

## The global and regional burden of stroke



Stroke is the second leading cause of death and the third leading cause of disability-adjusted life-years (DALYs) worldwide.<sup>1,2</sup> Moreover, the global burden of stroke is increasing. Between 1990 and 2010, the number of stroke-related deaths increased by 26% and DALYs by 19%.<sup>1,2</sup> Is this epidemic of stroke global or regional, and what is the explanation?

A systematic review<sup>3</sup> of 56 population-based studies of the incidence and early case fatality of stroke, published from 1970 to 2008, showed that, in ten low-income and middle-income countries, the age-adjusted incidence of stroke more than doubled, from 52 per 100 000 person-years in 1970–79 to 117 per 100 000 person-years in 2000–08—an increase of 5.6% per year. However, the incidence of stroke in 18 high-income countries almost halved, from 163 to 94 per 100 000 person-years—a decrease of 1% per year.<sup>3</sup> These data suggest divergent patterns of stroke epidemiology in different socioeconomic regions of the world, but might be subject to selection or sampling bias because of sampling of only ten of the world's low-income and middle-income countries over four decades, and diagnostic or stroke classification bias because of a failure to distinguish major pathological subtypes of stroke (ie, ischaemic vs haemorrhagic), which have different diagnostic criteria, causes, and outcomes.

In *The Lancet Global Health*, Rita Krishnamurthi and colleagues from the Global Burden of Diseases, Injuries, and Risk Factors Study 2010 (GBD 2010) and Stroke Expert Group estimate the incidence, mortality, and DALYs of first-ever ischaemic and haemorrhagic stroke (intracerebral and subarachnoid haemorrhage) in all 21 regions of the world in 1990, 2005, and 2010.<sup>4</sup> The investigators derived the estimates from a systematic review of all relevant studies published between 1990 and 2010. 119 studies were identified in which pathological subtypes of stroke were confirmed by brain imaging or autopsy in at least 70% of cases. Specific analytical techniques were used to calculate regional and country-specific estimates of incidence and mortality rates and DALYs lost, by age group and country income status.

Surprisingly, the major finding is that, in 2010, most of the global burden of stroke was due to haemorrhagic, not ischaemic, stroke. Haemorrhagic stroke constituted

a third (31.5%) of the 16.9 million incident stroke events (20% in the high-income countries and 37% in the low-income and middle-income countries), which is higher than hitherto appreciated.<sup>4</sup> However, despite being only half as common as ischaemic stroke, haemorrhagic stroke caused more than half (51.7%) of the 5.9 million stroke-related deaths, and three fifths (61.5%) of the 102.2 million DALYs lost throughout the world. The number of years of life lost were greater with haemorrhagic stroke because it affected people at a younger age (mean 65.1 years [SD 0.11]) than did ischaemic stroke (73.1 years [0.10]) and had a higher case fatality (57% vs 25%).

The second major finding is that most of the burden of ischaemic and haemorrhagic stroke is in low-income and middle-income countries, which bear 63% of incident ischaemic strokes and 80% of haemorrhagic strokes, 57% of deaths due to ischaemic stroke and 84% due to haemorrhagic stroke, and 64% of DALYs lost due to ischaemic stroke and 86% due to haemorrhagic stroke. The average age of incident and fatal ischaemic and haemorrhagic strokes was 6 years younger in low-income and middle-income countries than in high-income countries.

The third finding is that most of the burden of ischaemic and haemorrhagic stroke is in people younger

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	Prevalence		Odds ratio (99% CI)	Population-attributable risk
	Controls	Cases		
History of hypertension	954/2996 (32%)	399/662 (60%)	3.8 (3.0–4.8)	44% (37–52%)
Regular physical activity	362/2994 (12%)	45/662 (7%)	0.7 (0.4–1.1)	28% (7–67%)
Waist-to-hip ratio (T3 vs T1)	984/2960 (33%)	231/655 (35%)	1.4 (1.02–1.9)	26% (14–43%)
Diet risk score (T3 vs T1)	904/2982 (30%)	221/658 (34%)	1.4 (1.01–2.0)	24% (12–43%)
Alcohol intake*	324/2989 (11%)	108/660 (16%)	2.0 (1.3–3.0)	15% (8–24%)
Current smokers	732/2994 (24%)	207/662 (31%)	1.4 (1.1–2.0)	9% (4–20%)
Psychosocial stress	440/2987 (15%)	124/654 (19%)	1.2 (0.9–1.7)	3% (1–16%)

Data are n/N (%), unless otherwise indicated. Multivariable model adjusted for age, sex and region. \*More than 30 drinks per month or binge drinker. T3=tertile 3. T1=tertile 1.

**Table:** Risk factors for haemorrhagic stroke in 663 cases of acute first haemorrhagic stroke (within 5 days of symptom onset) compared with 3000 controls with no history of stroke who were matched with cases for age and sex, assessed in 22 countries between 2007 and 2010<sup>6</sup>

than 75 years, who bear 62% of incident ischaemic strokes and 78% of haemorrhagic strokes, and 63% of DALYs lost due to ischaemic stroke and 83% due to haemorrhagic stroke.

The fourth finding is that, over the past two decades (1990–2010) the absolute number of people with incident ischaemic stroke has increased significantly by 37% and incident haemorrhagic stroke by 47%, the number of deaths due to ischaemic stroke by 21% and haemorrhagic stroke by 20%, and the number of DALYs lost due to ischaemic stroke by 18% and haemorrhagic stroke by 14%. The increase in absolute numbers has arisen despite a reduction in the age-standardised incidence of ischaemic stroke by 13% and haemorrhagic stroke by 19%, a reduction in the mortality rates of ischaemic stroke by 37% and haemorrhagic stroke by 38%, and a reduction in DALYs rates of ischaemic stroke by 34% and haemorrhagic stroke by 39%. The reduction in rates probably shows improved education, prevention, diagnosis, treatment, and rehabilitation of stroke. The increase in absolute numbers, despite a reduction in rates, is presumably because global population growth and increasing life expectancy have increased the denominator by a greater proportion than the increasing number of stroke events has increased the numerator.

The fifth finding is that the incidence of haemorrhagic stroke in low-income and middle-income countries is one rate that has increased over the past two decades (22% increase, 95% CI 5–30), particularly in people younger than 75 years (19%, 5–30). Indeed, low-income and middle-income countries had a 40% higher incidence, 77% higher mortality, and 65% higher DALY rates of haemorrhagic stroke than did high-income countries.

Krishnamurthi and colleagues' results suggest that key priorities in the quest to reduce the global and regional burden of stroke are prevention of haemorrhagic stroke, particularly in low-income and middle-income countries, and in people younger than 75 years. Most haemorrhagic strokes can be attributed to hypertension and an

unhealthy lifestyle (eg, physical inactivity, obesity, unhealthy diet, alcohol excess, and smoking; table).<sup>5,6</sup>

Population-based mass strategies to reduce consumption of salt, calories, alcohol, and tobacco by improving education and the environment will complement high-risk strategies of identifying those at risk of haemorrhagic (and ischaemic) stroke, thus empowering these individuals to improve their lifestyle behaviours and, if necessary, lower their mean blood pressure and blood pressure variability with appropriate doses of antihypertensive drugs.<sup>7–10</sup>

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I declare that I have no conflicts of interest.

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