# Stroke epidemiology

- Beyond the Average: Trends in Extreme Sodium Intake in the U.S. Population, 2003-2018
- Understanding of Stroke Risk Among Smokers in Saudi Arabia
- Impact of exposure of particulate matters on stroke risk: exploring the influence of physical activity among middle-aged and older adults in China
- Heart transplantation outcomes with donation after circulatory death in patients with left ventricular assist device
- Artificial Intelligence-Based Detection of Central Retinal Artery Occlusion Within 4.5 Hours on Standard Fundus Photographs
- Association between glycemic variability and acute kidney injury incidence in patients with cerebral infarction: an analysis of the MIMIC-IV database
- Prediction of mortality in severe ischemic stroke during COVID-19 in patients with multiorgan dysfunction
- Better survival of older patients with stroke managed in a collaborative stroke pathway

## 🛛 Global Burden

- Leading cause of disability and 2nd cause of death worldwide.
- >12 million new strokes/year globally.
- >100 million stroke-related DALYs reported in 2021.

#### **Trends**

- \$\product Age-standardized mortality in high-income countries.
- ↑ Absolute number of strokes globally due to:
  - Aging population
  - Urbanization
  - Rise of metabolic risk factors
- 10-15% of all strokes occur in adults aged 20-49 (young stroke).
  - $\circ\,$  Hemorrhagic strokes more common in low-income countries.

#### **▲ Key Risk Factors**

#### Modifiable

- Hypertension (most significant)
- Diabetes mellitus
- Dyslipidemia
- Obesity and physical inactivity
- Smoking and alcohol
- Atrial fibrillation

# **Metabolic-Risk Factors in Stroke**

Metabolic-Risk Factors in Stroke

#### Non-modifiable

- Age
- Genetic predisposition
- Sex (Men <65, Women >75)

### **Regional Variation**

- High incidence: East Asia, Eastern Europe, Sub-Saharan Africa.
- High DALY burden in LMICs due to limited acute care access.

#### **Relevance for Neurosurgeons**

- ↑ Demand for surgical interventions:
  - Hematoma evacuation
  - Aneurysm clipping
  - Decompressive craniectomy (MCA infarction)
- Younger patients require tailored neurocritical management.
- Participation in multidisciplinary stroke teams is essential.

#### **Key Metrics**

Metric	Definition	Example Use
ASIR	Age-standardized incidence rate	Adjusts for aging
DALY	Disability-adjusted life year	Quantifies total health loss
EAPC	Estimated annual % change	Measures trend slope

Although stroke is more common with advancing age, especially in the elderly, women of reproductive age may still suffer from stroke, and from its deleterious consequences. Women of reproductive age who suffer a stroke may do so either due to a specific predisposition or due to pregnancy-related hypertensive emergencies.

The age-standardized incidence of stroke has decreased globally but, for reasons unknown, conflicting results have been observed regarding the trend in incidence of major stroke subtypes in young adults.

Stroke hospitalizations of young people declined in Finland, except for men 35-44 years of age for whom IS hospitalizations increased. Declining length of stay (LOS) and in-hospital mortality of IS patients suggests admission of less severe cases, improved care or both <sup>1)</sup>.

Spontaneous intracerebral hemorrhage (ICH) is a global public health issue and accounts for 10–15% of all stroke cases <sup>2)</sup>.

### **United States**

Stroke is a leading cause of death and disability in the US. Accurate and updated measures of stroke burden are needed to guide public health policies.

Objective: To present burden estimates of ischemic and hemorrhagic stroke in the US in 2019 and describe trends from 1990 to 2019 by age, sex, and geographic location.

Design, setting, and participants: An in-depth cross-sectional analysis of the 2019 Global Burden of Disease study was conducted. The setting included the time period of 1990 to 2019 in the US. The study encompassed estimates for various types of strokes, including all strokes, ischemic strokes, intracerebral hemorrhages (ICHs), and subarachnoid hemorrhages (SAHs). The 2019 Global Burden of Disease results were released on October 20, 2020.

Exposures: In this study, no particular exposure was specifically targeted.

Main outcomes and measures: The primary focus of this analysis centered on both overall and agestandardized estimates, stroke incidence, prevalence, mortality, and DALYs per 100 000 individuals.

Results: In 2019, the US recorded 7.09 million prevalent strokes (4.07 million women [57.4%]; 3.02 million men [42.6%]), with 5.87 million being ischemic strokes (82.7%). Prevalence also included 0.66 million ICHs and 0.85 million SAHs. Although the absolute numbers of stroke cases, mortality, and DALYs surged from 1990 to 2019, the age-standardized rates either declined or remained steady. Notably, hemorrhagic strokes manifested a substantial increase, especially in mortality, compared with ischemic strokes (incidence of ischemic stroke increased by 13% [95% uncertainty interval (UI), 14.2%-11.9%]; incidence of ICH increased by 39.8% [95% UI, 38.9%-39.7%]; incidence of SAH increased by 50.9% [95% UI, 49.2%-52.6%]). The downturn in stroke mortality plateaued in the recent decade. There was a discernible heterogeneity in stroke burden trends, with older adults (50-74 years) experiencing a decrease in incidence in coastal areas (decreases up to 3.9% in Vermont), in contrast to an uptick observed in younger demographics (15-49 years) in the South and Midwest US (with increases up to 8.4% in Minnesota).

Conclusions and relevance: In this cross-sectional study, the declining age-standardized stroke rates over the past 3 decades suggest progress in managing stroke-related outcomes. However, the increasing absolute burden of stroke, coupled with a notable rise in hemorrhagic stroke, suggests an evolving and substantial public health challenge in the US. Moreover, the significant disparities in stroke burden trends across different age groups and geographic locations underscore the necessity for region- and demography-specific interventions and policies to effectively mitigate the multifaceted and escalating burden of stroke in the country <sup>3</sup>.

Stroke is the fourth killer and number one cause of adult disability in the United States. The estimated direct and indirect costs of stroke care in this country are \$68.9 billion for 2009. The prevalence of stroke and its cost will undoubtedly arise as the aging population increases. In addition, stroke incidence and mortality are increasing in less developed countries in which lifestyles and population restructuring are rapidly changing. More population-based research to assess the incidence, risk

factors, and outcomes is needed in these countries. Epidemiologic studies can help identify groups of individuals or regions at higher risk for stroke. They can also help us better understand the natural history of certain conditions and therefore push the direction of therapeutic investigations. Furthermore, the study of trends across different time periods and different populations can help investigators evaluate the effects of stroke care programs and treatment options <sup>4)</sup>.

# China

In a large, nationally representative sample of adults aged 40 years or older, the estimated prevalence, incidence, and mortality rate of stroke in China in 2020 were 2.6%, 505.2 per 100 000 person-years, and 343.4 per 100 000 person-years, respectively, indicating the need for an improved stroke prevention strategy in the general Chinese population <sup>5)</sup>.

A community-based cross-sectional study with 8,018 Chinese adults aged  $\geq$ 40 years was used to determine the prevalence of stroke and associated risk factors. Within the screened population, the prevalence of stroke was 2.21% for both sexes, 1.60% for females, and 3.18% for males. Prevalence increased with age in both sexes (P < 0.0001). In a multivariable model, factors significantly associated with stroke were increasing age (odds ratio [OR] = 1.87, 95% CI: 1.58-2.24), male gender (OR = 2.03, 95% CI: 1.42-2.90), family history of stroke (OR = 4.33, 95% CI: 2.89-6.49), history of hyperlipidemia (OR = 1.87, 95% CI 1.31-2.68), history of hypertension (OR = 1.47, 95% CI 1.02-2.12), and physical inactivity (OR = 1.74, 95% CI: 1.16-2.59). The findings indicate that stroke prevalence in middle-aged and older Chinese adults is higher in males than in females, and increases with age in both sexes. Population-based public health intervention programs and policies targeting hyperlipidemia and hypertension control and encouragement of physical activity should be highly prioritized for middle-aged and older adults in Shenzhen, China<sup>6</sup>.

## South Korea

The stroke incidence has increased rapidly in South Korea, calling for a national-wide system for longterm stroke management. Park et al. investigated the effects of socioeconomic status (SES) and geographic factors on chronic phase survival after stroke. They retrospectively enrolled 6994 patients who experienced a stroke event in 2009 from the Korean National Health Insurance database. They followed them up from 24 to 120 months after stroke onset. The endpoint was all-cause mortality. They defined SES using a medical-aid group and four groups divided by health insurance premium quartiles. Geographic factors were defined using Model 1 (capital, metropolitan, city, and county) and Model 2 (with or without university hospitals). The higher the insurance premium, the higher the survival rate tended to be (P < 0.001). The patient survival rate was highest in the capital city and lowest at the county level (P < 0.001). Regions with a university hospital(s) showed a higher survival rate (P = 0.006). Cox regression revealed that the medical-aid group was identified as an independent risk factor for chronic phase mortality. Further, NHIP level had a more significant effect than geographic factors on chronic stroke mortality. From these results, long-term nationwide efforts to reduce inter-regional as well as SES discrepancies affecting stroke management are needed <sup>71</sup>.

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