Age and Ageing 2009; **38:** 4–5
doi: 10.1093/ageing/afn282

Human and economic burden of stroke

Stroke is a costly disease from human, family and societal perspectives. Starting from human costs, stroke is a leading cause of death and disability. Annually, about 16 million first-ever strokes occur in the world, causing a total of 5.7 million deaths [1]. As a consequence, stroke ranks as the second cause of death in the world population after ischaemic heart disease (the third only if neoplastic diseases are considered as a group).

In the United States, figures indicate a total of 5,800,000 prevalent stroke cases, with 780,000 first-ever or recurrent strokes expected each year [2]. In the elderly population of the 15-country Europe, estimates showed 2,700,000 prevalent cases, and 536,000 incident cases each year [3, 4]. Total number of stroke deaths in 48 European countries is currently estimated at 1,239,000 per year (508,000 per year in the 27 European Union members) [5].

Stroke is a global epidemic, and by no way a problem limited to western or high-income countries. About 85% of all stroke deaths are registered in low- and middle-income countries, which also account for 87% of total losses due to stroke in terms of disability-adjusted life years (DALYs), calculated, worldwide, in 72 millions per year [6].

Present and future figures of stroke are strictly related to the demographic transition, occurring in both developed and developing countries. The world population aged 60 and over was 488 millions in 1990, and was projected to about 1,363 millions in 2030, with a percentage increase of 180%. In 1990, developing countries contained the 58% of the world elderly, while in 2030 about two-thirds of the total elderly population will be dwelling in these countries [7].

Given that age is one of most substantiated risk factor for stroke, the ageing of the world population implies a growing number of persons at risk. Among EU members, for instance, Italy is the country with the highest percentage of people over the age of 65 years (19.9%). About 153,000 new stroke cases are expected each year in the Italian elderly population. Assuming stable incidence rates, a total of 195,000 new cases per year are expected in 2020, simply due to the ageing population [8]. While stroke will firmly remain the second cause of death in the world by 2030, its ranking as a major cause of DALY loss will increase during the same period [9].

About half of stroke survivors are left with some degree of physical or cognitive impairment [10, 11]. The need of support for common daily activities directly impacts quality of life of patients and their relatives, frequently taking the role of caregivers. Although often neglected, informal care is of paramount relevance to maintain stroke survivors in the community, and a valuable economic resource for health care systems.

Available facts and figures may easily explain why the economic burden of stroke is requiring increasing attention for more effective health care planning and resources allocation. An international comparison of stroke cost studies showed that, on average, 0.27% of gross domestic product was spent on stroke by national health systems, and stroke care accounted for ∼3% of total health care expenditures [12].

In the United States, the total direct and indirect cost of stroke for 2008 is estimated at $65.5 billion. Direct costs, which include the cost of physicians and other health professionals, acute and long-term care, medications and other medical durables, account for 67% of total costs, while the remaining 33% is due to indirect costs, which consider lost productivity resulting from morbidity and mortality [2]. In the 27 EU countries, total annual cost of stroke is estimated at €27 billion: €18.5 billion (68.5%) for direct and €8.5 billion (31.5%) for indirect costs. A further sum of €11.1 billion is calculated for the value of informal care [5]. Including informal care in the total amount, percentages would change to 48.6% for direct, 22.3% for indirect and 29.1% for informal care costs.

This issue of *Age and Ageing* presents a report on cost of stroke in the United Kingdom (UK) [13]. Direct, indirect and informal care costs were evaluated from a societal perspective, using data from the South London Stroke Register (SLSR) and other national sources. The percentage of elderly people in the UK is over 16% of total population; 130,000 new stroke cases are expected each year, and stroke survivors are more than one million. Considering the burden of stroke in the UK, economic evaluations are essential for an appropriate allocation of available resources.

Total societal costs were estimated at £8.9 billion a year. Percentage distribution was very close to the EU figures, with direct costs accounting for 49%, indirect costs for 24% and informal care for 27% of the total. Direct costs, evaluated at £4.4 billion, represent, approximately, 5.5% of the total UK national health expenditures.

Assuming resource use as gained mainly from the SLSR, a particular attention was paid to calculation of cost of inpatient stay, cost of physicians and therapists, diagnostic visits, tests and drugs in the acute phase, together with an analysis of expenses for residential, nursing or sheltered home. A careful evaluation of indirect costs was made with an estimation of loss of earnings due to premature death and stroke-related morbidity. Informal care was also evaluated, although

information was referred only to a limited time period of 2 weeks, and carer time was not quantified.

The study has among its strengths the calculation of cost based on a well-established stroke register, using data collection and variables definition in line with best-validated methods for stroke research. One study limitation might be the representativeness and generalisability of data from the SLSR to all UK stroke patients, with regards to case mix, resource use, stroke severity and outcome.

The number of stroke survivors needing assistance in daily living activities was calculated in about 200,000. Informal care costs were estimated at £2.4 billion, and indirect costs, including benefit payments, as well as productivity losses due to death and disability, at £2.1 billion. These figures point out the relevance, from a societal perspective, of the chronic phase of the disease, explaining more than half of total stroke expenditures.

Indirect and informal care costs are related to both frequency, i.e. crude numbers expressed as incidence and prevalence, and severity of the disease, in terms of mortality, morbidity and functional impairment. An effective resource optimisation starts from primary prevention and treatment of vascular risk factors, admission of stroke patients to dedicated wards with a multidisciplinary approach, adherence to guidelines for the acute phase management, early rehabilitation and availability of acute phase treatments, such as thrombolysis, for selected patients.

Reducing stroke frequency by preventive measures, as well as stroke mortality and long-term disability by evidence-based acute and post-discharge treatments, is essential to avoid the natural trend of increase in the human, economic and social burden of stroke.

Conflicts of interest

I certify that I wrote and approve the submitted commentary and that I have no conflict of interest related directly or indirectly to the subject of the work.

ANTONIO DI CARLO
Institute of Neurosciences, Italian National Research Council, Via Cesalpino, 11/C, 50134 Firenze, Italy
Email: dicarlo@in.cnr.it

References

1. Strong K, Mathers C, Bonita R. Preventing stroke: saving lives around the world. Lancet Neurol 2007; 6: 182–7.
2. Rosamond W, Flegal K, Furie K *et al.* Heart disease and stroke statistics—2008 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Circulation 2008; 117: e25–146.
3. Di Carlo A, Launer LJ, Breteler MMB *et al.* Frequency of stroke in Europe: a collaborative study of population-based cohorts. ILSA Working Group and the Neurologic Diseases in the Elderly Research Group. Italian Longitudinal Study on Aging. Neurology 2000; 54(Suppl 5): S28–33.
4. Launer LJ, Hofman A. Frequency and impact of neurologic diseases in the elderly of Europe: a collaborative study of population-based cohorts. Neurology 2000; 54(Suppl 5): S1–3.
5. European cardiovascular disease statistics 2008. European Heart Network, Brussels, 2008.
6. Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJ. Global and regional burden of disease and risk factors, 2001: systematic analysis of population health data. Lancet 2006; 367: 1747–57.
7. The World Bank. World Development Report 1993. New York: Oxford University Press, 1993.
8. Di Carlo A, Baldereschi M, Gandolfo C *et al.* Stroke in an elderly population: incidence and impact on survival and daily function. The Italian Longitudinal Study on Aging. Cerebrovasc Dis 2003; 16: 141–50.
9. Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. PLoS Med 2006; 3: e442.
10. Leys D, Hénon H, Mackowiak-Cordoliani MA, Pasquier F. Poststroke dementia. Lancet Neurol 2005; 4: 752–9.
11. Young J, Forster A. Review of stroke rehabilitation. BMJ 2007; 334: 86–90.
12. Evers SM, Struijs JN, Ament AJ, van Genugten ML, Jager JH, Van Den Bos GAM. International comparison of stroke cost studies. Stroke 2004; 35: 1209–15.
13. Saka O, McGuire A, Wolfe C. Cost of stroke in the United Kingdom. Age Ageing 2009; 38: 27–31.