

World Stroke Organization (WSO): Global Stroke Fact Sheet 2022

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Abstract

Stroke remains the second-leading cause of death and the third-leading cause of death and disability combined (as expressed by disability-adjusted life-years lost – DALYs) in the world. The estimated global cost of stroke is over US\$721 billion (0.66% of the global GDP). From 1990 to 2019, the burden (in terms of the absolute number of cases) increased substantially (70.0% increase in incident strokes, 43.0% deaths from stroke, 102.0% prevalent strokes, and 143.0% DALYs), with the bulk of the global stroke burden (86.0% of deaths and 89.0% of DALYs) residing in lower-income and lower-middle-income countries (LMIC). This World Stroke Organisation (WSO) Global Stroke Fact Sheet 2022 provides the most updated information that can be used to inform communication with all internal and external stakeholders; all statistics have been reviewed and approved for use by the WSO Executive Committee as well as leaders from the Global Burden of Disease research group.

Keywords

Stroke, transient ischemic attack, statistics, incidence, prevalence, mortality

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Overview

The most recent Global Burden of Disease (GBD) 2019 stroke burden estimates¹ showed that stroke remains the second leading cause of death and the third leading cause of death and disability combined (as expressed by disability-adjusted life-years lost—DALYs) in the world. The estimated global cost of stroke is over US\$891 billion (1.12% of the global GDP).² From 1990 to 2019, the burden (in terms of the absolute number of cases) increased substantially (70.0% increase in incident strokes, 43.0% deaths from stroke, 102.0% prevalent strokes, and 143.0% DALYs), with the bulk of the global stroke burden (86.0% of deaths and 89.0% of DALYs) residing in lower income and lower–middle income countries (LMIC). There were large geographical differences in age-standardized stroke incidence (six-fold), mortality (15-fold), prevalence (four-fold) and DALYs (20-fold) rates, with the highest rates in LMIC (particularly in Eastern Europe, Asia, and Sub-Saharan Africa).¹

Although the absolute number of DALYs due to stroke in males (77.0 million) exceeded that in females (66.0 million) at the global level in 2019, the point estimates of incident and prevalent strokes were higher in females (6.4 million incident strokes and 56.4 million prevalent strokes) than in males (5.8 million incident

strokes and 45.0 million prevalent strokes), and there were no noticeable sex differences in the number of stroke-related deaths (Tables 1 to 4). Although age-standardized incidence rates did not differ significantly between males and females, age-standardized death rates were greater in males than in females (96.4 per

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Table 1. GBD 2019 estimates for global incidence, prevalence, mortality, and DALYs for all stroke types combined.

Metric of the burden	Number	Crude rate per 100,000 per year (95% UI) ^a	Age-adjusted rate per 100,000 per year (95% UI) ^a	Approved statement for use in WSO Materials
Incidence				
Ages (all), sexes (both)	12,224,551	157.99 (142.71–175.63)	150.77 (136.52–167.46)	There are over 12.2 million new strokes each year. Globally, one in four people over age 25 will have a stroke in their lifetime
15–49 years	1,978,946	50.29 (43.02–58.71)	–	Each year, over 16% of all strokes occur in people 15–49 years of age.
<70 years	7,622,088	104.79 (92.54–119.06)	–	Each year, over 62% of all strokes occur in people under 70 years of age.
Men (all ages)	5,787,446	149.12 (134.95–166.31)	151.10 (136.90–167.54)	Each year, 47% of all strokes occur in men.
Women (all ages)	6,437,105	166.92 (150.75–185.90)	149.75 (135.58–166.56)	Each year, 53% of all strokes occur in women.
Prevalence				
Ages (all), sexes (both)	101,474,558	(1002.23–1167.80)	(1093.20–1273.43)	Globally, there are over 101 million people currently living who have experienced stroke.
15–49 years	22,766,796	578.56 (509.50–654.80)	–	22% of people who have experienced a stroke and are currently living are people 15–49 years of age.
<70 years	68,406,930	940.46 (859.03–1028.24)	–	67% of people who have experienced a stroke and are currently living are under the age of 70.
Men (all ages)	45,036,191	1160.44 (1059.77–1269.34)	1150.19 (1052.72–1259.30)	44% of people who have experienced a stroke and are currently living are men.
Women (all ages)	56,438,366	1463.46 (1347.19–1595.47)	1316.73 (1210.72–1433.71)	56% of people who have experienced a stroke and are currently living are women. Globally, women account for just over half (56%) of all persons who have experienced a stroke.
Deaths				
Ages (all), sexes (both)	6,552,724	84.69 (77.48–90.66)	–	Six and a half-million people die from stroke annually.

(continued)

Table 1. Continued.

Metric of the burden	Number	Crude rate per 100,000 per year (95% UI) ^a	Age-adjusted rate per 100,000 per year (95% UI) ^a	Approved statement for use in WSO Materials
15–49 years	370,056	9.40 (8.63–10.20)	–	About 6% of all deaths from stroke occur in people 15–49 years old.
<70 years	2,207,612	30.35 (28.06–32.65)	–	34% of all deaths from stroke occur in people under 70 years old.
Men (all ages)	3,331,206	85.8 (78.24–93.21)	96.36 (87.63–104.21)	51% of all deaths from stroke are in men.
Women (all ages)	3,221,518	83.53 (74.12–91.68)	73.50 (65.21–80.66)	49% of all deaths from stroke are in women.
DALYs				
Ages (all), Sexes (both)	143,232,184	1851.15 (1720.15–1980.52)	1768.05 (1640.65–1889.39)	Over 143 million years of healthy life is lost each year due to stroke-related death and disability.
15–49 years	21,456,824	545.27 (498.83–593.40)	–	15% of healthy life lost due to stroke-related death and disability affects people 15–49 years old.
<70 years	82,035,620	292.35 (270.27–314.42)	–	57% of healthy life lost due to stroke-related death and disability affects people under the age of 70 years.
Men (all ages)	76,875,834	1980.84 (1809.11–2150.30)	2024.28 (1852.42–2195.62)	Men account for 54% of healthy life lost due to stroke-related disability.
Women (all ages)	66,356,349	1720.64 (1569.61–1873.63)	1531.27 (1397.07–1667.60)	Women account for 46% of healthy life lost due to stroke-related disability.

DALYs: disability-adjusted life years.

^a(95% Uncertainty Interval (UI) represents a range of values that reflects the certainty of an estimate. In GBD, every estimate is calculated 1000 times; each time sampling from distributions rather than point estimates for data inputs, data transformations and model choice. The 95th uncertainty interval is determined by the 25th and 975th value of the 1000 values after ordering them from smallest to largest. Larger uncertainty intervals can result from limited data availability, small studies, and conflicting data, while smaller uncertainty intervals can result from extensive data availability, large studies, and data that are consistent across sources).

Table 2. GBD 2019 estimates for global incidence, prevalence, mortality and disability-adjusted life years (DALYs) for ischemic stroke.

Metric of the burden	Number	Crude rate per 100,000 per year (95% UI)	Age-adjusted rate per 100,000 per year (95% UI)	Approved Statement for use in WSO Materials
Incidence				
Ages (all), Sexes (both)	7,630,803	94.51 (81.91–110.76)	98.62 (84.90–115.80)	There are over 7.6 million new ischemic strokes each year. Globally, over 62% of all incident strokes are ischemic strokes.
15–49 years	865,723	22.00 (16.37–29.50)	–	Each year, over 11% of all ischemic strokes occur in people 15–49 years of age.
<70 years	4,427,351	60.87 (49.72–72.93)	–	Each year, over 58% of all ischemic strokes occur in people under 70 years of age.
Men (all ages)	3,445,762	88.79 (76.15–103.81)	90.91 (78.52–106.55)	Each year, 45% of all ischemic strokes occur in men.
Women (all ages)	4,185,041	108.52 (93.57–127.20)	97.22 (84.12–113.94)	Each year, 55% of all ischemic strokes occur in women.
Prevalence				
Ages (all), Sexes (both)	77,192,498	997.65 (889.92–1117.39)	950.97 (849.82–1064.06)	Globally, there are over 77 million people currently living who have experienced ischemic stroke.
15–49 years	14,480,207	367.97 (306.12–440.40)	–	19% of people who have experienced an ischemic stroke and are currently living are people 15–49 years of age.
<70 years	47,161,262	648.37 (569.07–730.52)	–	61% of people who have experienced an ischemic stroke and are currently living are under the age of 70.
Men (all ages)	33,216,442	855.88 (759.25–967.92)	863.51 (767.96–974.62)	43% of people who have experienced an ischemic stroke and are currently living are men.
Women (all ages)	43,976,056	1140.31 (1020.45–1273.16)	1025.52 (918.48–1144.69)	57% of people who have experienced an ischemic stroke and are currently living are women. Globally, women account for just over half (56%) of all persons who have experienced an ischemic stroke.

(continued)

Table 2. Continued.

Metric of the burden	Number	Crude rate per 100,000 per year (95% UI)	Age-adjusted rate per 100,000 per year (95% UI)	Approved Statement for use in WSO Materials
Deaths				
Ages (all), Sexes (both)	3,293,397	42.56 (38.43–45.70)	43.50 (39.08–46.77)	3.3 million people die from ischemic stroke annually.
15–49 years	53,263	1.35 (1.20–1.53)	–	About 2% of all deaths from ischemic stroke occur in people 15–49 years old.
<70 years	633,070	8.70 (7.94–9.45)	–	19% of all deaths from ischemic stroke occur in people under 70 years old.
Men (all ages)	1,573,961	40.56 (36.68–44.19)	48.44 (43.68–52.55)	48% of all deaths from ischemic stroke are in men.
Women (all ages)	1,719,435	44.59 (39.04–49.02)	39.12 (34.25–43.01)	52% of all deaths from ischemic stroke are in women.
DALYs				
Ages (all), Sexes (both)	63,478,271	820.40 (747.37–891.59)	798.81 (727.51–866.89)	Over 63 million years of healthy life is lost each year due to ischemic stroke-related death and disability.
15–49 years	4,658,243	118.38 (99.31–138.26)	–	7% of healthy life lost due to ischemic stroke-related death and disability affects people 15–49 years old.
<70 years	25,851,238	92.13 (82.11–102.17)	–	41% of healthy life lost due to ischemic stroke-related death and disability affects people under the age of 70 years.
Men (all ages)	31,809,849	819.64 (737.05–895.47)	878.51 (793.52–956.67)	Men account for 50% of healthy life lost due to ischemic stroke-related disability.
Women (all ages)	31,668,422	821.17 (733.39–901.65)	726.33 (648.67–798.32)	Women account for 50% of healthy life lost due to ischemic stroke-related disability.

Table 3. GBD 2019 estimates for global incidence, prevalence, mortality, and disability-adjusted life years (DALYs) for intracerebral hemorrhage.

Metric of the burden	Number	Crude rate per 100,000 per year (95% UI)	Age-adjusted rate per 100,000 per year (95% UI)	Approved Statement for use in WSO Materials
Incidence				
Ages (all), Sexes (both)	3,409,122	44.06 (38.39–50.52)	41.81 (36.53–47.88)	There are over 3.4 million new intracerebral hemorrhages each year. Globally, over 28% of all incident strokes are intracerebral hemorrhages.
15–49 years	776,886	19.74 (15.84–23.92)	–	Each year, over 23% of all intracerebral hemorrhages occur in people 15–49 years of age.
<70 years	2,326,254	31.98 (27.17–37.56)	–	Each year, over 68% of all intracerebral hemorrhages occur in people under 70 years of age.
Men (all ages)	1,830,930	47.18 (41.22–54.18)	47.17 (41.35–53.91)	Each year, 54% of all intracerebral hemorrhages occur in men.
Women (all ages)	1,578,192	40.92 (35.71–47.00)	36.81 (32.16–42.21)	Each year, 46% of all intracerebral hemorrhages occur in women.
Prevalence				
Ages (all), Sexes (both)	20,663,889	267.06 (232.84–302.66)	248.77 (217.09–281.43)	Globally, there are almost 21 million people currently living who have experienced intracerebral hemorrhage.
15–49 years	6,748,084	171.48 (143.25–201.51)	–	33% of people who have experienced an intracerebral hemorrhage and are currently living are people 15–49 years of age.
<70 years	17,614,906	242.17 (209.07–277.36)	–	85% of people who have experienced an intracerebral hemorrhage and are currently living are under the age of 70.
Men (all ages)	10,705,233	275.84 (239.51–313.54)	262.74 (229.37–298.14)	52% of people who have experienced an intracerebral hemorrhage and are currently living are men.
Women (all ages)	9,958,655	258.23 (225.62–291.87)	235.22 (205.79–265.79)	48% of people who have experienced an intracerebral hemorrhage and are currently living are women. Globally, women account for just over half (56%) of all persons who have experienced an intracerebral hemorrhage.

(continued)

Table 3. Continued.

Metric of the burden	Number	Crude rate per 100,000 per year (95% UI)	Age-adjusted rate per 100,000 per year (95% UI)	Approved Statement for use in WSO Materials
Deaths				
Ages (all), Sexes (both)	2,886,196	37.30 (34.18–40.06)	36.04 (32.98–38.67)	Almost three million people die from intracerebral hemorrhage annually.
15–49 years	253,682	6.45 (5.85–7.04)	–	About 9% of all deaths from intracerebral hemorrhage occur in people 15–49 years old.
<70 years	1,365,183	18.77 (17.16–20.30)	–	47% of all deaths from intracerebral hemorrhage occur in people under 70 years old.
Men (all ages)	1,571,624	40.50 (36.38–44.30)	42.89 (38.60–46.87)	55% of all deaths from intracerebral hemorrhage are in men.
Women (all ages)	1,314,571	34.09 (30.33–37.63)	30.06 (26.75–33.18)	45% of all deaths from intracerebral hemorrhage are in women.
DALYs				
Ages (all), Sexes (both)	68,572,498	886.24 (817.74–952.28)	832.77 (769.21–894.68)	Almost 69 million years of healthy life is lost each year due to intracerebral hemorrhage-related death and disability.
15–49 years	13,227,060	336.13 (305.58–366.49)	–	19% of healthy life lost due to intracerebral hemorrhage-related death and disability affects people 15–49 years old.
<70 years	47,440,867	169.07 (154.78–182.01)	–	69% of healthy life lost due to intracerebral hemorrhage-related death and disability affects people under the age of 70 years.
Men (all ages)	39,336,302	1013.57 (912.53–1106.61)	1001.11 (902.02–1092.01)	Men account for 57% of healthy life lost due to intracerebral hemorrhage-related disability.
Women (all ages)	29,236,195	758.10 (682.76–830.32)	676.79 (610.14–741.11)	Women account for 43% of healthy life lost due to intracerebral hemorrhage-related disability.

Table 4. GBD 2019 estimates for global incidence, prevalence, mortality, and disability-adjusted life years (DALYs) for subarachnoid hemorrhage.

Metric of the burden	Number	Crude rate per 100,000 per year (95% UI)*	Age-adjusted rate per 100,000 per year (95% UI)	Approved statement for use in WSO materials
Incidence				
Ages (all), Sexes (both)	1,184,625	15.31 (13.00–17.97)	14.46 (12.33–16.94)	There are over 12.2 million new subarachnoid hemorrhages each year. Globally, one in four people over age 25 will have a stroke in their lifetime.
15–49 years	336,336	8.55 (6.70–10.64)	–	Each year, over 16% of all subarachnoid hemorrhages occur in people 15–49 years of age.
<70 years	868,483	11.94 (9.84–14.28)	–	Each year, over 62% of all subarachnoid hemorrhages occur in people under 70 years of age.
Men (all ages)	510,753	13.16 (11.16–15.53)	13.02 (11.12–15.30)	Each year, 47% of all subarachnoid hemorrhages occur in men.
Women (all ages)	673,871	17.47 (14.85–20.47)	15.72 (13.40–18.34)	Each year, 53% of all subarachnoid hemorrhages occur in women.
Prevalence				
Ages (all), Sexes (both)	8,396,540	108.52 (92.90–127.09)	101.57 (87.13–118.54)	Globally, there are almost 8.4 million people currently living who have experienced subarachnoid hemorrhage.
15–49 years	2,911,795	74.00 (60.76–89.19)	–	35% of people who have experienced a subarachnoid hemorrhage and are currently living are people 15–49 years of age.
<70 years	6,883,509	94.63 (80.09–112.82)	–	82% of people who have experienced a subarachnoid hemorrhage and are currently living are under the age of 70.
Men (all ages)	3,332,026	85.86 (72.93–101.08)	82.24 (70.07–96.53)	40% of people who have experienced a subarachnoid hemorrhage and are currently living are men.
Women (all ages)	5,064,514	131.32 (112.51–153.81)	118.50 (101.58–138.36)	60% of people who have experienced a subarachnoid hemorrhage and are currently living are women. Globally, women account for just over half (56%) of all persons who have experienced a subarachnoid hemorrhage.

(continued)

Table 4. Continued.

Metric of the burden	Number	Crude rate per 100,000 per year (95% UI)*	Age-adjusted rate per 100,000 per year (95% UI)	Approved statement for use in WSO materials
Deaths				
Ages (all), Sexes (both)	373,131	4.82 (4.27–5.38)	4.66 (4.13–5.17)	Over 373,000 people die from subarachnoid hemorrhage annually.
15–49 years	63,110	1.60 (1.37–1.95)	–	About 17% of all deaths from subarachnoid hemorrhage occur in people 15–49 years old.
<70 years	209,358	2.88 (2.50–3.38)	–	56% of all deaths from subarachnoid hemorrhage occur in people under 70 years old.
Men (all ages)	185,619	4.78 (4.10–5.88)	5.03 (4.32–6.05)	50% of all deaths from subarachnoid hemorrhage are in men.
Women (all ages)	187,511	4.86 (4.29–5.47)	4.32 (3.81–4.87)	50% of all deaths from subarachnoid hemorrhage are in women.
DALYs				
Ages (all), Sexes (both)	11,181,414	144.51 (127.86–163.73)	136.47 (120.83–154.66)	Over 143 million years of healthy life is lost each year due to subarachnoid hemorrhage-related death and disability.
15–49 years	3,571,519	90.76 (78.30–108.78)	–	15% of healthy life lost due to subarachnoid hemorrhage-related death and disability affects people 15–49 years old.
<70 years	8,743,514	31.16 (27.22–36.25)	–	57% of healthy life lost due to subarachnoid hemorrhage-related death and disability affects people under the age of 70 years.
Men (all ages)	5,729,682	147.64 (126.43–182.31)	144.67 (123.86–178.38)	Men account for 54% of healthy life lost due to subarachnoid hemorrhage-related disability.
Women (all ages)	5,451,732	141.37 (125.84–159.23)	128.15 (113.91–144.35)	Women account for 46% of healthy life lost due to subarachnoid hemorrhage-related disability.

100,000 vs. 73.5 per 100,000) as were DALY rates (2024.3 per 100,000 vs. 1531.3 per 100,000). The lifetime risk of stroke has also increased over the last 20 years by 50% and is now one in four people.³

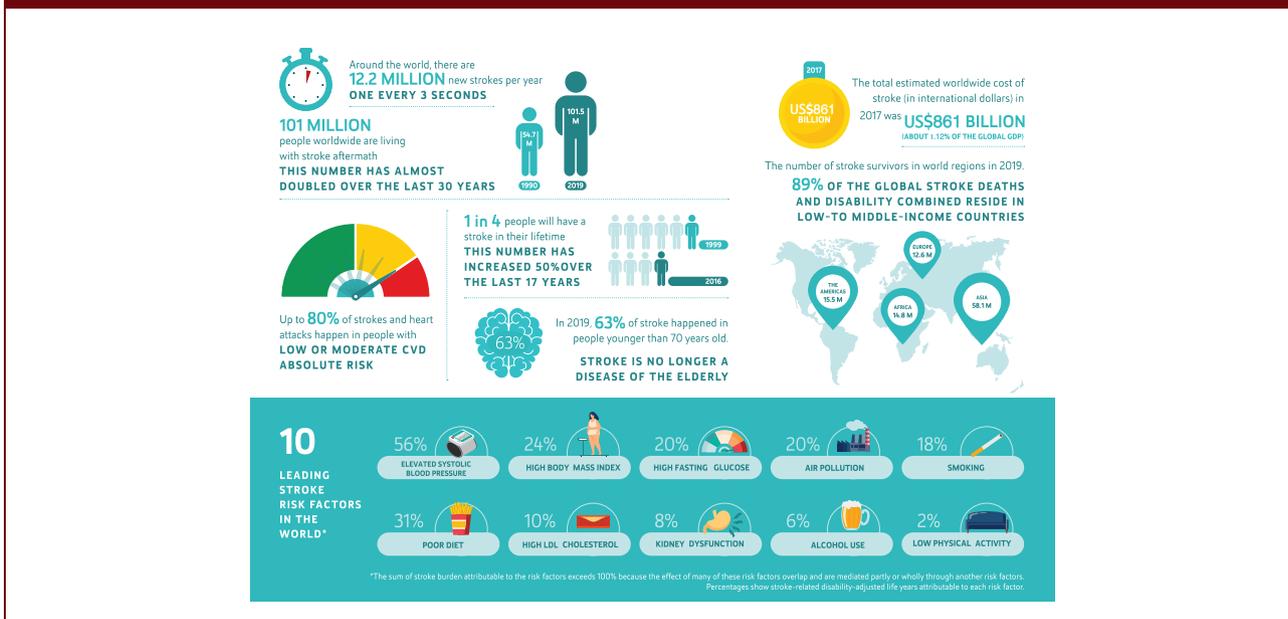
Table 5. 2019 Global Burden of Disease estimates for stroke burden (as measured by DALYs) attributable to risk factors.

1. Metabolic risks (high systolic blood pressure (SBP), high body-mass index (BMI), high fasting plasma glucose (FPG), high total cholesterol, and low glomerular filtration rate) account for 71.0% (64.6–77.1) of stroke burden.
2. Behavioral factors (smoking, poor diet, and low physical activity) account for 47.4% (41.3 to 54.4) of stroke burden, and environmental risks (air pollution and lead exposure) 37.8% (35.0 to 41.0).
3. Globally, high systolic blood pressure is the largest single risk for stroke (contributing 79.6 million DALYs (67.7–90.8); or 55.5% of total stroke DALYs (48.2–62.0)), high body mass index (BMI) (34.9 million (22.3–48.6); 24.4% (15.7–33.2)), high fasting plasma glucose (28.9 million (19.8–41.5); 20.2% (13.8–29.1)), ambient particulate matter (PM_{2.5}) pollution (28.7 million (23.4–33.4); 20.1% (16.6–23.0)), and smoking (25.3 million (22.6–28.2); 17.7% (16.4–19.0)).
4. All risk factors combined account for 87.0% (84.2–89.8) of the global stroke burden.

From the GBD viz <http://ghdx.healthdata.org/gbd-results-tool>

From 1990 to 2019, the total number of stroke related DALYs due to risk factors increased from 91.5 million to 125.0 million (Table 5), with a decrease in the high-income countries (from 16.4 million to 13.1 million in 2019) and an increase in the LMIC (from 75.1 million in 1990 to 111.0 million in 2019), with the largest (almost four-fold) increase in the age-standardized stroke-related DALYs globally due to high body mass index (BMI). The five leading risk factors for stroke were high systolic blood pressure (SBP; contributing to 55.5% of total stroke DALYs), high BMI (24.3%), high fasting plasma glucose (FPG; 20.2%), ambient particulate matter pollution (20.1%), and smoking (17.6%). Metabolic risks (high SBP, high BMI, high FPG, high LDL cholesterol, and kidney dysfunction) accounted for 70.3% of stroke-related DALYs (70.3 in females and 70.1% in males), dietary risks (diet high in sodium and red meat, diet low in fruits, vegetables, whole grains, and alcohol consumption) for 30.0% (27.5% in females and 32.1% in males), behavioral risks (smoking and dietary risks) for 46.6% (37.0% in females and 54.6% in males), and environmental risks (air pollution cluster, low ambient temperature, high ambient temperature, and lead exposure) for 37.3% (36.0% in females and 38.4% in males). From 1990 to 2019, there was a significant reduction in the contribution of behavioral, dietary, and environmental risks (5.4%, 7.9% and 8.2%, respectively), but a significant increase in the contribution of metabolic risks (8.4%), especially due

Figure 1. Stroke infographic (modified from Owolabi et al.,² with permission).



to the increase in high BMI (52.7%) and high FBG (39.3%). The summary of the stroke burden is graphically presented in Figure 1.

The World Stroke Organization (WSO) leads many advocacy efforts through their membership, targeted efforts in low- and middle-income countries, and through the strong voice of Stroke Support Organizations. Governments, system leaders, health-care providers, and the general population need to increase efforts for raising awareness, educating individuals and populations of their risk factors, implementing effective and widely available stroke risk prevention strategies (for example, the free Stroke Riskometer app supported by the WSO and already translated into 19 languages and available for over 5.3 billion people in their native languages), and ensuring timely acute treatments to reduce the long-term burden of stroke. Advocacy efforts require reliable and consistent stroke data to build awareness of the scale of the disease and support for calls for urgent action at global, regional, and national levels.

This WSO Global Stroke Fact Sheet 2022 provides the most updated information that can be used to

inform communication with all internal and external stakeholders; all statistics have been reviewed and approved for use by the WSO Executive Committee as well as leaders from the Global Burden of Disease research group. The facts are endorsed by the WSO will be updated every one to two years as new data emerges.

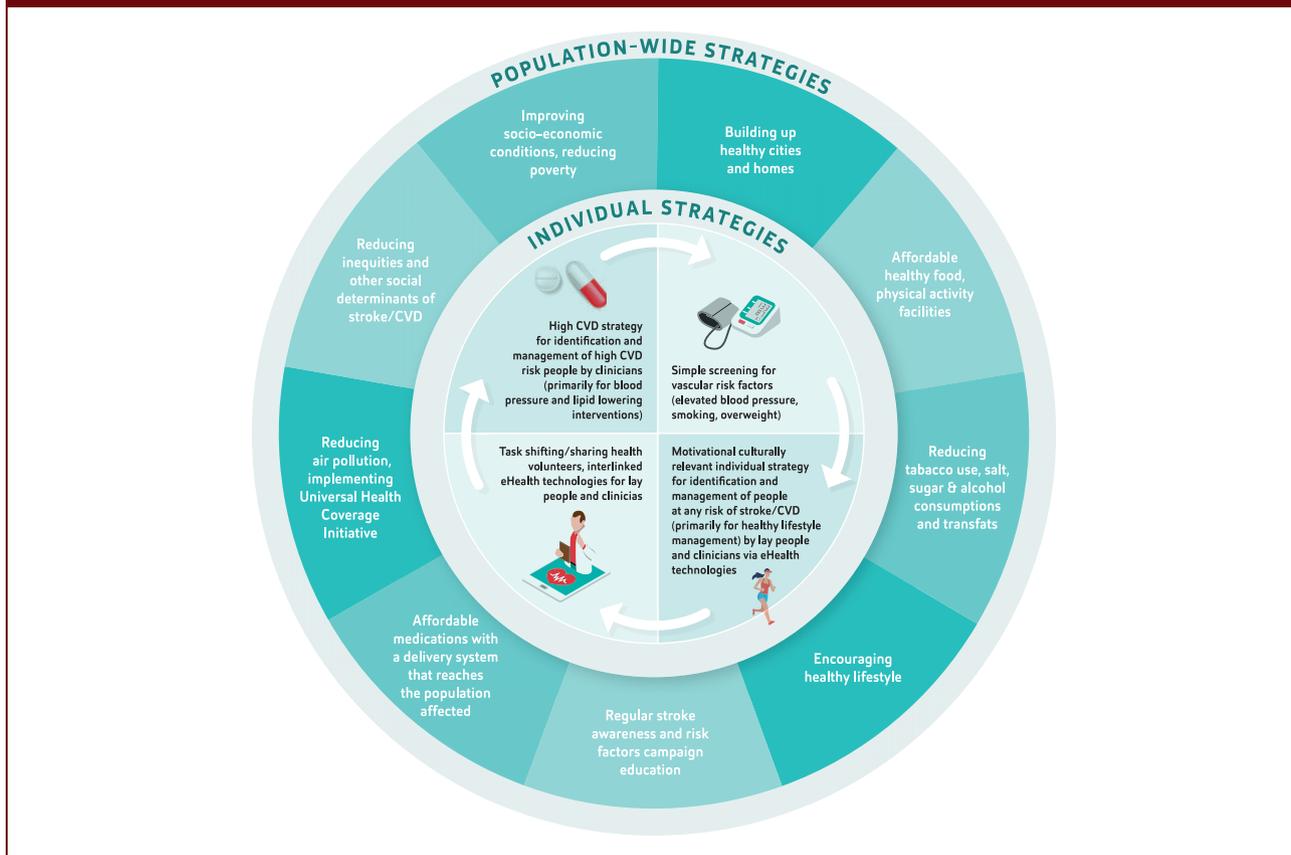
Methods

The values contained in this Fact Sheet have all been extracted from the most current GBD publication on stroke burden in *The Lancet Neurology*¹ (Tables 1 to 5) as well as the recent publication on primary stroke prevention in *The Lancet Public Health*² and online GBD Visualisation Tool (<http://ghdx.healthdata.org/gbd-results-tool>).

Discussion

The large and fast-growing stroke burden in the world, particularly in young people and LMICs where almost 90% of stroke burden currently resides, necessitates urgent measures to reduce stroke incidence and

Figure 2. Ecosystem for primary stroke prevention (adapted from Owolabi et al.,² with permission).



improve outcomes post-stroke at all geographical (global, regional, national) and stakeholder levels (individual, health professional, local authorities, health policy makers, non-government organizations, and population wide). A set of pragmatic solutions for implementation of primary stroke prevention, with an emphasis on population-wide strategies, including task shifting/sharing and health system re-engineering that includes patients, health professionals, funders, policy-makers, implementation partners, and the entire population along the life course has recently been published in *The Lancet Public Health* (Figure 2).² Although atrial fibrillation and flutter (AF) are well-established risk factors for ischemic stroke, they are not currently included in the GBD stroke burden estimates. GBD 2019 data⁴ show that there are almost 59.7 million people in the world with AF (30.3 million men and 29.4 million women) and globally every year AF affects over 4.7 million new people (2.4 million men and 2.3 million women).

The WSO has developed a set of guidelines for stroke care leaders and frontline providers offering easy access to current evidence-based recommendations to guide stroke care planning and delivery across the continuum of care.⁵ In addition, a road map has been developed to provide additional details on implementation strategies and metrics to monitor progress and identify opportunities for ongoing improvement efforts at the local, regional, and national levels. With these combined efforts, progress will be made towards the non-communicable disease targets and achieve a measurable decrease in stroke burden worldwide.

Authors' contributions

Valery L. Feigin conducted the literature reviews, calculated the statistics and developed the draft Fact Sheet. Bo Norrving, Ralph L. Sacco, Michael Brainin, Werner Hacke, Sheila Martins, Jeyaraj Pandian, Marc Fisher, and Patrice Lindsay provided guidance, input, and edits throughout the development of this work.

Declaration of conflicting interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: VLF declares that free Stroke Riskometer app is owned and copyrighted by Auckland University of Technology, New Zealand. None of other authors declared any conflict of interest.

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