·3)	47 000 (39 000 to 57 000)	−50·1% (−59·8 to −39·1)
Guatemala	10 000 (9000 to 10 000)	−22·2% (−26·0 to −18·1)	4000 (4000 to 5000)	−36·6% (−44·4 to −27·5)	89 000 (86 000 to 92 000)	−19·9% (−21·6 to −17·6)	101 000 (88 000 to 115 000)	−39·1% (−47·5 to −30·6)
Honduras	6000 (6000 to 7000)	0·4% (−4·3 to 5·2)	6000 (5000 to 8000)	23·4% (0·2 to 54·4)	56 000 (54 000 to 58 000)	−12·6% (−14·9 to −10·5)	147 000 (120 000 to 182 000)	5·4% (−15·0 to 31·6)
Mexico	100 000 (89 000 to 111 000)	−34·6% (−36·7 to −32·1)	38 000 (34 000 to 43 000)	−50·1% (−55·1 to −44·9)	1 100 000 (1 029 000 to 1 179 000)	−21·7% (−23·6 to −19·7)	915 000 (821 000 to 1 020 000)	−43·5% (−49·0 to −37·6)
Nicaragua	5000 (4000 to 5000)	−33·7% (−37·5 to −30·2)	1000 (1000 to 2000)	−45·9% (−54·4 to −34·9)	43 000 (42 000 to 45 000)	−21·5% (−23·4 to −19·5)	36 000 (31 000 to 43 000)	−47·2% (−55·0 to −36·9)
Panama	4000 (4000 to 4000)	−30·7% (−34·6 to −27·1)	2000 (2000 to 2000)	−38·6% (−51·4 to −27·6)	37 000 (36 000 to 39 000)	−17·5% (−19·4 to −15·5)	40 000 (32 000 to 48 000)	−39·0% (−51·1 to −28·1)
Venezuela	29 000 (26 000 to 31 000)	−25·3% (−29·1 to −21·4)	16 000 (12 000 to 20 000)	−24·3% (−41·0 to −5·9)	257 000 (248 000 to 266 000)	−18·5% (−20·6 to −16·4)	363 000 (279 000 to 458 000)	−26·1% (−42·8 to −7·4)
Tropical Latin America	245 000 (218 000 to 275 000)	−47·3% (−49·5 to −45·2)	129 000 (118 000 to 137 000)	−61·7% (−63·3 to −60·3)	2 105 000 (1 950 000 to 2 262 000)	−32·8% (−34·8 to −30·8)	2 926 000 (2 755 000 to 3 053 000)	−61·4% (−62·9 to −60·1)
Brazil	239 000 (212 000 to 268 000)	−47·7% (−49·9 to −45·6)	126 000 (115 000 to 133 000)	−62·2% (−63·8 to −60·8)	2 053 000 (1 898 000 to 2 207 000)	−33·1% (−35·1 to −31·1)	2 843 000 (2 679 000 to 2 966 000)	−61·8% (−63·3 to −60·5)
Paraguay	6000 (6000 to 7000)	−28·6% (−33·0 to −23·9)	4000 (3000 to 5000)	−37·3% (−51·6 to −21·8)	52 000 (50 000 to 54 000)	−19·0% (−21·5 to −16·6)	83 000 (65 000 to 103 000)	−38·1% (−52·4 to −22·0)
North Africa and Middle East	615 000 (560 000 to 672 000)	−21·2% (−23·9 to −18·2)	372 000 (327 000 to 417 000)	−40·3% (−46·6 to −32·4)	5 573 000 (5 372 000 to 5 794 000)	−11·2% (−12·7 to −9·7)	8 891 000 (7 809 000 to 10 011 000)	−44·4% (−51·1 to −37·1)
Afghanistan	22 000 (20 000 to 24 000)	−21·6% (−25·5 to −17·5)	15 000 (11 000 to 19 000)	−28·1% (−43·7 to −8·7)	171 000 (164 000 to 178 000)	−14·7% (−17·3 to −12·3)	459 000 (355 000 to 579 000)	−32·0% (−47·6 to −11·4)
Algeria	52 000 (46 000 to 57 000)	−24·3% (−30·6 to −18·0)	27 000 (21 000 to 34 000)	−36·1% (−47·5 to −21·2)	458 000 (443 000 to 476 000)	−11·9% (−14·5 to −9·2)	572 000 (456 000 to 712 000)	−40·6% (−51·1 to −27·7)
Bahrain	730 (650 to 810)	−35·5% (−39·2 to −31·4)	360 (310 to 420)	−49·1% (−57·3 to −39·0)	10 000 (10 000 to 10 000)	−21·3% (−23·5 to −19·4)	10 000 (9000 to 12 000)	−52·9% (−60·3 to −44·0)
Egypt	105 000 (95 000 to 117 000)	3·4% (−2·4 to 11·3)	73 000 (60 000 to 89 000)	−36·1% (−47·4 to −23·7)	897 000 (859 000 to 936 000)	11·5% (6·6 to 15·8)	1 848 000 (1 512 000 to 2 235 000)	−39·8% (−50·9 to −27·5)
Iran	76 000 (67 000 to 86 000)	−31·8% (−34·7 to −29·2)	42 000 (38 000 to 46 000)	−48·8% (−53·3 to −43·1)	787 000 (727 000 to 855 000)	−14·8% (−17·4 to −11·9)	905 000 (828 000 to 981 000)	−50·2% (−54·5 to −45·2)
Iraq	45 000 (41 000 to 50 000)	−8·1% (−14·0 to −1·9)	31 000 (24 000 to 37 000)	−14·4% (−34·3 to 6·3)	379 000 (366 000 to 393 000)	−7·2% (−9·8 to −4·0)	764 000 (602 000 to 932 000)	−27·2% (−44·8 to −7·1)
Jordan	12 000 (11 000 to 13 000)	−24·1% (−29·4 to −17·8)	4000 (3000 to 4000)	−53·7% (−63·8 to −40·2)	118 000 (113 000 to 122 000)	−4·6% (−7·5 to −1·1)	97 000 (81 000 to 114 000)	−55·8% (−65·0 to −43·8)

(Table 1 continues on next page)

	Incident cases		Deaths		Prevalent cases		DALYs	
	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021
(Continued from previous page)								
Kuwait	3000 (3000 to 4000)	−9·2% (−15·1 to −3·7)	770 (630 to 920)	−32·7% (−43·0 to −20·4)	43 000 (41 000 to 44 000)	−8·0% (−10·6 to −5·2)	23 000 (20 000 to 27 000)	−36·9% (−45·8 to −27·0)
Lebanon	7000 (6000 to 8000)	−24·1% (−28·5 to −19·2)	3000 (2000 to 3000)	−68·6% (−76·3 to −59·3)	65 000 (62 000 to 68 000)	−1·5% (−4·1 to 1·2)	57 000 (49 000 to 66 000)	−68·9% (−76·4 to −60·0)
Libya	6000 (6000 to 7000)	1·7% (−4·4 to 7·9)	3000 (3000 to 5000)	−3·8% (−27·3 to 26·3)	66 000 (64 000 to 68 000)	0·8% (−1·9 to 3·5)	95 000 (71 000 to 125 000)	−6·7% (−28·8 to 20·8)
Morocco	53 000 (48 000 to 58 000)	−5·8% (−11·2 to 0·7)	37 000 (29 000 to 46 000)	−16·6% (−33·7 to 0·8)	413 000 (395 000 to 431 000)	−3·5% (−6·5 to −0·5)	811 000 (633 000 to 1 024 000)	−25·4% (−41·0 to −9·4)
Oman	3000 (3000 to 4000)	−13·1% (−19·4 to −6·0)	1000 (1000 to 1000)	−41·3% (−55·9 to −18·5)	40 000 (38 000 to 41 000)	−4·7% (−7·8 to −1·6)	30 000 (25 000 to 35 000)	−48·3% (−61·1 to −28·6)
Palestine	4000 (3000 to 4000)	−13·4% (−18·3 to −8·2)	2000 (2000 to 2000)	−42·2% (−53·3 to −28·8)	29 000 (28 000 to 30 000)	−12·4% (−15·4 to −9·5)	46 000 (41 000 to 52 000)	−45·6% (−55·9 to −32·5)
Qatar	1000 (1000 to 2000)	−36·7% (−40·8 to −33·1)	250 (190 to 320)	−65·4% (−73·3 to −56·1)	22 000 (21 000 to 23 000)	−37·1% (−38·9 to −35·4)	10 000 (8000 to 12 000)	−65·8% (−73·5 to −56·8)
Saudi Arabia	28 000 (25 000 to 31 000)	−21·4% (−26·5 to −16·4)	13 000 (11 000 to 17 000)	−38·5% (−53·2 to −17·3)	278 000 (268 000 to 289 000)	−1·8% (−4·9 to 1·2)	439 000 (351 000 to 545 000)	−39·5% (−53·4 to −19·3)
Sudan	34 000 (31 000 to 37 000)	−17·0% (−21·5 to −11·4)	20 000 (15 000 to 25 000)	−40·0% (−53·3 to −20·3)	293 000 (281 000 to 305 000)	−4·5% (−7·5 to −1·4)	545 000 (403 000 to 704 000)	−46·1% (−58·7 to −26·8)
Syria	16 000 (15 000 to 18 000)	−25·7% (−29·8 to −22·0)	11 000 (8000 to 13 000)	−29·2% (−47·1 to −2·2)	148 000 (143 000 to 154 000)	−24·3% (−26·2 to −22·5)	260 000 (202 000 to 332 000)	−40·1% (−55·6 to −17·1)
Tunisia	15 000 (13 000 to 17 000)	−11·4% (−16·4 to −6·1)	9000 (7000 to 13 000)	−33·8% (−52·2 to −11·5)	123 000 (118 000 to 128 000)	0·4% (−2·3 to 3·5)	189 000 (137 000 to 256 000)	−35·9% (−53·0 to −15·4)
Türkiye	98 000 (87 000 to 108 000)	−37·9% (−41·8 to −33·3)	59 000 (49 000 to 71 000)	−50·2% (−59·8 to −37·5)	927 000 (895 000 to 964 000)	−30·1% (−31·9 to −28·2)	1 185 000 (996 000 to 1 388 000)	−56·9% (−65·2 to −46·7)
United Arab Emirates	10 000 (9000 to 12 000)	−28·1% (−32·8 to −23·6)	1000 (1000 to 2000)	−34·8% (−46·1 to −21·7)	113 000 (109 000 to 118 000)	−15·8% (−18·8 to −12·9)	52 000 (43 000 to 62 000)	−43·6% (−53·2 to −32·2)
Yemen	24 000 (22 000 to 26 000)	−15·9% (−20·7 to −10·8)	18 000 (14 000 to 25 000)	−25·2% (−44·1 to 0·4)	188 000 (180 000 to 196 000)	−8·7% (−11·5 to −5·7)	485 000 (364 000 to 635 000)	−31·6% (−48·8 to −7·1)
South Asia	1 697 000 (1 540 000 to 1 860 000)	−22·2% (−24·7 to −19·5)	1 067 000 (976 000 to 1 173 000)	−23·1% (−32·4 to −12·4)	12 593 000 (11 789 000 to 13 537 000)	−8·2% (−10·0 to −6·5)	26 602 000 (24 487 000 to 29 128 000)	−26·4% (−35·3 to −17·2)
Bangladesh	221 000 (204 000 to 241 000)	−15·4% (−19·3 to −10·7)	177 000 (144 000 to 215 000)	−26·7% (−42·0 to −6·7)	1 449 000 (1 395 000 to 1 511 000)	−10·5% (−12·9 to −7·9)	3 942 000 (3 209 000 to 4 819 000)	−35·8% (−49·2 to −18·1)
Bhutan	670 (610 to 730)	−22·0% (−26·2 to −16·9)	390 (310 to 480)	−32·2% (−48·5 to −10·2)	5000 (5000 to 5000)	−10·7% (−13·2 to −7·9)	9000 (7000 to 11 000)	−37·8% (−53·2 to −18·4)
India	1 251 000 (1 127 000 to 1 378 000)	−24·0% (−26·7 to −21·0)	773 000 (695 000 to 858 000)	−22·8% (−33·8 to −10·0)	9 338 000 (8 687 000 to 10 110 000)	−8·0% (−10·0 to −6·0)	19 436 000 (17 539 000 to 21 385 000)	−26·1% (−36·5 to −14·8)
Nepal	26 000 (24 000 to 28 000)	−18·0% (−21·8 to −13·9)	17 000 (14 000 to 22 000)	−32·0% (−47·8 to −10·6)	181 000 (173 000 to 189 000)	−14·1% (−16·6 to −11·4)	411 000 (330 000 to 520 000)	−36·9% (−51·8 to −18·3)
Pakistan	198 000 (180 000 to 219 000)	−15·1% (−18·7 to −11·3)	100 000 (83 000 to 124 000)	−8·1% (−25·0 to 14·7)	1 620 000 (1 500 000 to 1 746 000)	−5·6% (−8·2 to −2·8)	2 804 000 (2 318 000 to 3 459 000)	−8·5% (−25·2 to 14·2)
Southeast Asia, east Asia, and Oceania	5 425 000 (4 831 000 to 6 143 000)	−9·5% (−13·9 to −5·0)	3 554 000 (3 106 000 to 4 001 000)	−37·5% (−46·1 to −27·1)	36 232 000 (33 712 000 to 38 979 000)	6·7% (4·3 to 8·9)	77 453 000 (68 193 000 to 86 258 000)	−39·2% (−47·1 to −29·8)
East Asia	4 220 000 (3 717 000 to 4 838 000)	−10·5% (−15·7 to −5·2)	2 664 000 (2 248 000 to 3 100 000)	−43·0% (−52·6 to −31·2)	27 268 000 (25 077 000 to 29 587 000)	10·0% (7·0 to 12·8)	54 947 000 (46 857 000 to 63 714 000)	−45·0% (−54·1 to −33·8)

(Table 1 continues on next page)

	Incident cases		Deaths		Prevalent cases		DALYs	
	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021
(Continued from previous page)								
China	4 090 000 (3 594 000 to 4 700 000)	−9·8% (−15·2 to −4·2)	2 592 000 (2 179 000 to 3 033 000)	−43·0% (−52·8 to −30·9)	26 335 000 (24 155 000 to 28 626 000)	11·5% (8·3 to 14·5)	53 191 000 (45 109 000 to 61 958 000)	−45·2% (−54·4 to −33·7)
North Korea	79 000 (72 000 to 85 000)	−8·2% (−12·8 to −2·7)	58 000 (48 000 to 71 000)	−12·8% (−30·9 to 12·2)	472 000 (455 000 to 492 000)	−6·6% (−9·4 to −3·5)	1 408 000 (1 132 000 to 1 711 000)	−9·4% (−29·7 to 16·9)
Taiwan (province of China)	51 000 (46 000 to 56 000)	−44·6% (−48·6 to −40·8)	14 000 (12 000 to 15 000)	−76·4% (−78·3 to −74·8)	461 000 (445 000 to 477 000)	−26·1% (−28·2 to −24·2)	349 000 (312 000 to 378 000)	−70·8% (−73·0 to −68·8)
Oceania	12 000 (11 000 to 13 000)	−16·3% (−19·0 to −12·9)	10 000 (8 000 to 12 000)	−21·8% (−35·6 to −4·8)	99 000 (96 000 to 102 000)	−11·2% (−12·7 to −9·6)	291 000 (238 000 to 348 000)	−22·4% (−37·0 to −4·9)
American Samoa	70 (60 to 80)	−21·4% (−25·8 to −17·5)	50 (40 to 50)	−25·1% (−37·3 to −9·2)	620 (600 to 640)	−16·0% (−18·0 to −14·1)	1000 (1000 to 1000)	−24·0% (−36·3 to −8·7)
Cook Islands	30 (30 to 40)	−21·9% (−25·7 to −17·7)	20 (10 to 20)	−52·0% (−61·6 to −40·2)	320 (310 to 330)	−4·9% (−7·2 to −2·6)	380 (310 to 440)	−49·5% (−59·5 to −37·1)
Federated States of Micronesia	180 (160 to 190)	−13·8% (−17·4 to −10·1)	120 (90 to 150)	−25·8% (−40·6 to −5·7)	1000 (1000 to 1000)	−10·3% (−12·4 to −8·2)	4000 (3000 to 5000)	−25·9% (−41·3 to −3·5)
Fiji	1000 (1000 to 1000)	−23·0% (−26·5 to −18·5)	770 (600 to 960)	−20·7% (−37·4 to 1·5)	12 000 (11 000 to 12 000)	−14·5% (−16·5 to −12·4)	21 000 (17 000 to 27 000)	−25·4% (−40·7 to −4·7)
Guam	260 (240 to 280)	−21·0% (−25·3 to −16·5)	80 (70 to 90)	−60·9% (−65·9 to −54·7)	3000 (3000 to 3000)	−1·7% (−4·3 to 0·9)	3000 (2000 to 3000)	−40·5% (−47·8 to −32·3)
Kiribati	220 (210 to 240)	−16·4% (−19·9 to −12·6)	110 (90 to 140)	−9·2% (−25·7 to 14·4)	2000 (2000 to 2000)	−13·3% (−15·4 to −11·4)	4000 (3000 to 5000)	−12·5% (−29·0 to 11·3)
Marshall Islands	90 (80 to 90)	−9·8% (−13·2 to −6·3)	60 (40 to 70)	−19·4% (−35·2 to −0·9)	670 (650 to 690)	−5·6% (−8·0 to −3·4)	2000 (1000 to 2000)	−17·7% (−34·3 to 3·6)
Nauru	10 (10 to 20)	−26·0% (−29·3 to −22·4)	10 (10 to 20)	−14·9% (−31·4 to 9·4)	150 (140 to 150)	−9·6% (−12·0 to −7·4)	410 (320 to 530)	−13·8% (−31·0 to 11·9)
Niue	0 (0 to 0)	−22·5% (−26·1 to −18·1)	0 (0 to 0)	−25·4% (−38·9 to −8·7)	30 (30 to 30)	−13·0% (−15·2 to −10·7)	60 (50 to 80)	−22·8% (−37·8 to −6·0)
Northern Mariana Islands	70 (60 to 80)	−17·2% (−21·9 to −12·0)	40 (30 to 40)	−34·4% (−47·1 to −20·9)	650 (630 to 670)	−14·0% (−16·2 to −11·9)	1000 (1000 to 1000)	−35·0% (−47·2 to −21·3)
Palau	40 (40 to 50)	−14·7% (−18·7 to −10·5)	20 (20 to 30)	−23·7% (−41·1 to −2·0)	400 (380 to 410)	−3·9% (−6·1 to −1·5)	720 (600 to 870)	−23·8% (−40·6 to −2·2)
Papua New Guinea	7000 (7000 to 8000)	−13·1% (−17·2 to −8·5)	7000 (5000 to 9000)	−20·4% (−40·5 to 6·0)	59 000 (57 000 to 61 000)	−7·5% (−9·8 to −5·1)	207 000 (161 000 to 258 000)	−22·4% (−42·9 to 5·0)
Samoa	280 (260 to 310)	−16·7% (−21·1 to −12·2)	190 (160 to 230)	−22·8% (−36·0 to −4·0)	2000 (2000 to 3000)	−4·6% (−7·1 to −1·9)	5000 (4000 to 6000)	−20·7% (−34·4 to −0·9)
Solomon Islands	1000 (1000 to 1000)	−3·8% (−8·1 to 0·9)	630 (510 to 790)	−12·5% (−30·2 to 12·5)	8000 (8 000 to 8 000)	−3·4% (−6·0 to −0·8)	19 000 (15 000 to 23 000)	−12·1% (−32·1 to 18·7)
Tokelau	0 (0 to 0)	−29·3% (−33·1 to −25·7)	0 (0 to 0)	−39·1% (−51·3 to −23·7)	20 (20 to 20)	−10·0% (−12·3 to −7·5)	40 (40 to 50)	−35·4% (−48·5 to −18·5)
Tongo	110 (100 to 110)	−11·7% (−16·3 to −7·0)	60 (50 to 70)	−15·3% (−34·8 to 10·5)	950 (920 to 980)	−7·2% (−9·3 to −5·0)	1000 (1000 to 2000)	−17·4% (−36·1 to 7·0)
Tuvalu	20 (20 to 20)	−19·7% (−23·3 to −15·7)	20 (10 to 20)	−35·8% (−45·9 to −23·8)	160 (150 to 160)	−8·5% (−10·9 to −6·5)	430 (370 to 510)	−36·6% (−47·1 to −23·4)
Vanuatu	450 (420 to 490)	−5·3% (−9·5 to −1·0)	260 (210 to 320)	−20·2% (−35·5 to −3·0)	4000 (4000 to 4000)	−1·0% (−3·6 to 1·4)	8000 (7000 to 10 000)	−18·5% (−35·3 to 1·8)

(Table 1 continues on next page)

	Incident cases		Deaths		Prevalent cases		DALYs	
	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021
(Continued from previous page)								
Southeast Asia	1 193 000 (1 090 000 to 1 305 000)	−12·4% (−14·5 to −10·2)	880 000 (791 000 to 959 000)	−20·6% (−29·9 to −9·5)	8 865 000 (8 402 000 to 9 372 000)	−6·7% (−8·1 to −5·3)	22 214 000 (19 885 000 to 24 341 000)	−22·8% (−31·3 to −13·1)
Cambodia	24 000 (22 000 to 25 000)	−11·1% (−15·5 to −6·6)	18 000 (14 000 to 22 000)	−22·1% (−39·4 to −3·3)	145 000 (140 000 to 151 000)	−6·5% (−9·1 to −3·4)	435 000 (339 000 to 535 000)	−29·8% (−45·5 to −11·9)
Indonesia	543 000 (487 000 to 611 000)	−0·1% (−3·7 to 3·9)	405 000 (338 000 to 464 000)	5·5% (−14·2 to 26·3)	3 942 000 (3 639 000 to 4 286 000)	−6·7% (−9·0 to −4·3)	10 624 000 (8 957 000 to 12 309 000)	−5·8% (−20·9 to 12·4)
Laos	9000 (9000 to 10 000)	−19·7% (−23·7 to −15·1)	7000 (6000 to 9000)	−38·2% (−52·9 to −19·9)	66 000 (63 000 to 68 000)	−10·8% (−13·5 to −8·2)	193 000 (154 000 to 240 000)	−43·3% (−57·6 to −26·5)
Malaysia	45 000 (41 000 to 49 000)	−29·5% (−33·0 to −25·1)	23 000 (21 000 to 26 000)	−32·7% (−40·1 to −23·6)	401 000 (388 000 to 415 000)	−9·1% (−11·4 to −6·6)	593 000 (541 000 to 650 000)	−36·1% (−42·2 to −28·7)
Maldives	460 (430 to 510)	−47·5% (−50·2 to −44·3)	220 (180 to 260)	−64·7% (−71·3 to −57·1)	4000 (4000 to 4000)	−40·2% (−41·8 to −38·4)	6000 (5000 to 6000)	−70·1% (−75·6 to −63·6)
Mauritius	2000 (2000 to 2000)	−48·2% (−51·4 to −44·9)	1000 (1000 to 1000)	−62·4% (−65·0 to −60·3)	18 000 (18 000 to 19 000)	−35·2% (−37·0 to −33·3)	29 000 (27 000 to 30 000)	−60·7% (−63·4 to −58·6)
Myanmar	88 000 (82 000 to 96 000)	−25·3% (−29·1 to −20·6)	77 000 (62 000 to 96 000)	−37·5% (−52·5 to −16·7)	597 000 (577 000 to 620 000)	−15·4% (−17·6 to −13·0)	1 961 000 (1 594 000 to 2 424 000)	−42·6% (−56·5 to −23·5)
Philippines	133 000 (121 000 to 148 000)	27·9% (22·7 to 33·7)	84 000 (71 000 to 96 000)	−14·1% (−25·9 to −0·9)	1 052 000 (981 000 to 1 134 000)	19·6% (16·7 to 22·3)	2 364 000 (2 037 000 to 2 715 000)	−4·2% (−17·1 to 11·3)
Sri Lanka	31 000 (28 000 to 34 000)	−24·9% (−28·5 to −20·7)	25 000 (18 000 to 33 000)	−37·4% (−56·2 to −16·5)	271 000 (260 000 to 281 000)	−15·2% (−17·3 to −13·0)	498 000 (361 000 to 642 000)	−39·1% (−57·3 to −18·5)
Seychelles	150 (130 to 160)	−25·7% (−29·3 to −22·2)	80 (70 to 90)	−39·1% (−46·2 to −31·3)	1000 (1000 to 1000)	−16·1% (−18·5 to −13·5)	2000 (2000 to 2000)	−42·3% (−48·9 to −35·1)
Thailand	118 000 (108 000 to 128 000)	−35·1% (−38·5 to −31·9)	70 000 (54 000 to 86 000)	−46·1% (−57·9 to −29·7)	1 070 000 (1 037 000 to 1 109 000)	−18·2% (−20·3 to −15·9)	1 676 000 (1 347 000 to 2 042 000)	−40·5% (−52·8 to −24·2)
Timor-Leste	2000 (1000 to 2000)	2·9% (−2·5 to 8·6)	1000 (1000 to 2000)	−7·6% (−30·4 to 23·1)	10 000 (10 000 to 10 000)	1·3% (−1·4 to 4·2)	32 000 (25 000 to 41 000)	−11·9% (−34·4 to 16·1)
Viet Nam	196 000 (183 000 to 209 000)	−9·3% (−14·8 to −4·4)	167 000 (140 000 to 193 000)	−14·3% (−33·4 to 7·4)	1 275 000 (1 238 000 to 1 318 000)	1·7% (−1·4 to 5·2)	3 769 000 (3 132 000 to 4 444 000)	−17·4% (−36·5 to 5·5)
Sub-Saharan Africa	867 000 (795 000 to 944 000)	−17·8% (−19·8 to −15·3)	484 000 (433 000 to 539 000)	−23·0% (−30·6 to −13·2)	7 769 000 (7 457 000 to 8 094 000)	−12·0% (−13·3 to −10·8)	13 251 000 (11 716 000 to 14 891 000)	−26·6% (−33·8 to −17·4)
Central sub-Saharan Africa	103 000 (94 000 to 113 000)	−18·4% (−22·0 to −14·6)	57 000 (44 000 to 73 000)	−16·4% (−33·2 to 3·8)	837 000 (808 000 to 868 000)	−13·6% (−15·8 to −11·6)	1 587 000 (1 225 000 to 1 988 000)	−21·6% (−36·9 to −2·4)
Angola	23 000 (21 000 to 25 000)	−23·6% (−28·2 to −18·5)	12 000 (9000 to 15 000)	−25·2% (−43·0 to −2·5)	202 000 (195 000 to 209 000)	−12·3% (−15·3 to −9·7)	340 000 (269 000 to 418 000)	−31·4% (−48·4 to −11·3)
Central African Republic	5000 (4000 to 5000)	−14·0% (−18·7 to −9·1)	3000 (2000 to 4000)	−14·8% (−31·8 to 4·8)	35 000 (34 000 to 36 000)	−11·3% (−14·1 to −8·7)	97 000 (70 000 to 132 000)	−18·0% (−35·5 to 1·7)
Congo (Brazzaville)	5000 (5000 to 6000)	−25·6% (−29·8 to −21·0)	3000 (2000 to 4000)	−31·4% (−45·1 to −14·2)	46 000 (44 000 to 48 000)	−18·5% (−21·0 to −15·8)	82 000 (62 000 to 103 000)	−35·1% (−49·1 to −18·5)
Democratic Republic of the Congo	67 000 (62 000 to 74 000)	−16·2% (−20·5 to −11·7)	38 000 (28 000 to 51 000)	−10·9% (−32·9 to 16·9)	530 000 (510 000 to 550 000)	−13·9% (−16·6 to −11·2)	1 032 000 (760 000 to 1 368 000)	−16·2% (−35·8 to 9·3)
Equatorial Guinea	860 (770 to 950)	−35·7% (−39·7 to −31·6)	410 (270 to 590)	−48·9% (−63·9 to −26·5)	8000 (8000 to 9000)	−18·0% (−20·2 to −15·7)	11 000 (8000 to 16 000)	−53·8% (−67·3 to −34·5)
Gabon	2000 (2000 to 2000)	−20·8% (−25·7 to −15·4)	940 (710 to 1210)	−26·6% (−42·9 to −6·7)	17 000 (16 000 to 17 000)	−15·8% (−18·1 to −13·1)	24 000 (18 000 to 31 000)	−30·1% (−45·6 to −11·4)

(Table 1 continues on next page)

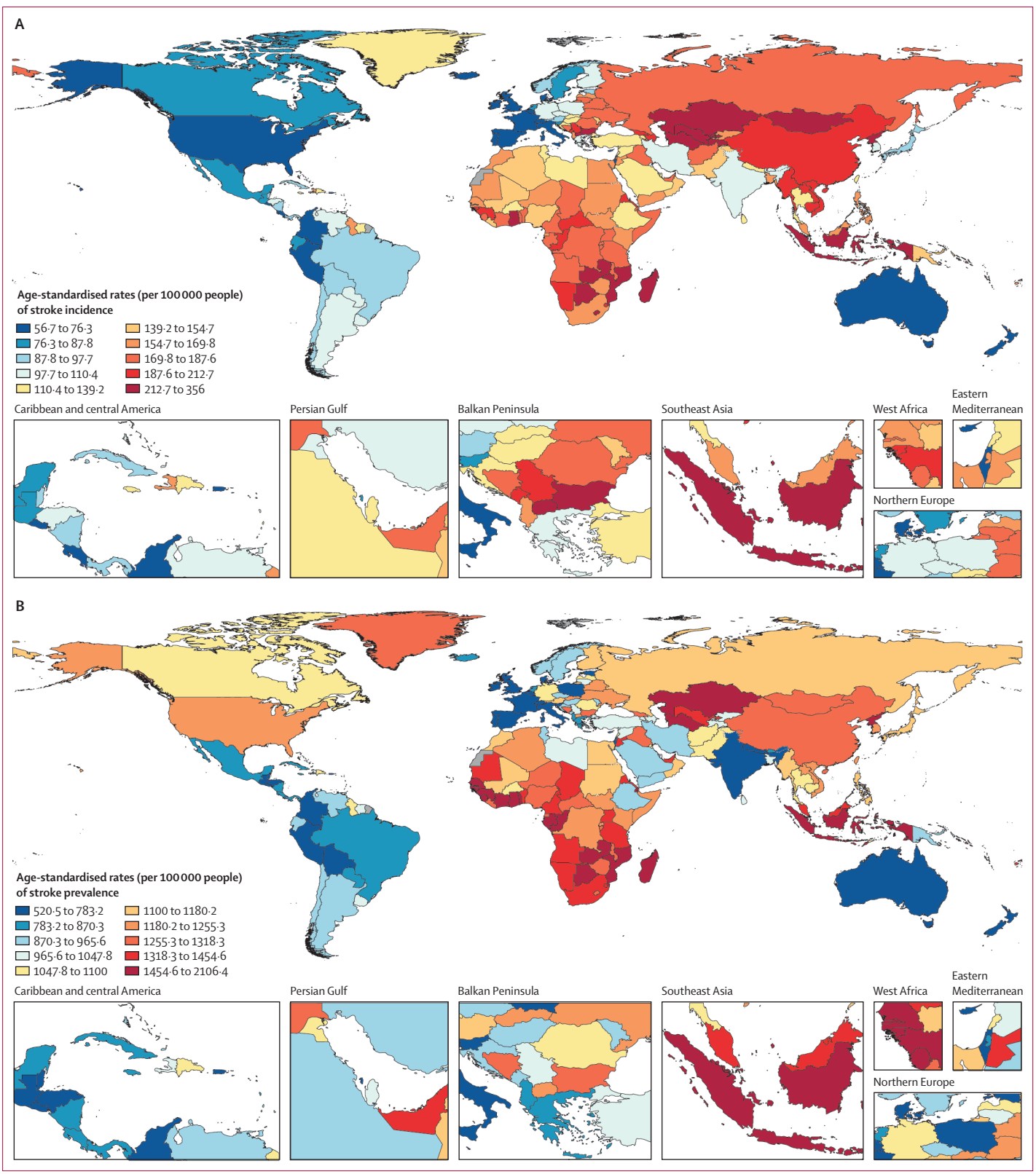
	Incident cases		Deaths		Prevalent cases		DALYs	
	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021
(Continued from previous page)								
Eastern sub-Saharan Africa	311 000 (285 000 to 338 000)	−21·6% (−23·8 to −19·0)	169 000 (147 000 to 193 000)	−31·3% (−40·8 to −21·0)	2 612 000 (2 509 000 to 2 720 000)	−13·7% (−15·0 to −12·3)	4 698 000 (4 075 000 to 5 316 000)	−34·1% (−44·0 to −24·0)
Burundi	9000 (9000 to 10 000)	−36·9% (−40·3 to −33·2)	6000 (4000 to 7000)	−45·9% (−59·3 to −27·1)	76 000 (74 000 to 79 000)	−29·4% (−31·4 to −27·5)	158 000 (126 000 to 194 000)	−49·4% (−62·4 to −31·9)
Comoros	830 (750 to 910)	−26·9% (−31·7 to −22·6)	470 (360 to 580)	−38·3% (−53·0 to −17·8)	7000 (7000 to 8000)	−19·9% (−22·1 to −17·5)	12 000 (9000 to 15 000)	−41·6% (−56·0 to −21·2)
Djibouti	1000 (1000 to 1000)	−14·6% (−19·3 to −9·4)	570 (420 to 760)	−25·0% (−43·9 to 2·2)	11 000 (11 000 to 12 000)	−9·1% (−11·7 to −6·2)	16 000 (12 000 to 22 000)	−27·5% (−46·2 to −0·8)
Eritrea	6000 (5000 to 6000)	−28·5% (−32·1 to −24·5)	3000 (3000 to 4000)	−33·1% (−46·3 to −16·3)	47 000 (45 000 to 49 000)	−12·7% (−15·2 to −10·1)	99 000 (76 000 to 126 000)	−38·5% (−50·9 to −21·9)
Ethiopia	59 000 (54 000 to 65 000)	−42·2% (−45·2 to −38·9)	30 000 (25 000 to 36 000)	−51·6% (−65·8 to −39·6)	500 000 (467 000 to 539 000)	−29·9% (−32·5 to −27·2)	807 000 (674 000 to 944 000)	−56·0% (−69·2 to −44·5)
Kenya	37 000 (34 000 to 42 000)	−9·3% (−12·2 to −6·0)	18 000 (14 000 to 22 000)	−0·6% (−18·5 to 24·0)	332 000 (308 000 to 358 000)	−8·8% (−10·5 to −7·1)	468 000 (374 000 to 572 000)	−4·0% (−20·0 to 18·4)
Madagascar	30 000 (28 000 to 32 000)	−13·4% (−17·7 to −9·0)	18 000 (14 000 to 24 000)	−18·9% (−38·3 to 3·1)	251 000 (243 000 to 259 000)	−9·9% (−12·2 to −7·5)	572 000 (431 000 to 733 000)	−21·8% (−40·2 to −0·1)
Malawi	14 000 (12 000 to 15 000)	−15·6% (−20·3 to −10·7)	9000 (8000 to 11 000)	−6·0% (−23·0 to 14·0)	117 000 (113 000 to 122 000)	−10·8% (−13·3 to −8·0)	257 000 (215 000 to 305 000)	−9·4% (−26·0 to 11·0)
Mozambique	29 000 (27 000 to 32 000)	3·4% (−1·9 to 9·1)	21 000 (17 000 to 26 000)	7·9% (−18·2 to 35·1)	221 000 (213 000 to 229 000)	8·8% (5·1 to 12·7)	599 000 (466 000 to 738 000)	9·7% (−15·9 to 36·0)
Rwanda	11 000 (10 000 to 12 000)	−43·6% (−46·8 to −40·2)	6000 (5000 to 8000)	−56·6% (−68·9 to −42·9)	88 000 (85 000 to 91 000)	−34·4% (−36·4 to −32·5)	166 000 (123 000 to 212 000)	−61·3% (−72·5 to −47·8)
Somalia	13 000 (12 000 to 15 000)	−20·5% (−24·5 to −16·6)	8000 (5000 to 10 000)	−29·3% (−45·3 to −8·6)	107 000 (103 000 to 111 000)	−14·4% (−16·6 to −12·1)	238 000 (169 000 to 320 000)	−31·0% (−47·6 to −9·3)
South Sudan	6000 (6000 to 7000)	−19·8% (−24·2 to −16·0)	4000 (3000 to 6000)	−25·0% (−43·0 to −1·5)	55 000 (53 000 to 57 000)	−15·9% (−18·1 to −13·5)	121 000 (88 000 to 165 000)	−26·2% (−44·3 to −1·2)
Tanzania	49 000 (45 000 to 54 000)	−3·7% (−8·5 to 1·8)	23 000 (18 000 to 29 000)	−19·1% (−35·3 to 5·2)	432 000 (417 000 to 449 000)	6·5% (3·2 to 9·6)	583 000 (461 000 to 738 000)	−25·2% (−41·6 to −2·8)
Uganda	28 000 (25 000 to 31 000)	−15·4% (−20·4 to −9·8)	12 000 (10 000 to 16 000)	−36·0% (−51·5 to −14·4)	242 000 (233 000 to 251 000)	−12·2% (−14·5 to −9·4)	348 000 (273 000 to 441 000)	−36·7% (−52·1 to −16·3)
Zambia	16 000 (14 000 to 17 000)	−1·2% (−6·8 to 4·9)	9000 (7000 to 12 000)	−11·6% (−32·6 to 14·3)	122 000 (118 000 to 126 000)	−2·4% (−5·2 to 0·6)	251 000 (189 000 to 328 000)	−14·8% (−37·4 to 10·7)
Southern sub-Saharan Africa	89 000 (78 000 to 100 000)	−8·9% (−12·1 to −5·4)	54 000 (50 000 to 58 000)	14·8% (4·0 to 34·6)	789 000 (732 000 to 845 000)	−15·3% (−18·2 to −12·7)	1 325 000 (1 226 000 to 1 427 000)	4·6% (−4·2 to 18·2)
Botswana	3000 (3000 to 3000)	−5·2% (−11·1 to 1·3)	1000 (1000 to 2000)	−43·2% (−57·1 to −22·1)	25 000 (24 000 to 26 000)	−3·7% (−7·0 to −0·3)	30 000 (24 000 to 38 000)	−43·8% (−57·9 to −25·1)
Eswatini	1000 (1000 to 1000)	3·3% (−3·0 to 10·1)	700 (490 to 980)	−10·0% (−35·0 to 21·4)	8000 (8000 to 8000)	−0·6% (−3·6 to 2·7)	19 000 (13 000 to 27 000)	−7·7% (−33·5 to 27·6)
Lesotho	2000 (2000 to 3000)	36·6% (28·6 to 45·7)	2000 (1000 to 2000)	43·4% (3·4 to 104·2)	14 000 (14 000 to 15 000)	19·5% (15·1 to 23·7)	48 000 (36 000 to 65 000)	50·3% (8·4 to 115·9)
Namibia	3000 (2000 to 3000)	−16·7% (−21·7 to −11·1)	2000 (1000 to 2000)	−18·9% (−36·9 to 1·1)	19 000 (19 000 to 20 000)	−16·0% (−18·7 to −13·3)	40 000 (31 000 to 51 000)	−21·9% (−40·1 to −1·3)
South Africa	69 000 (60 000 to 79 000)	−13·8% (−17·3 to −9·9)	39 000 (35 000 to 43 000)	16·4% (4·7 to 37·4)	621 000 (569 000 to 674 000)	−20·8% (−23·9 to −17·9)	944 000 (853 000 to 1 022 000)	0·1% (−8·3 to 11·4)

(Table 1 continues on next page)

	Incident cases		Deaths		Prevalent cases		DALYs	
	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021	Counts, 2021	Percentage change in age-standardised rates, 1990–2021
(Continued from previous page)								
Zimbabwe	11 000 (10 000 to 12 000)	14·6% (7·9 to 21·7)	9000 (7000 to 11 000)	39·1% (10·0 to 82·3)	102 000 (97 000 to 106 000)	10·3% (7·1 to 13·5)	244 000 (195 000 to 304 000)	50·0% (19·1 to 97·3)
Western sub-Saharan Africa	365 000 (335 000 to 397 000)	−17·3% (−19·5 to −14·6)	204 000 (176 000 to 235 000)	−24·6% (−34·8 to −11·3)	3 531 000 (3 383 000 to 3 685 000)	−9·6% (−10·7 to −8·4)	5 641 000 (4 774 000 to 6 597 000)	−26·9% (−36·9 to −13·6)
Benin	10 000 (9000 to 11 000)	−19·9% (−24·2 to −15·1)	6000 (5000 to 7000)	−22·7% (−35·7 to −3·8)	93 000 (90 000 to 97 000)	−14·1% (−16·3 to −11·8)	161 000 (133 000 to 194 000)	−25·8% (−39·0 to −6·9)
Burkina Faso	14 000 (13 000 to 15 000)	−8·0% (−12·4 to −3·1)	8 000 (7 000 to 10 000)	−9·9% (−28·1 to 14·9)	131 000 (127 000 to 136 000)	−9·4% (−11·8 to −7·3)	230 000 (186 000 to 285 000)	−13·9% (−30·5 to 9·5)
Cabo Verde	660 (610 to 720)	−3·7% (−8·6 to 1·9)	440 (360 to 530)	7·1% (−16·2 to 40·2)	7000 (7000 to 7000)	−6·8% (−9·0 to −4·6)	10 000 (8000 to 11 000)	−6·7% (−26·3 to 20·6)
Cameroon	25 000 (23 000 to 27 000)	−6·6% (−11·0 to −1·7)	15 000 (11 000 to 20 000)	−7·1% (−28·6 to 24·2)	233 000 (226 000 to 241 000)	−4·2% (−6·7 to −1·8)	438 000 (325 000 to 575 000)	−9·3% (−30·7 to 20·6)
Chad	13 000 (12 000 to 14 000)	−5·3% (−9·8 to −0·6)	8000 (6000 to 10 000)	4·3% (−19·3 to 34·3)	115 000 (111 000 to 119 000)	−5·8% (−8·2 to −3·5)	242 000 (188 000 to 302 000)	2·2% (−20·9 to 30·8)
Côte d'Ivoire	23 000 (21 000 to 24 000)	−17·9% (−22·0 to −13·6)	13 000 (10 000 to 16 000)	−13·7% (−31·9 to 12·0)	224 000 (217 000 to 232 000)	−16·2% (−18·2 to −14·1)	378 000 (288 000 to 485 000)	−16·6% (−35·7 to 9·2)
The Gambia	2000 (2000 to 2000)	−8·0% (−12·3 to −2·7)	1000 (1000 to 2000)	3·3% (−22·1 to 36·6)	19 000 (18 000 to 20 000)	−10·3% (−13·0 to −7·9)	38 000 (29 000 to 47 000)	−1·9% (−26·4 to 30·1)
Ghana	42 000 (39 000 to 45 000)	−6·3% (−11·3 to −1·2)	25 000 (20 000 to 31 000)	−9·6% (−30·9 to 18·8)	422 000 (409 000 to 436 000)	−2·3% (−5·0 to 0·4)	694 000 (558 000 to 855 000)	−15·1% (−34·5 to 11·9)
Guinea	12 000 (12 000 to 13 000)	−4·1% (−8·9 to 1·2)	8000 (6000 to 10 000)	−2·7% (−25·8 to 31·4)	108 000 (104 000 to 112 000)	−3·0% (−5·6 to −0·2)	215 000 (166 000 to 270 000)	−6·7% (−28·7 to 24·0)
Guinea-Bissau	2000 (2000 to 2000)	−15·2% (−19·1 to −10·8)	1000 (1000 to 2000)	−13·8% (−33·8 to 9·0)	16 000 (16 000 to 17 000)	−12·9% (−15·1 to −10·7)	40 000 (31 000 to 50 000)	−20·1% (−39·3 to 1·1)
Liberia	4000 (4000 to 4000)	−22·8% (−26·4 to −18·8)	3000 (2000 to 3000)	−11·3% (−31·3 to 16·9)	38 000 (37 000 to 39 000)	−18·1% (−20·0 to −16·1)	74 000 (57 000 to 96 000)	−15·9% (−35·4 to 11·5)
Mali	14 000 (13 000 to 16 000)	−19·4% (−22·9 to −15·0)	9000 (7000 to 11 000)	−21·3% (−37·4 to −1·2)	138 000 (133 000 to 143 000)	−14·7% (−16·5 to −12·8)	253 000 (202 000 to 312 000)	−24·7% (−39·8 to −5·5)
Mauritania	4000 (3000 to 4000)	−30·8% (−34·0 to −27·3)	2000 (2000 to 3000)	−32·4% (−47·9 to −11·3)	36 000 (35 000 to 38 000)	−24·6% (−26·4 to −22·4)	59 000 (45 000 to 77 000)	−37·3% (−51·6 to −19·1)
Niger	16 000 (15 000 to 17 000)	−18·9% (−22·6 to −15·2)	9000 (7000 to 12 000)	−10·8% (−29·1 to 14·2)	143 000 (138 000 to 147 000)	−17·2% (−19·4 to −15·3)	259 000 (196 000 to 334 000)	−17·4% (−35·5 to 6·5)
Nigeria	153 000 (138 000 to 170 000)	−22·9% (−25·5 to −20·0)	74 000 (61 000 to 92 000)	−39·7% (−51·0 to −22·7)	1 518 000 (1 415 000 to 1 633 000)	−10·3% (−11·9 to −8·6)	2 010 000 (1 637 000 to 2 544 000)	−41·2% (−53·2 to −23·9)
São Tomé and Príncipe	250 (230 to 270)	−4·8% (−9·3 to 0·3)	120 (100 to 150)	−2·0% (−16·3 to 17·0)	3000 (2000 to 3000)	−3·9% (−6·4 to −1·6)	3000 (3000 to 4000)	−4·9% (−19·6 to 14·9)
Senegal	14 000 (13 000 to 15 000)	−17·7% (−21·7 to −13·5)	10 000 (8000 to 12 000)	−13·2% (−32·2 to 8·7)	139 000 (135 000 to 144 000)	−14·9% (−17·0 to −12·8)	247 000 (199 000 to 304 000)	−20·1% (−37·6 to −0·3)
Sierra Leone	8000 (7000 to 8000)	−12·4% (−16·6 to −7·4)	5000 (4000 to 7000)	−10·8% (−28·7 to 15·1)	77 000 (74 000 to 79 000)	−10·3% (−12·9 to −8·2)	148 000 (113 000 to 194 000)	−14·3% (−32·0 to 11·6)
Togo	7000 (7000 to 8000)	−14·4% (−18·5 to −10·2)	5000 (4000 to 6000)	−5·5% (−26·0 to 21·4)	71 000 (69 000 to 74 000)	−13·7% (−15·7 to −11·2)	142 000 (107 000 to 178 000)	−9·6% (−30·2 to 15·9)

Data in parentheses are 95% uncertainty intervals. DALYs=disability-adjusted life-years.

Table 1: **Incident cases, deaths, prevalent cases, and DALYs for stroke in 2021 and percentage change in age-standardised rates for 1990–2021, by location, for both sexes**



(Figure 1 continues on next page)

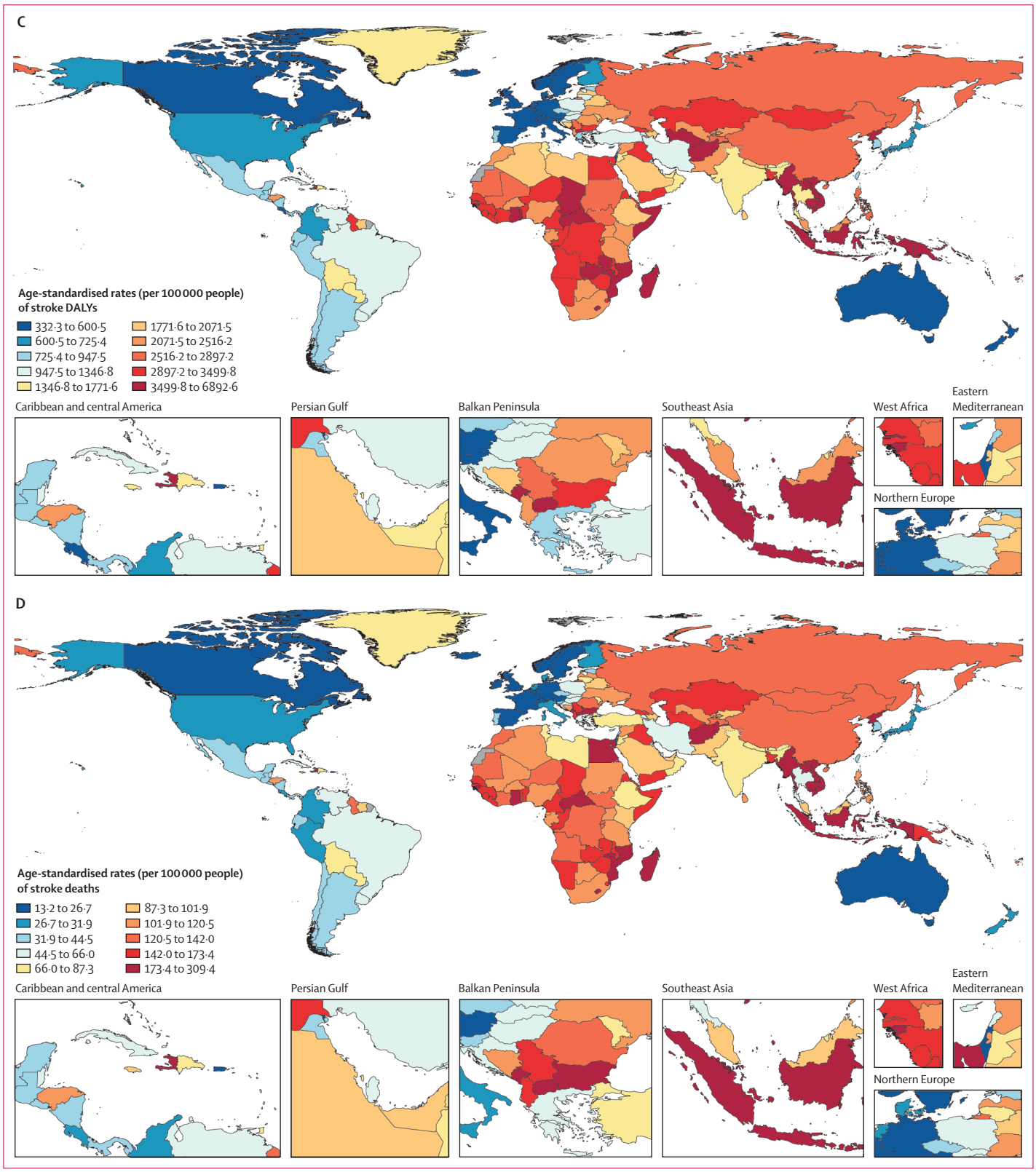


Figure 1: **Global age-standardised rates (per 100 000 people) of stroke incidence (A), prevalence (B), DALYs (C), and deaths (D) for both sexes, 2021**
DALYs=disability-adjusted life-years.

fruits, diet low in vegetables, and diet low in wholegrains), alcohol use, and low physical activity. The dietary risks cluster includes diet high in sodium, diet high in processed meat, diet high in red meat, diet high in sugar-sweetened beverages, diet low in omega-6 polyunsaturated fatty acids, diet low in fruits, diet low in vegetables, and diet low in wholegrains. The environmental risks cluster includes the air pollution cluster, low ambient temperature, high ambient temperature, and lead exposure. The metabolic risks cluster includes high fasting plasma glucose, high LDL cholesterol, high systolic blood pressure, high BMI, and kidney dysfunction. Finally, the tobacco smoke cluster includes smoking and second-hand smoking.

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or the writing of the report.

Results

Stroke incidence, prevalence, death, and DALYs by geographical location

In 2021, there were 93·8 million (95% UI 89·0–99·3) stroke survivors, 11·9 million (10·7–13·2) new stroke events, 7·3 million (6·6–7·8) deaths from stroke, and 160·5 million (147·8–171·6) DALYs from stroke, comprising 10·7% (9·8–11·3) of all deaths and 5·6% (5·0–6·1) of all DALYs from all causes, the third leading cause of deaths (after ischaemic heart disease and COVID-19) and the fourth leading cause of DALYs (after COVID-19, ischaemic heart disease, and neonatal disorders; table 1; appendix p 204).

In 2021, 83·3% incident, 76·7% prevalent, and 87·2% fatal strokes, and 89·4% stroke-related DALYs occurred in all low-income and middle-income countries (LMICs) combined (appendix pp 48–49). We also observed geographical differences in age-standardised stroke incidence, with the lowest in Luxembourg (57·7 [95% UI 53·5–62·1] per 100 000) and highest in the Solomon Islands (355·0 [332·7–378·1] per 100 000); prevalence, with the highest in Ghana (2045·8 [1977·3–2120·1] per 100 000) and lowest in Cyprus (521·5 [495·7–553·5] per 100 000); deaths, with the lowest in Singapore (14·2 [12·3–15·6] per 100 000) and highest in North Macedonia (277·4 [235·5–321·2] per 100 000); and in DALY rates, with the lowest in Switzerland (333·3 [291·0–368·8] per 100 000) and highest in Nauru (6100·0 [4917·8–7576·1] per 100 000). Overall, the highest stroke burden (as measured by age-standardised incidence, prevalence, death, and DALY rates) in 2021 was observed in east Asia, central Asia, and sub-Saharan regions and lowest in high-income North America, Australasia, and Latin America regions, with the majority of the stroke burden in middle SDI, high-middle, and low-middle SDI regions (figure 1; appendix pp 50–85).

Burden by pathological type of stroke

Ischaemic stroke constituted the largest proportion of all incident strokes (7·8 million [95% UI 6·7–8·9], or 65·3% [62·4–67·7] of all strokes), followed by intracerebral haemorrhage (3·4 million [3·1–3·8] incident events, or 28·8% [28·3–28·8] of all strokes). However, the absolute number of DALYs due to intracerebral haemorrhage (79·5 million [72·7–85·2], or 49·6% [49·3–49·8] of total DALYs due to stroke) was greater than the number of DALYs due to ischaemic stroke (70·4 million [64·1–76·0], or 43·8% [43·5–44·3]). In 2021, subarachnoid haemorrhage occurred in 0·7 million (0·6–0·8) people (5·8% [5·7–6·0] of all strokes), and there were 10·6 million (9·4–12·1) DALYs due to subarachnoid haemorrhage (6·6% of DALYs from all strokes combined). Similar to total stroke, differences were observed for age-standardised rates for the three pathological types of stroke and their trends from 1990 to 2021 globally and by SDI (appendix pp 50–85, 208): rates of incident and fatal stroke were highest for ischaemic stroke (92·4 [79·8–105·8] per 100 000 and 44·2 [39·5–47·8] per 100 000, respectively) followed by intracerebral haemorrhage (40·8 [36·2–45·2] per 100 000 and 39·1 [35·4–42·6] per 100 000, respectively) and subarachnoid haemorrhage (8·3 [7·3–9·5] per 100 000 and 4·2 [3·7–4·8] per 100 000, respectively).

In 2021, there were large variations in the proportion of ischaemic stroke and intracerebral haemorrhage between high-income countries and LMICs (appendix pp 100–101). Whereas in high-income countries ischaemic stroke constituted 74·9% (95% UI 72·3–84·1) and intracerebral haemorrhage constituted 17·8% (17·3–17·9) of all incident strokes, in all LMICs combined these stroke subtypes constituted 63·4% (53·6–73·7) and 31·1% (30·2–31·3), respectively. Among all LMICs combined, the proportion of intracerebral haemorrhage was highest in low-income countries (36·9% [36·5–37·1]). The proportion of subarachnoid haemorrhage in high-income countries (7·3% [7·2–8·3]) was higher than that in all LMICs combined (5·5% [5·4–5·7]).

Trends in stroke burden by age, sex and geographical location

Among 11·9 million new strokes in 2021, 6·3 million (95% UI 5·6 to 7·0; or 52·6% [52·4 to 53·1]) occurred in males and 5·7 million (5·1 to 6·3; or 47·4% [47·3 to 47·6]) in females; the corresponding sex distribution of prevalent stroke was 51·0% (47·8 million [45·3 to 50·6]) for males and 49·0% (46·0 million [43·5 to 48·8]) for females; that for deaths from stroke was 52·1% (3·8 million [3·4 to 4·1]) for males and 47·9% (3·5 million [3·1 to 3·8] for females; and that for stroke-related DALYs was 55·0% (88·3 million [80·6 to 97·2]) for males and 45·0% (72·2 million [65·6 to 78·2) for females (table 1; appendix pp 138–139). From 1990 to 2021, the age-standardised incidence, prevalence, death, and DALY rates (table 1) of stroke and its pathological types were reduced virtually across all

	Low-income countries		Lower-middle-income countries		Upper-middle-income countries		High-income countries	
	Absolute number	Percentage	Absolute number	Percentage	Absolute number	Percentage	Absolute number	Percentage
Air pollution and environmental risks								
Ambient particulate matter pollution	655 000 (449 000 to 922 000)	7·3% (4·9 to 9·9)	9 103 000 (5 695 000 to 12 188 000)	15·3% (9·5 to 20·2)	15 557 000 (10 431 000 to 20 052 000)	20·9% (14·8 to 25·7)	1 448 000 (1 043 000 to 1 897 000)	8·8% (6·5 to 11·5)
High ambient temperature	169 000 (78 000 to 305 000)	1·7% (0·8 to 3·1)	1 141 000 (365 000 to 2 202 000)	1·9% (0·6 to 3·7)	407 000 (−142 000 to 1 340 000)	0·6% (−0·2 to 1·8)	78 000 (−25 000 to 222 000)	0·6% (−0·1 to 1·5)
Household air pollution from solid fuels	3 492 000 (2 721 000 to 4 278 000)	38·3% (31·7 to 44·6)	11 410 000 (7 024 000 to 17 273 000)	19·1% (11·7 to 28·3)	3 244 000 (479 000 to 10 588 000)	4·3% (0·6 to 14·3)	13 000 (0 to 134 000)	0·1% (0·0 to 0·8)
Lead exposure	822 000 (−106 000 to 1 793 000)	9·3% (−1·3 to 20·9)	4 965 000 (−672 000 to 10 922 000)	8·4% (−1·1 to 18·8)	5 572 000 (−727 000 to 12 374 000)	7·4% (−1·0 to 16·5)	656 000 (−87 000 to 1 485 000)	3·7% (−0·5 to 8·5)
Low ambient temperature	299 000 (248 000 to 363 000)	3·2% (2·8 to 3·8)	1 248 000 (801 000 to 1 801 000)	2·1% (1·4 to 3·0)	4 939 000 (4 153 000 to 5 937 000)	6·7% (6·0 to 7·5)	1 119 000 (964 000 to 1 295 000)	6·3% (5·6 to 7·2)
Dietary risks								
Alcohol use	302 000 (61 000 to 603 000)	3·2% (0·7 to 6·3)	2 018 000 (483 000 to 3 902 000)	3·2% (0·8 to 6·1)	4 710 000 (1 122 000 to 8 961 000)	6·2% (1·5 to 11·8)	1 399 000 (251 000 to 2 856 000)	8·1% (1·6 to 16·0)
Diet high in processed meat	8 000 (2 000 to 14 000)	0·1% (0·0 to 0·2)	58 000 (13 000 to 105 000)	0·1% (0·0 to 0·2)	181 000 (42 000 to 326 000)	0·2% (0·1 to 0·4)	189 000 (46 000 to 334 000)	1·1% (0·3 to 1·9)
Diet high in red meat	−162 000 (−607 000 to 250 000)	−1·3% (−5·1 to 2·1)	−905 000 (−3 475 000 to 1 258 000)	−1·3% (−5·0 to 1·9)	−3 528 000 (−15 465 000 to 4 994 000)	−4·7% (−20·0 to 6·8)	−561 000 (−2 380 000 to 834 000)	−4·3% (−19·0 to 6·4)
Diet high in sodium	528 000 (71 000 to 1 443 000)	6·1% (0·8 to 16·0)	4 558 000 (574 000 to 11 393 000)	7·5% (0·9 to 19·0)	11 095 000 (3 669 000 to 22 286 000)	14·3% (4·8 to 27·5)	1 207 000 (159 000 to 3 109 000)	7·1% (1·0 to 18·0)
Diet high in sugar-sweetened beverages	2000 (1000 to 3000)	0·0% (0·0 to 0·0)	24 000 (12 000 to 39 000)	0·0% (0·0 to 0·1)	64 000 (31 000 to 101 000)	0·1% (0·0 to 0·1)	54 000 (26 000 to 85 000)	0·3% (0·2 to 0·5)
Diet low in fibre	240 000 (−51 000 to 502 000)	2·1% (−0·5 to 4·4)	2 357 000 (−567 000 to 4 845 000)	3·5% (−0·8 to 7·2)	1 175 000 (−243 000 to 2 521 000)	1·6% (−0·3 to 3·4)	298 000 (−59 000 to 643 000)	2·2% (−0·5 to 4·7)
Diet low in fruits	784 000 (38 000 to 1 393 000)	7·1% (0·4 to 12·7)	5 318 000 (395 000 to 9 047 000)	7·9% (0·7 to 13·8)	2 969 000 (183 000 to 5 711 000)	3·9% (0·2 to 7·2)	550 000 (49 000 to 995 000)	4·1% (0·3 to 7·2)
Diet low in omega-6 polyunsaturated fatty acids	1000 (0 to 2000)	0·0% (0·0 to 0·0)	7000 (2000 to 13 000)	0·0% (0·0 to 0·0)	8000 (2000 to 16 000)	0·0% (0·0 to 0·0)	2000 (0 to 3000)	0·0% (0·0 to 0·0)
Diet low in vegetables	689 000 (97 000 to 1 189 000)	6·3% (1·1 to 11·0)	1 477 000 (374 000 to 2 504 000)	2·3% (0·6 to 3·8)	278 000 (106 000 to 461 000)	0·4% (0·1 to 0·6)	93 000 (18 000 to 167 000)	0·6% (0·3 to 1·0)
Diet low in wholegrains	187 000 (−202 000 to 497 000)	1·8% (−1·9 to 5·1)	1 000 000 (−1 041 000 to 2 710 000)	1·5% (−1·5 to 4·4)	1 595 000 (−1 612 000 to 4 382 000)	2·1% (−2·1 to 5·8)	340 000 (−335 000 to 1 083 000)	2·3% (−2·4 to 6·7)
Physical activity								
Low physical activity	163 000 (68 000 to 272 000)	1·7% (0·6 to 3·0)	1 191 000 (427 000 to 2 092 000)	2·0% (0·5 to 3·7)	1 587 000 (361 000 to 3 094 000)	2·1% (0·3 to 4·3)	415 000 (−56 000 to 951 000)	2·5% (0·4 to 5·0)
Tobacco smoking								
Second-hand smoke	320 000 (212 000 to 434 000)	3·1% (2·1 to 4·2)	2 694 000 (1 843 000 to 3 599 000)	4·3% (3·0 to 5·7)	3 548 000 (2 410 000 to 4 722 000)	4·8% (3·3 to 6·4)	402 000 (270 000 to 549 000)	2·8% (1·9 to 3·7)
Smoking	780 000 (627 000 to 941 000)	7·3% (6·2 to 8·5)	7 248 000 (6 162 000 to 8 491 000)	11·1% (9·5 to 12·6)	12 606 000 (10 200 000 to 15 551 000)	16·4% (13·9 to 19·0)	1 870 000 (1 573 000 to 2 225 000)	13·1% (11·2 to 15·0)

(Table 2 continues on next page)

	Low-income countries		Lower-middle-income countries		Upper-middle-income countries		High-income countries	
	Absolute number	Percentage	Absolute number	Percentage	Absolute number	Percentage	Absolute number	Percentage
(Continued from previous page)								
Physiological factors								
High BMI	357 000 (31 000 to 752 000)	3·4% (0·3 to 7·0)	2 276 000 (202 000 to 4 653 000)	3·5% (0·3 to 7·0)	3 848 000 (294 000 to 8 127 000)	5·1% (0·4 to 10·5)	1 197 000 (90 000 to 2 420 000)	8·2% (0·5 to 16·4)
High fasting plasma glucose	672 000 (491 000 to 873 000)	8·4% (6·4 to 10·5)	5 510 000 (4 189 000 to 6 899 000)	10·1% (7·9 to 12·4)	7 838 000 (6 087 000 to 9 926 000)	10·6% (8·3 to 13·2)	2 433 000 (1 909 000 to 2 978 000)	13·0% (10·5 to 15·5)
High LDL cholesterol	857 000 (304 000 to 1 429 000)	9·7% (3·3 to 16·2)	6 557 000 (2 425 000 to 10 763 000)	11·4% (3·9 to 19·2)	10 521 000 (3 652 000 to 17 446 000)	14·1% (4·9 to 23·0)	3 019 000 (1 003 000 to 5 043 000)	17·3% (6·1 to 27·8)
High systolic blood pressure	5 004 000 (3 684 000 to 6 327 000)	55·5% (41·1 to 66·2)	35 018 000 (26 696 000 to 42 407 000)	59·0% (44·3 to 69·9)	42 461 000 (30 731 000 to 54 201 000)	56·7% (42·4 to 68·4)	9 286 000 (6 804 000 to 11 360 000)	53·3% (39·5 to 64·0)
Kidney dysfunction	844 000 (592 000 to 1 103 000)	9·3% (6·9 to 11·7)	6 603 000 (4 928 000 to 8 309 000)	11·1% (8·2 to 14·0)	6 119 000 (4 382 000 to 8 066 000)	8·1% (5·8 to 10·5)	1 430 000 (946 000 to 1 948 000)	7·9% (5·5 to 10·4)
Cluster of risk factors								
Air pollution*	4 147 000 (3 281 000 to 5 058 000)	45·5% (37·9 to 52·7)	20 516 000 (16 091 000 to 24 931 000)	34·3% (27·8 to 41·4)	18 805 000 (13 812 000 to 24 803 000)	25·2% (19·6 to 32·0)	1 461 000 (1 053 000 to 1 920 000)	8·9% (6·6 to 11·8)
Behavioural risks†	3 009 000 (1 856 000 to 4 044 000)	30·0% (18·4 to 40·5)	20 601 000 (14 385 000 to 26 447 000)	32·5% (22·6 to 42·5)	28 745 000 (20 905 000 to 38 190 000)	37·6% (27·8 to 48·4)	5 093 000 (3 497 000 to 6 929 000)	31·9% (23·1 to 41·8)
Dietary risks‡	1 887 000 (585 000 to 2 974 000)	18·7% (5·9 to 31·2)	10 873 000 (3 590 000 to 18 064 000)	17·0% (5·6 to 29·0)	12 749 000 (4 384 000 to 23 122 000)	16·5% (5·5 to 29·2)	1 846 000 (649 000 to 3 690 000)	11·1% (3·4 to 21·5)
Environmental or occupational risks§	4 828 000 (3 842 000 to 5 781 000)	53·0% (44·2 to 60·8)	24 989 000 (19 266 000 to 29 973 000)	41·9% (33·0 to 50·3)	26 451 000 (19 722 000 to 33 653 000)	35·5% (27·7 to 43·4)	3 093 000 (2 287 000 to 3 958 000)	18·1% (13·6 to 22·7)
Metabolic risks¶	5 925 000 (4 692 000 to 7 204 000)	65·9% (54·9 to 74·8)	41 558 000 (34 711 000 to 47 433 000)	70·3% (59·7 to 78·7)	51 450 000 (41 291 000 to 61 419 000)	68·9% (57·4 to 77·9)	11 980 000 (9 919 000 to 13 788 000)	68·7% (57·9 to 77·5)
Tobacco smoke‖	1 067 000 (830 000 to 1 318 000)	10·2% (8·2 to 12·2)	9 631 000 (7 866 000 to 11 484 000)	14·9% (12·3 to 17·5)	15 602 000 (12 447 000 to 19 422 000)	20·4% (16·8 to 24·0)	2 209 000 (1 825 000 to 2 669 000)	15·4% (12·8 to 17·8)
Combined risk factors**								
All risk factors	7 812 000 (6 670 000 to 8 973 000)	85·4% (79·3 to 89·2)	51 119 000 (46 489 000 to 55 450 000)	85·7% (79·7 to 89·8)	62 283 000 (53 668 000 to 70 765 000)	83·6% (76·9 to 88·7)	13 633 000 (11 938 000 to 15 151 000)	79·2% (71·6 to 85·4)

Data in parentheses are 95% uncertainty intervals. Percentages and number of DALYs are not mutually exclusive. The sum of percentages and number of DALYs in the columns exceeds the totals for all risk factors combined because the effect of many of these risk factors are mediated partly or wholly through other risk factors. 0% represents very low numbers. DALYs=disability-adjusted life-years. *Air pollution cluster includes ambient $PM_{2·5}$ pollution and household air pollution. †Behavioural risks cluster includes smoking (including second-hand smoking), dietary risks (diet high in sodium, diet high in processed meat diet, high in red meat, diet high in sugar-sweetened beverages, diet low in omega-6 polyunsaturated fatty acids, diet low in fruits, diet low in vegetables, and diet low in wholegrains), alcohol use, and low physical activity. ‡Dietary risks cluster includes diet high in sodium, diet high in processed meat diet, high in red meat, diet high in sugar-sweetened beverages, diet low in omega-6 polyunsaturated fatty acids, diet low in fruits, diet low in vegetables, and diet low in whole grains. §Environmental risks cluster includes air pollution cluster, low ambient temperature, high ambient temperature, and lead exposure. ¶Metabolic risks cluster includes high fasting plasma glucose, high LDL cholesterol, high systolic blood pressure, high BMI, and kidney dysfunction. ‖Tobacco smoke includes smoking and second-hand smoking. **Age-standardised total percentage of DALYs due to all risk factors combined.

Table 2: **Stroke-related DALYs associated with risk factors and their clusters by World Bank country income level, for both sexes, 2021**

World Bank country income levels (except for ischaemic stroke incidence and prevalence in upper-middle-income countries, where the rates were increased by 1% [–4 to 5] for ischaemic stroke incidence and 11% [8 to 14] for ischaemic stroke prevalence). Although there was a trend towards lower age-standardised stroke burden rates (incidence, prevalence, deaths, and DALYs) across all quintiles of the SDI, there was a stagnation in the reduction of incidence rates from 2015 onwards, and even some increase in the prevalence rates in high-middle SDI countries from 2020 to 2021 (appendix p 209). Similar trend patterns were observed in seven GBD super-regions, with more prominent increases in age-standardised incidence and prevalence rates after 2015 in southeast Asia, east Asia, and Oceania (appendix p 206).

Although from 1990 to 2021 there was a decrease in the age-standardised incidence (–21·8% [95% UI–23·7 to –19·8]), prevalence (–8·5% [–9·7 to –7·3]), death (–39·4% [–44·0 to –34·6]), and DALY (–38·7% [–43·4 to –34·0]) stroke rates, increases were seen over that period in the numbers of people who had a new stroke (70·2% [65·9 to 74·6]), survived stroke (86·1% [83·0 to 89·4]), died from stroke (44·1% [32·3 to 56·0]), and who died or remained disabled from stroke (as measured by DALYs; 32·2% [21·7 to 42·7]; table 1; appendix pp 100–101). The percentage decline in age-standardised stroke incidence rates in the 2019–2021 period (–1·8% [–2·8 to –0·6]) was smaller than that for the overall 2010–21 period (–3·1% [–4·2 to –2·0]).

Although all-age (not age-standardised) stroke incidence, death, and DALY rates were substantially reduced in people aged 70 years or older between 1990 and 2021 (–18·2% [95% UI –21·3 to – 14·6] incidence rate, –34·2% [–39·4 to –29·3] death rate, and –35·6% [–40·2 to –30·8] DALY rate), and all-age prevalence rate in this age group did not change over this period (–1·0 [–3·1 to 1·2]), all-age incidence increased by 4·1% (0·9 to 7·6), prevalence increased in people younger than 70 years by 14·8% (13·1 to 16·8), and death and DALY rates were reduced in people younger than 70 years by 17·4% (–25·0 to –8·9) and 19·0% (–26·0 to –11·6), respectively (appendix p 140). Similar patterns were observed for all-age

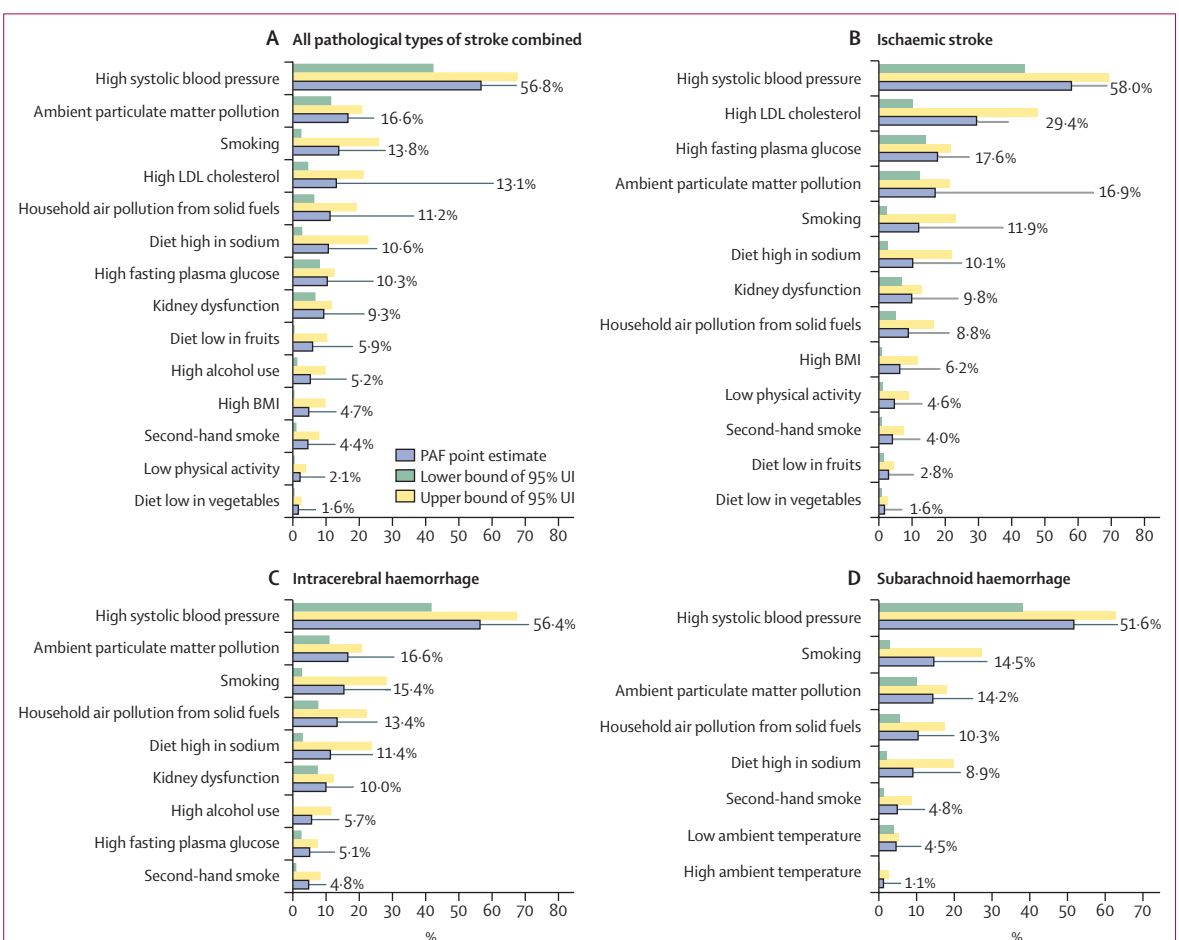


Figure 2: **Most individually significant risk factors for total stroke (A), ischaemic stroke (B), intracerebral haemorrhage (C), and subarachnoid haemorrhage (D), as measured by the PAF of stroke DALYs attributable to the risk factors, for both sexes**
DALYs=disability-adjusted life-years. PAF=population attributable fraction.

incidence, prevalence, death, and DALY rates of ischaemic stroke for both age groups (<70 years and ≥70 years). Of the three pathological types of stroke, only all-age subarachnoid haemorrhage prevalence rates increased in people younger than 70 years, by 3·4% (1·3 to 5·5), whereas all-age incidence, prevalence, death, and DALY rates of intracerebral haemorrhage and incidence, death, and DALY rates of subarachnoid haemorrhage were reduced in both age groups (appendix pp 88, 210–211).

Contribution of risk factors to stroke-related DALYs

Globally, the total number of stroke-related DALYs due to risk factors increased substantially from 1990 (100·1 million [95% UI 92·7 to 107·8]) to 2021 (135·0 million [122·0 to 147·7]), but there was no substantial change in the age-standardised stroke DALYs attributable to risk factors (–0·5% [–2·4 to 1·1]). In 2021, 84·1% (77·8 to 88·8) of DALYs from stroke were attributed to the 23 risk factors analysed (table 2), with the largest proportions of attributable risks for total stroke, ischaemic stroke, intracerebral haemorrhage, and subarachnoid haemorrhage observed in eastern Europe, Asia, and sub-Saharan Africa (appendix p 212).

At level 1 of the GBD risk factors hierarchy (table 2, appendix pp 141–253), metabolic risk factors contributed most to the stroke-related DALYs (range 66–70%) across all World Bank country income levels, followed by the environmental risk cluster in low-income, lower-middle-income, and upper-middle-income countries (range 35–53%), and behavioural risks (range 30–38%) across different income level countries. Stroke burden associated with the environmental or occupational risks was lowest in high-income countries (18·1% [95% UI 13·6 to 22·7]). Similarly, regions with higher SDI (appendix pp 141–143) had a larger contribution of metabolic and behavioural risks to stroke-related DALYs, whereas environmental risks most prominently contributed to stroke-related DALYs in lower SDI quintiles. From 1990 to 2021, the age-standardised proportion of stroke DALYs attributable to risk factors increased in north Africa and the Middle East (6·8% [4·1 to 11·5]) and sub-Saharan Africa (3·3% [1·8 to 5·3]), but did not change in south Asia (0·4% [–1·0 to 1·9]) and southeast Asia, east Asia, and Oceania (–0·9% [–4·2 to 1·9]), and decreased in central Europe, eastern Europe, and central Asia (–2·0% [–3·8 to –0·7]) and Latin America and the Caribbean (–5·0% [–9·1 to –2·3]), as well as high-income GBD regions (–7·3% [–10·1 to –5·0]).

Globally, of the 23 risk factors analysed, 14 individually significant risk factors for stroke were high systolic blood pressure (56·8% [95% UI 42·5–68·0] attributable DALYs), ambient particular matter (16·6% [11·5–20·9]), smoking (13·8% [2·5–26·0]), high LDL cholesterol (13·1% [4·6–21·3]), household air pollution (11·2% [6·4–19·3]), diet high in sodium (10·6% [2·8–22·8]), high fasting plasma glucose (10·3% [8·1–12·6]), kidney disfunction (9·3% [6·8–11·8]), diet low in fruits (5·9% [0·4–10·4]), high alcohol use (5·2% [1·3–9·8]), high BMI (4·7% [0·4–9·8]), second-hand smoking (4·4% [1·0–7·9]), low physical activity (2·1% [0·5–3·9]), and diet low in vegetables (1·6% [0·4–2·6]; figure 2).

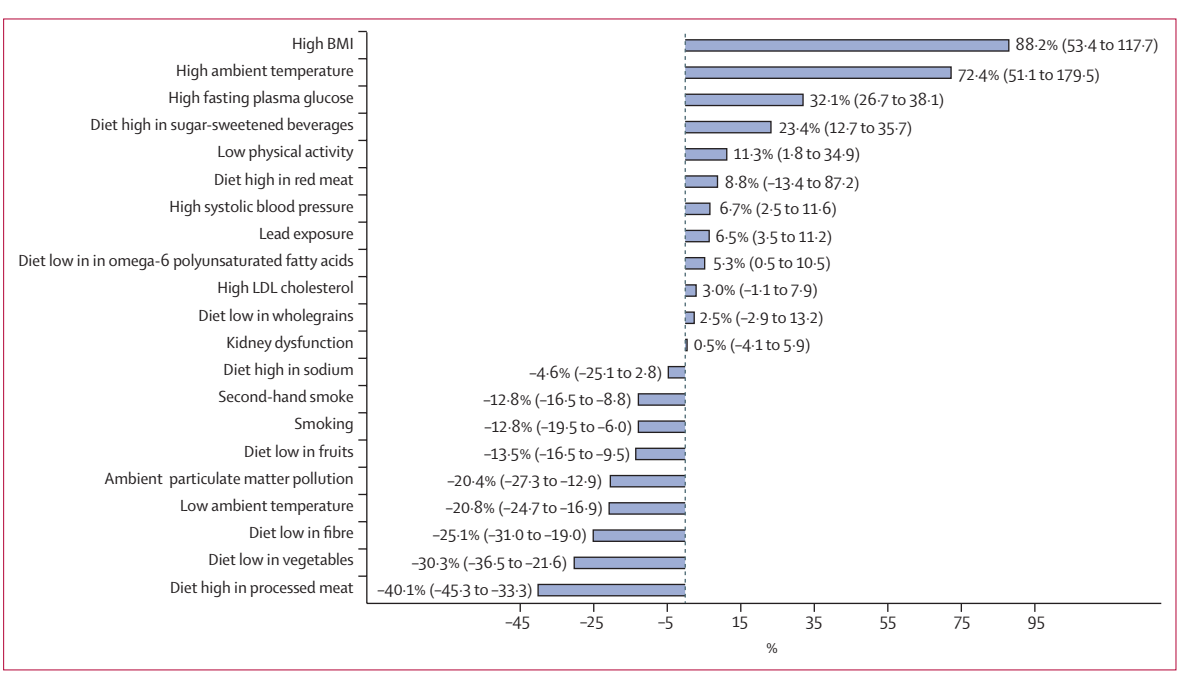


Figure 3: **Trends in the PAF of stroke DALYs due to risk factors, for both sexes, 1990–2021**
Data in parentheses are 95% uncertainty intervals. DALYs=disability-adjusted life-years. PAF=population attributable fraction.

Stroke attributable to metabolic risks constituted 68·8% (95% UI 57·6 to 77·5) of all strokes, environmental risks constituted 36·7% (29·0 to 44·2), and behavioural risks constituted 35·2% (26·9 to 44·7). Although the proportion of stroke DALYs attributable to metabolic risks increased from 1990 to 2021 by 6·7% (3·8 to 10·0; mainly because of the increase in the burden attributable to high BMI, high fasting plasma glucose, and high systolic blood pressure), proportions of stroke DALYs attributable to behavioural risks decreased by 8·0% (–13·6 to –3·4) and those due to environmental risks by 14·8% (–21·6 to –8·7), mainly because of the decrease in the burden attributable to diet high in processed meat, diet low in vegetables, diet low in fibre, low ambient temperature, particulate matter pollution, diet low in fruits, and smoking (figure 3). However, from 1990 to 2021, there was a substantial increase in the stroke DALYs attributable to high ambient temperature, high fasting plasma glucose, diet high in sugar-sweetened beverages, low physical activity, diet high in red meat, lead exposure, and diet low in omega-6 polyunsaturated fatty acids. There were noticeable geographical and regional variations in the PAF of the risk factors for ischaemic stroke, intracerebral haemorrhage, subarachnoid haemorrhage, and all stroke types combined (appendix p 264), as well as in the ranking of PAFs of age-standardised stroke DALYs attributable to risk factors by 21 GBD regions (figure 4). For the PAF of risk factors by pathological type of stroke, SDI, 21 GBD regions, and 204 countries and territories were used (appendix pp 89–201). Unlike the PAF of risk factors for total stroke, high alcohol use was not associated with ischaemic stroke-related DALYs (appendix pp 92–95, 126–149, 199), and diet low in fruits and vegetables and high BMI were not associated with intracerebral haemorrhage-related DALYs (appendix pp 92–95, 150–173, 200). Unlike ischaemic stroke and intracerebral haemorrhage, non-optimal ambient temperature appeared to be associated with the subarachnoid haemorrhage-related DALYs, with the greater contribution of low ambient temperature (4·5% [3·8 to 5·3]) than high ambient temperature (1·1% [0·2 to 2·5]). Other substantial risk factors for subarachnoid haemorrhage (appendix pp 151–153) were second-hand smoking (4·7% [3·2 to 6·2]), diet high in sodium (8·9% [2·0 to 19·8]), household air pollution from solid fuels (10·3% [5·5 to 17·4]), ambient particulate matter pollution (14·2% [9·8 to 18·0]), smoking (14·5% [2·7 to 27·2]), and high systolic blood pressure (51·6% [38·0 to 62·6]).

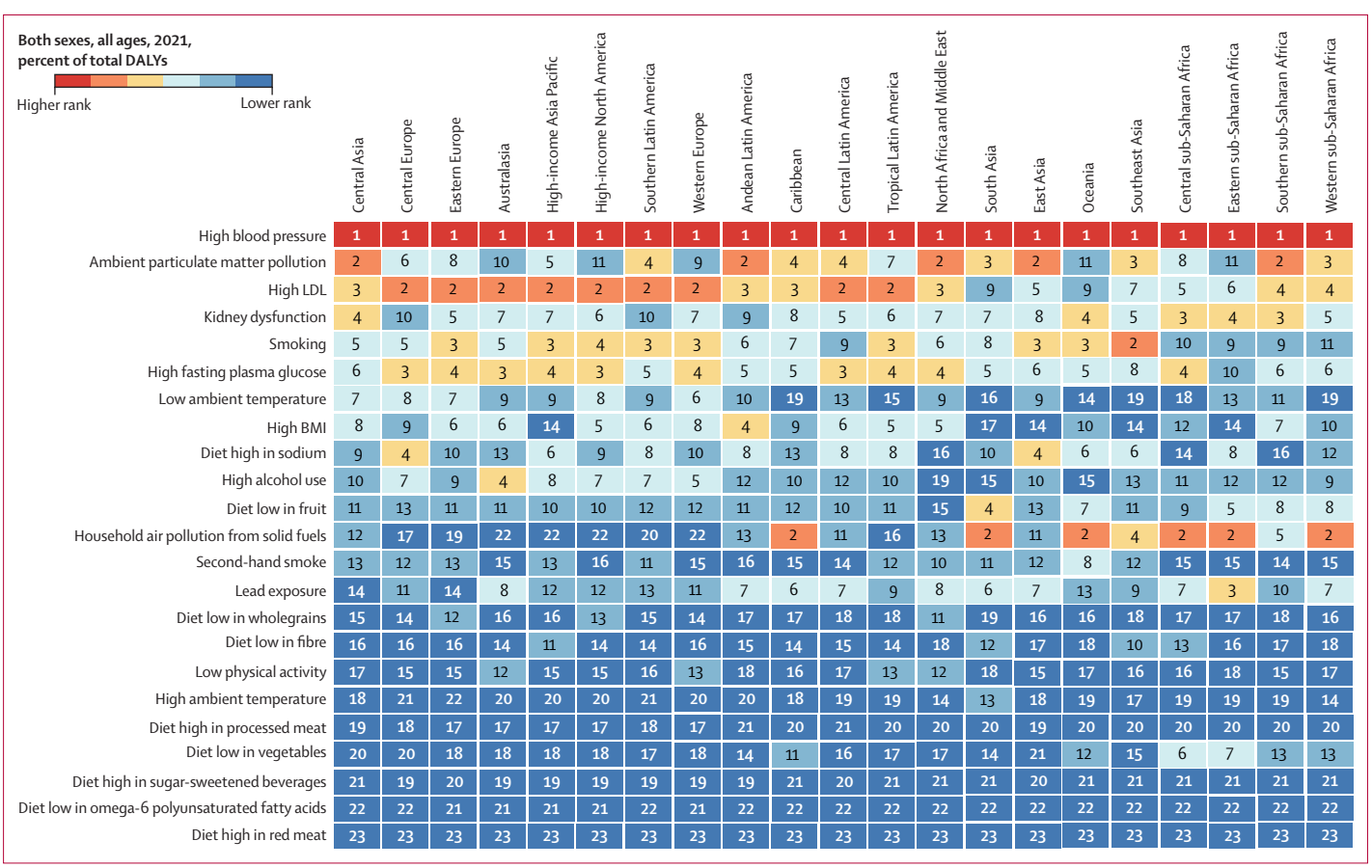


Figure 4: **Ranking of age-standardised stroke DALYs attributable to risk factors by 21 GBD regions, for both sexes, 2021**
DALYs=disability-adjusted life-years. GBD=Global Burden of Diseases, Injuries, and Risk Factors Study.

Discussion

In 2021, stroke remained the second most common cause (after ischaemic heart disease) of death and the third most common cause of DALYs (after ischaemic heart disease and neonatal disorders) among non-communicable disorders (NCDs) globally. However, at level 3 of the GBD all-cause hierarchy, stroke was the third most common cause of death (after ischaemic heart disease and COVID-19) and the fourth most common cause of DALYs (after COVID-19, ischaemic heart disease, and neonatal disorders), with the bulk of the stroke burden in LMICs and countries with lower SDI. Consistent with previous studies,[5,17] this study showed disparities in stroke burden (including almost two times greater proportion of intracerebral haemorrhage in LMICs than in high-income countries)[18] and risk factors by GBD region, country, country income level, and SDI quintiles, as well as an overall trend towards decreasing age-standardised stroke incidence, prevalence, and DALY rates from 1990 to 2021. Given the leading role of arterial hypertension in the occurrence of intracerebral haemorrhage,[19] the greater prevalence and poorer control of hypertension in LMICs[20] than in high-income countries are the most likely causes of the differences in the proportion of intracerebral haemorrhage in those countries. Similar proportions of subarachnoid haemorrhage in high-income countries and LMICs are likely to be related to the significant reduction in tobacco smoking prevalence that we observed since 2010 in high-income countries, with almost no change in tobacco smoking prevalence in LMICs.[21] However, the current study documented a stagnation in the reduction of age-standardised incidence rates from 2015 onwards, and even some increase in the age-standardised stroke incidence, death, prevalence, and DALY rates in southeast Asia, east Asia, and Oceania, and countries with lower SDI from 2015 onwards. Globally, there was also an increase in all-age incidence and prevalence rates in people younger than 70 years, whereas there was a reduction in all-age stroke incidence, prevalence, death, and DALY rates in people aged 70 years or older. A trend towards increasing incidence and prevalence rate of cardiovascular diseases (including stroke) in people aged 15–39 years globally[22] and stroke incidence rates in people younger than 55 years[3] versus older people has also been shown in previous systematic reviews and is likely to be related to the increase in prevalence of arterial hypertension[23,24] (including poorly controlled and uncontrolled hypertension),[25] overweight or obesity,[26–28] and type 2 diabetes[29] in young adults, especially in LMICs.[24,26–29] This situation is complicated by the fact that a large proportion of young adults with vascular risk factors, arterial hypertension,[30] and dyslipidaemia[31] remain under-treated owing at least partly to the widespread use of absolute cardiovascular disease risk[32] treatment thresholds.[3] The observed slowing down of the percentage of decline of age-standardised stroke incidence rates in 2019–21 is likely to be related to the decreased hospital admissions of patients with acute stroke that was observed over the COVID-19 period in many countries.[33]

Apart from population growth and ageing,[1,34] other factors responsible for the increased burden of stroke, in terms of absolute numbers in the world, are likely to be related to the insufficient effectiveness of the currently used primary stroke and cardiovascular disease prevention strategies[35,36] as well as the disparities and major gaps in stroke service provision and accessibility, and workforce of stroke care providers in many countries (especially LMICs).[17,37,38] Although stroke is highly preventable, globally there were substantial increases in DALYs attributable to high BMI, high ambient temperature, high fasting plasma glucose, diet high in sugar-sweetened beverages, low physical activity, high systolic blood pressure, and diet low in polyunsaturated omega-6 fatty acids, suggesting the growing role of these environmental and behavioural risks in the stroke burden. However, from 1990 to 2021, we also observed a reduction of PAF due to diet high in processed meat, diet low in vegetables, diet low in fibre, low ambient temperature, ambient particulate matter pollution, diet low in fruits, and smoking, suggesting effectiveness of the strategies towards reduction of the exposure to these risk factors. The observed increase in the age-standardised proportion of stroke DALYs attributable to risk factors in north Africa and the Middle East and sub-Saharan Africa regions might reflect a failure in the control of stroke risk factors. However, in central Europe, eastern Europe, central Asia, Latin America and the Caribbean, and high-income GBD regions, this might reflect a success in the control of stroke risk factors.

This study is, to our knowledge, the first to show the large contribution of ambient particulate matter pollution and household air pollution from solid fuels to subarachnoid haemorrhage DALYs, with a similar PAF to that of smoking. A close relationship between ambient air pollution and subarachnoid haemorrhage mortality was found in some studies.[39–41] Air pollution in 2021 appeared to be highly important to other types of stroke and also caused 11·9% (95% UI 10·0–13·8) of total deaths from all causes, making it the second largest cause of deaths from all causes globally (after high systolic blood pressure) and the second leading cause of DALYs (8·2% [6·9–9·6]) from all causes (after malnutrition).[42] These findings are in line with research showing that rises in ambient temperature (including heatwaves) and climate change are associated with increased stroke morbidity and mortality.[43,44] Because ambient air pollution is reciprocally associated with the ambient temperature and climate change,[44] all of which synergistically influence cardiovascular disease (including stroke) occurrence[44–46] and overall health,[47,48] the importance of urgent climate actions and measures to reduce ambient air pollution cannot be

overestimated.[47,48] Experts have recommended that governments increase implementation of a clean-energy economy, promote unprocessed plant-based food choices,[44] and globally phase out industrialised animal farming.[49]

Every member state of the UN has committed to meeting the Sustainable Development Goals (SDGs), but currently few countries are on target to achieve SDG 3.4, which is to reduce by a third premature mortality from NCDs through prevention and treatment and promote mental health and wellbeing by 2030. By implementing and monitoring the World Stroke Organization–*Lancet Neurology* Commission's recommendations,[38] the global burden of stroke would be reduced drastically this decade and beyond. Not only would this substantial reduction enable SDG 3.4, as well as other key SDGs, to be met, it would improve brain health and the overall wellbeing of millions of people across the globe. One of the most common problems in implementing stroke prevention and care recommendations is the scarcity of funding. The World Stroke Organization–*Lancet Neurology* Commission on stroke[38] recommends introducing legislative regulations and taxation of unhealthy products by each government in the world. Such taxation would not only reduce consumption of these products and, therefore, lead to the reduction of burden from stroke and other major NCDs,[50–52] but also generate a large revenue[50] sufficient to fund prevention programmes and services for stroke and other major disorders, reduce poverty and inequality in health service provision, improve wellbeing of the population, and boost local economies.

The main strength of this study is the extended number of data sources included in the analysis that allowed us to generate more accurate and up-to-date stroke burden and risk factor estimates. This allows evidence-based health-care planning and resource allocation by health policy makers on the national, regional, and global levels. However, good-quality stroke epidemiological studies[7] are still scarce in most countries, which prevented us from including in the analysis many other important risk factors, such as sickle cell disease and HIV, which are particularly important for sub-Saharan Africa. Differences in health-care systems and completeness and accuracy of stroke case ascertainment might play a part in the observed between-country differences (eg, very high stroke prevalence in Ghana compared with neighbouring countries). Although the GBD methods for estimating attributable burden of stroke due to risk factors accounts for a cumulative effect of multiple risk factors, it might not fully account for all potential confounders. Moreover, some new risk factors, such as high ambient temperature, might require further validation and examination to confirm their impact on stroke burden. Furthermore, more granular data analysis is needed. For example, stroke burden variation by race and ethnicity within countries, which can mask disparities in stroke incidence, risk factors, and outcomes among different population groups, and analysis of attributable effects of different levels of exposure to smoking, alcohol, and so on. We expect such analysis will be done in future GBD iterations.

In summary, our study findings continue to point out that currently used stroke prevention strategies are not sufficiently effective to halt, let alone reduce, the fast-growing stroke burden. Additional, more effective stroke prevention strategies (with the emphasis on population-wide measures, task shifting from doctors to nurses or health volunteers, and the wider use of evidence-based mobile and telehealth platforms) and pragmatic solutions to address the critical gaps in stroke service delivery, along with development of context-appropriate workforce capacity building and epidemiological surveillance systems,[38] need to be urgently implemented across all countries. Without scaling up these innovative evidence-based strategies and policies that target local, national, regional, and global stroke prevention and care disparities, the burden of stroke will continue to grow, thus threatening the sustainability of health systems worldwide.

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For individual authors' contributions to the manuscript, please see the appendix (pp 47–61), divided into the following categories: managing the overall research enterprise; writing the first draft of the manuscript; primary responsibility for applying analytical methods to produce estimates; primary responsibility for seeking, cataloguing, extracting, or cleaning data; designing or coding figures and tables; providing data or critical feedback on data sources; developing methods or computational machinery; providing critical feedback on methods or results; drafting the manuscript or revising it critically for important intellectual content; and managing the estimation or publications process. The corresponding and senior authors had full access to the data in the study and had final responsibility for the decision to submit for publication. V L Feigin, C O Johnson, G A Roth, C Bisignano, T Vos, and C J L Murray had full access to and verified data.

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Data sharing

To download GBD data used in these analyses, please visit the GBD 2021 Sources Tool website. To download forecasted estimates used in these analyses, please visit the GBD visualisation tools.

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References

1 Roth GA, Mensah GA, Johnson CO, et al. Global Burden of Cardiovascular Diseases and Risk Factors, 1990–2019: update from the GBD 2019 Study. *J Am Coll Cardiol* 2020; **76:** 2982–3021.

2 Vaughan AS, Ritchey MD, Hannan J, Kramer MR, Casper M. Widespread recent increases in county-level heart disease mortality across age groups. *Ann Epidemiol* 2017; **27:** 796–800.

3 Scott CA, Li L, Rothwell PM. Diverging temporal trends in stroke incidence in younger vs older people: a systematic review and meta-analysis. *JAMA Neurol* 2022; **79:** 1036–48.

4 Wright JS, Wall HK, Ritchey MD. Million Hearts 2022: small steps are needed for cardiovascular disease prevention. *JAMA* 2018; **320:** 1857–58.

5 GBD 2019 Stroke Collaborators. Global, regional, and national burden of stroke and its risk factors, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet Neurol* 2021; **20:** 795–820.

6 Feigin VL, Owolabi MO, Feigin VL, et al. Pragmatic solutions to reduce the global burden of stroke: a World Stroke Organization–*Lancet Neurology* Commission. *Lancet Neurol* 2023; **22:** 1160–206.

7 Lin X, Xu Y, Pan X, et al. Global, regional, and national burden and trend of diabetes in 195 countries and territories: an analysis from 1990 to 2025. *Sci Rep* 2020; **10:** 14790.

8 GBD 2019 Risk Factors Collaborators. Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet* 2020; **396:** 1223–49.

9 GBD 2021 Risk Factors Collaborators. Global burden and strength of evidence for 88 risk factors in 204 countries and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet* 2024; **403:** 2162–203.

10 GBD 2021 Diseases and Injuries Collaborators. Global incidence, prevalence, years lived with disability (YLDs), disability-adjusted life-years (DALYs), and healthy life expectancy (HALE) for 371 diseases and injuries in 204 countries and territories and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet* 2024; **403:** 2133–61.

11 Aho K, Harmsen P, Hatano S, Marquardsen J, Smirnov VE, Strasser T. Cerebrovascular disease in the community: results of a WHO collaborative study. *Bull World Health Organ* 1980; **58:** 113–30.

12 GBD 2016 Causes of Death Collaborators. Global, regional, and national age-sex specific mortality for 264 causes of death, 1980–2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet* 2017; **390:** 1151–210.

13 GBD 2016 Stroke Collaborators. Global, regional, and national burden of stroke, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet Neurol* 2019; **18:** 439–58.

14 Foreman KJ, Marquez N, Dolgert A, et al. Forecasting life expectancy, years of life lost, and all-cause and cause-specific mortality for 250 causes of death: reference and alternative scenarios for 2016–40 for 195 countries and territories. *Lancet* 2018; **392:** 2052–90.

15 Feigin VL, Roth GA, Naghavi M, et al. Global burden of stroke and risk factors in 188 countries, during 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet Neurol* 2016; **15:** 913–24.

16 Murray CJL, Lopez AD. Measuring the global burden of disease. *N Engl J Med* 2013; **369:** 448–57.

17 Prust ML, Forman R, Ovbiagele B. Addressing disparities in the global epidemiology of stroke. *Nat Rev Neurol* 2024; **20:** 207–21.

18 An SJ, Kim TJ, Yoon BW. Epidemiology, risk factors, and clinical features of intracerebral hemorrhage: an update. *J Stroke* 2017; **19:** 3–10.

19 Wang S, Zou XL, Wu LX, et al. Epidemiology of intracerebral hemorrhage: a systematic review and meta-analysis. *Front Neurol* 2022; **13:** 915813.

20 Nissinen A, Bothig S, Granroth H, Lopez AD. Hypertension in developing countries. *World Health Stat Q* 1988; 41: 141–54.

21 Dai X, Gakidou E, Lopez AD. Evolution of the global smoking epidemic over the past half century: strengthening the evidence base for policy action. *Tob Control* 2022; **31:** 129–37.

22 Sun J, Qiao Y, Zhao M, Magnussen CG, Xi B. Global, regional, and national burden of cardiovascular diseases in youths and young adults aged 15–39 years in 204 countries/territories, 1990–2019: a systematic analysis of Global Burden of Disease Study 2019. *BMC Med* 2023; **21:** 222.

23 De Venecia T, Lu M, Figueredo VM. Hypertension in young adults. *Postgrad Med* 2016; **128:** 201–07.

24 Haseler E, Sinha MD. Hypertension in children and young adults. *Pediatr Clin North Am* 2022; **69:** 1165–80.

25 Shin D, Choi J, Lee H-Y. Suboptimal control status of young hypertensive population. *Clin Hypertens* 2023; **29:** 13.

26 Poobalan A, Aucott L. Obesity among young adults in developing countries: a systematic overview. *Curr Obes Rep* 2016; **5:** 2–13.

27 de Onis M, Blössner M, Borghi E. Global prevalence and trends of overweight and obesity among preschool children. *Am J Clin Nutr* 2010; **92:** 1257–64.

28 Abarca-Gómez L, Abdeen ZA, Hamid ZA, et al. Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. *Lancet* 2017; **390:** 2627–42.

29 GBD 2021 Diabetes Collaborators. Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet* 2023; **402:** 203–34.

30 Roseleur J, Gonzalez-Chica DA, Karnon J, Stocks NP. Predicted cardiovascular disease risk and prescribing of antihypertensive therapy among patients with hypertension in Australia using MedicineInsight. *J Hum Hypertens* 2023; **37:** 370–78.

31 Mortensen MB, Tybjærg-Hansen A, Nordestgaard BG. Statin eligibility for primary prevention of cardiovascular disease according to 2021 European Prevention Guidelines compared with other international guidelines. *JAMA Cardiol* 2022; **7:** 836–43.

32 Jackson R, Lawes CMM, Bennett DA, Milne RJ, Rodgers A. Treatment with drugs to lower blood pressure and blood cholesterol based on an individual's absolute cardiovascular risk. *Lancet* 2005; **365:** 434–41.

33 Van Dusen RA, Abernethy K, Chaudhary N, Paudyal V, Kurmi O. Association of the COVID-19 pandemic on stroke admissions and treatment globally: a systematic review. *BMJ Open* 2023; **13:** e062734.

34 Roth GA, Forouzanfar MH, Moran AE, et al. Demographic and epidemiologic drivers of global cardiovascular mortality. *N Engl J Med* 2015; **372:** 1333–41.

35 Feigin VL, Brainin M, Norrving B, et al. What is the best mix of population-wide and high-risk targeted strategies of primary stroke and cardiovascular disease prevention? *J Am Heart Assoc* 2020; **9:** e014494.

36 Feigin VL, Martins SC, Brainin M, et al. Hankey Graeme J. Twenty years on from the introduction of the high risk strategy for stroke and cardiovascular disease prevention: a systematic scoping review. *Eur J Neurol* 2024; **31:** e16157.

37 Owolabi MO, Thrift AG, Martins S, et al. The state of stroke services across the globe: report of World Stroke Organization–World Health Organization surveys. *Int J Stroke* 2021; **16:** 889–901.

38 Feigin VL, Owolabi MO, World Stroke Organization–*Lancet Neurology* Commission Stroke Collaboration Group. Pragmatic solutions to reduce the global burden of stroke: a World Stroke Organization–*Lancet Neurology* Commission. *Lancet Neurol* 2023; **22:** 1160–206.

39 Hwang J, Yi H, Jang M, et al. Air pollution and subarachnoid hemorrhage mortality: a stronger association in women than in men. *J Stroke* 2022; **24:** 429–32.

40 Yorifuji T, Kawachi I, Sakamoto T, Doi H. Associations of outdoor air pollution with hemorrhagic stroke mortality. *J Occup Environ Med* 2011; **53:** 124–26.

41 Xu R, Wang Q, Wei J, et al. Association of short-term exposure to ambient air pollution with mortality from ischemic and hemorrhagic stroke. *Eur J Neurol* 2022; **29:** 1994–2005.

42 Institute for Health Metrics and Evaluation. GBD 2021 Compare Data Visualization. https://collab2021.healthdata.org/gbd-compare/ (accessed Feb 29, 2024).

43 Vineis P, Chan Q, Khan A. Climate change impacts on water salinity and health. *J Epidemiol Glob Health* 2011; **1:** 5–10.

44 Ranta A, Kang J, Saad A, et al. Climate change and stroke: a topical narrative review. *Stroke* 2024; **55:** 1118–28.

45 Anenberg SC, Haines S, Wang E, Nassikas N, Kinney PL. Synergistic health effects of air pollution, temperature, and pollen exposure: a systematic review of epidemiological evidence. *Environ Health* 2020; **19:** 130.

46 Lee BJ, Kim B, Lee K. Air pollution exposure and cardiovascular disease. *Toxicol Res* 2014; **30:** 71–75.

47 WHO. Climate change. Oct 12, 2023. https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health (accessed March 10, 2024).

48 WHO. Climate change and noncommunicable diseases: connections. Nov 2, 2023. https://www.who.int/news/item/02-11-2023-climate-change-and-noncommunicable-diseases-connections (accessed March 10, 2024).

49 Feigin SV, Wiebers DO, Lueddeke G, et al. Proposed solutions to anthropogenic climate change: a systematic literature review and a new way forward. *Heliyon* 2023; **9:** e20544.

50 Koon AD, Marten R. Framing health taxes: a scoping review. *BMJ Glob Health* 2023; **8** (suppl 8)**:** e012055.

51 Wright A, Smith KE, Hellowell M. Policy lessons from health taxes: a systematic review of empirical studies. *BMC Public Health* 2017; **17:** 583.

52 Blakely T, Cleghorn C, Mizdrak A, et al. The effect of food taxes and subsidies on population health and health costs: a modelling study. *Lancet Public Health* 2020; **5:** e404–13.

53 GBD 2019 Diseases and Injuries Collaborators. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet* 2020; **396:** 1204–22.