TOBACCO & STROKE

2016

WHO TOBACCO KNOWLEDGE SUMMARIES

- *Tobacco use is a major avoidable risk factor for cerebrovascular disease.*
- *Two fifths of all stroke deaths under the age of 65 years are linked to smoking.*
- *Exposure to second-hand smoke and use of smokeless tobacco also increase the risk of stroke.*
- *Four to five years after quitting smoking, a former smoker's risk of stroke is almost identical to that of a lifetime non-smoker.*
- *Governments should actively implement and enforce the measures of the WHO Framework Convention on Tobacco Control, especially smoke-free environment laws and systematic access to tobacco cessation services.*

What is a stroke?

A stroke or cerebrovascular event occurs when there is a blockage in brain blood vessels (ischaemic stoke) or when a blood vessel ruptures in the brain (haemorragic stroke) (1-4). Stroke – or acute cerebrovascular event – is often referred to as the brain equivalent of a heart attack (1, 2).

The warning signs of a stroke may include (3, 4):

- sudden numbness or weakness of the face, arm or leg, especially on one side of the body;
- sudden confusion, trouble speaking or understanding;
- sudden trouble seeing in one or both eyes;
- sudden trouble walking, dizziness, loss of balance or coordination;
- sudden severe headache with no known cause.

The severity of a stroke depends on the area of the brain that is affected and the extent of the blockage. Stroke has a high risk of death and an even greater risk of disability. Survivors may have a loss of vision, speech or paralysis. Indeed, about two thirds have significant physical, psychological and/or behavioural problems and require assistance in their everyday activities (1).

The problem

Globally, stroke is the second leading cause of death, and the sixth most common cause of disability (5). About 15 million people suffer from first-ever stroke every year, with a third of these cases – or approximately 6.6 million – resulting in death (3.5 million women and 3.1 million men) (1, 5). In terms of premature death and years of life lost, stroke is a greater problem in low- and middle-income countries (LMICs) than in high-income countries. More than 81% of deaths from stroke are in LMICs (5); the percentage of premature deaths from stroke in these countries rises to 94% for stroke deaths in people under the age of 70 years (6).

Of 33 million stroke survivors currently living in the world (7), over 12 million are left with permanent moderate to severe disabilities (8).

Tobacco definitions

Smoked tobacco product: "any product made or derived from tobacco that is intended for human consumption". Examples include manufactured cigarettes, roll-your-own tobacco, cigars, *shisha, kreteks* and *bidis*.

Smokeless tobacco: any product that consists of cut, ground, powdered, or leaf tobacco and that is intended to be placed in the oral or nasal cavity. Examples include gutka, mishri, and snus.

Second-hand smoke (SHS): the combination of "mainstream" smoke exhaled by the smoker, and "side-stream" smoke emitted into the environment from lit cigarettes and other tobacco products. The terms "passive smoking" or "involuntary smoking" are also often used to describe exposure to SHS.

Stroke becomes more common as people age. Although most high-income countries have an ageing population, the overall incidence of stroke is declining in some of these countries partly due to reduced levels of smoking (1). The number of stroke victims in low- and middle-income countries is expected to rise substantially as these countries experience increases in population ageing and tobacco-use prevalence. As a consequence, these countries face substantial health and social costs resulting from the high disability burden associated with stroke (7).

Even with the most advanced medical technologies, 60% of people who suffer a stroke either die or develop permanent disabilities (9). Disabilities as a result of stroke commonly include permanent paralysis, which may require significant assistance to complete the activities of daily life, a task that usually falls to unpaid family caregivers.

World Stroke Organization
WORLD HEART FEDERATION
World Health Organization

Pathophysiology of tobacco use in stroke

Tobacco smoking contributes to stroke through various pathways. Nicotine, carbon monoxide and oxidant gases are the main components of tobacco smoke that can cause stroke (10). The toxic substances contained in tobacco-smoking products damage blood vessels inducing inflammation and endothelial cell dysfunction (5, 11). Additionally, tobacco smoke exposure in non-smokers leads to an increased risk of thrombosis, a major factor in the pathogenesis of smoking-induced cardiovascular events. The cerebrovascular effects of second-hand smoke are nearly as large as for smoking, and operate through essentially the same biological mechanisms such as inflammation, vaso¬constriction, and enhanced formation of clots. (11-14).

Although less is known about the cerebrovascular effects of smokeless tobacco, smokeless tobacco contains over 2000 chemical compounds including nicotine. Smokeless tobacco may cause stroke by elevating blood pressure acutely, and contributing to chronic hypertension (15).

Tobacco use and exposure to second-hand smoke increase risk of stroke

Risk factors for stroke can be divided into non-modifiable and modifiable risk factors. The non-modifiable risk factors beyond the control of the individual include age, genes, race, and ethnicity. Other non-modifiable risk factors for stroke include various forms of heart disease, such as atrial fibrillation and heart failure (1).

The most significant modifiable risk factors for stroke are high blood pressure and tobacco (use of smoked and smokeless tobacco and second-hand smoke exposure) (1, 16). The link between tobacco use and stroke is well established (17). A far greater number of smokers develop heart disease or stroke than develop lung cancer, and smoking may double the risk of stroke (1). It is estimated that 7% of total cerebrovascular disease deaths are due to tobacco smoking. Tobacco smoking is responsible for 17.6% of premature deaths due to cerebrovascular disease among adults 30–60 years of age (18).

Tobacco smoking and stroke

There is a strong and well-established causal link between tobacco smoking and stroke. Smoking increases the risk of stroke two to fourfold, both among men and women (14, 17, 19, 21). Research also indicates a high dose response in that the higher the number of cigarettes smoked, the higher the risk of stroke (17, 20, 22-23).

Since 1964, a number of the United States of America's Surgeon General's reports on tobacco have described the link between smoking and stroke (10, 12, 14, 17, 24-25), and have highlighted several key relationships:

1. Smoking is linked to an increase in the incidence of cerebrovas¬cular disease. Even after adjustment for other risk factors, cigarette smokers have a higher risk of stroke and higher mortality from cerebrovascular disease than do lifetime never smokers
2. Smoking is linked to an increase in the risk of various types of ischemic stroke.
3. Smoking is linked to an increase in the risk of subarachnoid hemorrhage.
4. Within four to five years of quitting smoking, stroke risk is reduced to that of a non-smoker.

Second-hand smoke and stroke

Although the current literature on the relationship between SHS and stroke is not as exhaustive as that between tobacco smoking and stroke, exposure to SHS is clearly linked to stroke in adults (1, 12, 14). A 2011 review of 20 stroke studies found a strong risk of stroke from exposure to second-hand smoke (RR 1.25, 95% CI 1.12–1.38). The same review also found evidence of a dose-response relationship, with the relative risk for stroke increasing from 1.16 (95% CI 1.06–1.27) for exposure to 5 cigarettes per day, to 1.56 (95% CI 1.25–1.96) for exposure to 40 cigarettes per day, reinforcing that there is no safe lower limit of exposure (26).

Smokeless tobacco and stroke

Although smokeless tobacco is used across the globe with heavy concentration in South and South-East Asia, Africa and South America, there is limited research on the relationship between smokeless tobacco and stroke. One systematic review consisting of American and European studies has reported an association between smokeless tobacco use and stroke (RR 1.19, 95% CI 0.97–1.47) (26). The risk of fatal stroke associated with smokeless tobacco use was significantly higher (RR 1.40, 95% CI 1.28–1.54).

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Impact of quitting and tobacco control interventions on stroke

Among the 30 million stroke survivors, about one third live with moderate to severe disability (5, 8). The significant economic impact and social cost of caregiving for people living with disabilities makes its prevention crucial (8). Quitting smoking and eliminating exposure to second-hand smoke significantly reduces the risk of stroke (17, 29).

A 12-year follow-up study found a 34% significantly decreased risk of stroke for former smokers compared with current smokers. Former smokers who had stopped smoking for two to four years had an almost identical risk of stroke as that of lifetime non-smokers (10, 28). Another study with a 26-year follow-up period also demonstrated that after quitting smoking, stroke risk decreased significantly by two years and was at the level of non-smokers by five years after cessation (10, 29).

A study from the United States of America reported that reducing adult smoking resulted in immediate short-term health and cost savings, specifically with respect to heart attacks and stroke (30). Following the implementation of smoke-free legislation, evidence is emerging for consequent reductions in heart attacks and stroke morbidity and mortality (31-34). A 2012 meta-analysis reported a 16% reduction in hospital admissions for stroke following the implementation of smoke-free laws (RR 0.84, 95% CI 0.75–0.93). The review also found evidence of a dose response, as more comprehensive laws (including all workplaces, restaurants, and bars rather than single public place ban) were associated with larger health benefits for stroke (RR 0.81, 95% CI 0.70, 0.94) (32).

Next steps

While there is significant evidence demonstrating a clear link between smoking and stroke, more research is needed to determine the magnitude and causal pathways of the association between stroke and smokeless tobacco.

Population level actions

As tobacco-related stroke places a huge health and socioeconomic burden on individuals, families, and communities, reducing exposure to tobacco smoke is a key area of action. With recent research demonstrating the effectiveness of smoke-free legislation for protecting health of non-smokers, governments should continue to incorporate the measures relating to create smoke-free environments laid out in the WHO Framework Convention on Tobacco Control (WHO FCTC) (35). This effort should include increasing awareness in public of the risk of tobacco-caused stroke via information to patients: labelling of tobacco products and mass-media campaigns; creating smoke-free public places and workplaces; ensuring availability of tobacco-cessation services including tobacco quitlines and integration of brief advice into the health system at all levels; and raising taxes on tobacco products.

Individual level action

Given that quitting tobacco use has a clear and profound effect on reducing the risk of stroke, encouraging and supporting current tobacco users to quit should be a top priority for both primary and secondary prevention of stroke (33). Non-smokers should demand smoke-free legislation and make their homes, and other places they control, smoke-free.

Information and advice on quitting tobacco use can be found through the following:

- www.smokefree.gov
- Quitlines/Helplines
- WHO package of essential noncommunicable (PEN) disease interventions (36) http://www.who.int/cardiovascular_diseases/publications/pen2010/en/

Further information

- WHO FCTC http://www.who.int/fctc/en/
- WHO Tobacco Free Initiative (TFI) http://www.who.int/tobacco/en/
- World Stroke Organization http://www.world-stroke.org/
- World Heart Federation http://www.world-heart-federation.org/
- American Cancer Society http://www.cancer.org/

Method

WHO conducted a comprehensive literature review that searched for all systematic reviews and studies that studied smoking tobacco and stroke, smokeless tobacco and stroke, and second-hand smoke and stroke. Inclusion criteria included a human study population, a stroke outcome, and tobacco use or exposure at any time over the life course. The review was not limited to any particular study design or language; however very few non-English language studies or reports were identified. Studies funded by, or with links to, the tobacco industry were excluded, as their conclusions were considered non-independent as per Article 5.3 of the WHO FCTC (35). The evidence linking stroke to tobacco smoking is well established. For this publication, the World Health Organization (WHO) also used evidence from various United States of America Surgeon General's reports (10, 12, 14, 17, 23-24), the WHO stroke report (3), and the Global atlas on cardiovascular disease prevention and control (2).

www.who.int/tobacco

References:

1. Mackay J et al. The atlas of heart disease and stroke. Geneva, World Health Organization, 2004.
2. World Health Organization. Global atlas on cardiovascular disease prevention and control. Geneva, World Health Organization, 2011, [available at: http://www.who.int/cardiovascular_diseases/publications/atlas_cvd/en/, accessed February 2015].
3. World Health Organization. Stroke, cerebrovascular accident. Geneva, World Health Organization, 2013, [available at: http://www.who.int/topics/cerebrovascular_accident/en/, accessed February 2015].
4. World Heart Federation. Warning signs. Cardiovascular Health, World Heart Federation web site, [available at: http://www.world-heart-federation.org/cardiovascular-health/heart-disease/warning-signs/, accessed February 2015).
5. World Health Organization. Global Health Estimates 2013: Deaths by Cause, Age and Sex, by Country, 2000-2012 (provisional estimates). Geneva, World Health Organization, 2014. [available at: http://www.who.int/healthinfo/global_burden_disease/en/, accessed February 2015].
6. Strong K, Mathers C, Bonita R. Preventing stroke: saving lives around the world. The Lancet Neurology, 2007, 6(2):182–7.
7. Valery L et al. Worldwide stroke incidence and early case fatality reported in 56 population-based studies: a systematic review. The Lancet Neurology, 2009, 8(4):355–69.
8. World Health Organization. World report on disability. World Health Organization/World Bank, 2011, [available at: http://whqlibdoc.who.int/publications/2011/9789240685215_eng.pdf, accessed February 2015].
9. Heller RF, Langhorne P, James E. Improving stroke outcome: the benefits of increasing availability of technology. Bulletin of the World Health Organization, 2000, 78:1337–43.
10. How tobacco smoke causes disease: the biology and behavioral basis for smoking-attributable disease: a report of the Surgeon General. Centers for Disease Control and Prevention, Washington, DC, 2010.
11. Secondhand smoke exposure and cardiovascular effects: making sense of the evidence. National Research Council, The National Academies Press, Washington, DC, 2010.
12. The health consequences of involuntary exposure to tobacco smoke: a report of the Surgeon General. Centers for Disease Control and Prevention, Washington, DC, 2006.
13. Barnoya J, Glantz SA. Cardiovascular effects of secondhand smoke: nearly as large as smoking. Circulation, 2005, 111:2684–98.
14. The health consequences of smoking – 50 years of progress. A report of the Surgeon General. Atlanta: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2014 (http://www.surgeongeneral.gov/library/reports/50-years-ofprogress/full-report.pdf,accessed 10 June 2015)
15. Yatsuya H, Folsom AR. Risk of incident cardiovascular disease among users of smokeless tobacco in the atherosclerosis risk in communities (ARIC) study. American Journal of Epidemiology, 2010, 172(5):600–5.
16. Feigin V et al. Asia Pacific Cohort Studies Collaboration. Smoking and elevated blood pressure are the most important risk factors for subarachnoid hemorrhage in the Asia-Pacific region: an overview of 26 cohorts involving 306,620 participants. Stroke, 2005, 36(7):1360–5.
17. The health consequences of smoking: a report of the Surgeon General.
18. World Health Organization. WHO global report: mortality attributable to tobacco. Geneva, World Health Organization, 2015. (In Press)
19. Thun MJ et al. 50-year trends in smoking-related mortality in the United States. New England Journal of Medicine 2013;368(4):351–64.
20. Shinton R, Beevers G. Meta-analysis of relation between cigarette smoking and stroke. British Medical Journal, 1989, 298(6676):789–94.
21. Kontis V, Mathers CD, Rehm J, Stevens GA, Shield KD, Bonita R, Riley LM, Poznyak V, Beaglehole R, Ezzati M: Contribution of six risk factors to achieving the 25×25 non-communicable disease mortality reduction target: a modelling study. Lancet 2014, 384:427-437
22. Foody J et al. Unique and varied contributions of traditional CVD risk factors: a systematic literature review of CAD risk factors in China. Clinical Medicine Insights: Cardiology, 2013, 7:59–86.
23. Kannel WB, Higgins M. Smoking and hypertension as predictors of cardiovascular risk in population studies. Journal of Hypertension Supplement, 1990, 8(Suppl 5):S3–8.
24. The health consequences of smoking: cardiovascular disease: a report of the Surgeon General. Centers for Disease Control and Prevention, Washington, DC, 1983.
25. Women and smoking: a report of the Surgeon General. Centers for Disease Control and Prevention, Washington, DC, 2001.
26. Oono IP, Mackay DF, Pell JP. Meta-analysis of the association between secondhand smoke exposure and stroke. Journal of Public Health, 2011, 33(4):496–502.
27. Boffetta P, Straif K. Use of smokeless tobacco and risk of myocardial infarction and stroke: systematic review with meta-analysis. British Medical Journal, 2009, 339(b3060).
28. Kawachi I et al. Smoking cessation and decreased risk of stroke in women. Journal of the American Medical Association, 1993, 269(2):232–6.
29. Wolf PA et al. Cigarette smoking as a risk factor for stroke: the Framingham Study. Journal of the American Medical Association, 1988, 259(7):1025–9.
30. Lightwood J, Glantz SA. Short-term economic and health benefits of smoking cessation: myocardial infarction and stroke. Circulation, 1997, 96(4):1089–96.
31. Tan CE, Glantz SA. Association between smoke-free legislation and hospitalizations for cardiac, cerebrovascular, and respiratory diseases: a meta-analysis. Circulation, 2012, 126(18):2177–83.
32. Aguero F et al. Impact of a partial smoke-free legislation on myocardial infarction incidence, mortality and case-fatality in a population-based registry: the REGICOR Study. PLoS One, 2013, 8(1):23.
33. Mackay DF et al. Impact of Scotland's comprehensive, smoke-free legislation on stroke. PLoS One, 2013, 8(5):e62597.
34. Lin H et al. The effects of smoke-free legislation on acute myocardial infarction: a systematic review and meta-analysis. BMC Public Health, 2013, 13:529.
35. World Health Organization. WHO framework convention on tobacco control. Geneva, World Health Organization, 2003 (updated 2004, 2005), [available at: http://www.who.int/tobacco/framework/WHO_FCTC_english.pdf, accessed February 2015].
36. World Health Organization. Package of essential noncommunicable (PEN) disease interventions for primary health care in low-resource settings. Ge-