Stroke Prevention, Treatment, and Rehabilitation in Sub-Saharan Africa

Daniel Lemogoum, MD, MPH, Jean-Paul Degaute, MD, PhD, Pascal Bovet, MD, MPH

Abstract: Stroke is emerging as a leading cause of preventable death and disability in adults in many developing nations. In Sub-Saharan Africa (SSA), stroke mortality and case fatality in some countries exceed those in the developed world. Stroke also occurs at much earlier ages in SSA, resulting in a greater number of years of potential life lost. The high social and economic burden of stroke calls for effective strategies for prevention, treatment, and rehabilitation in SSA. High blood pressure is the most powerful predictor of stroke, and its treatment can reduce the risk of stroke by ≥40%. Effective stroke prevention calls for comprehensive risk reduction including blood pressure control. Population-based health education programs and appropriate public health policy coupled with high-risk strategies targeting hypertensive persons and stroke patients must be developed. A broad partnership of key players, innovative funding mechanisms, and increased national and international commitment for the prevention and control of stroke in sub-Saharan Africa and other developing countries is needed.

Introduction

Cardiovascular diseases (CVD), principally ischemic heart disease and stroke, cause nearly 17 million deaths worldwide every year. Although available data on CVD mortality are still limited, it is now well recognized that stroke is a major cause of death in developing countries, and that approximately 80% of all deaths by stroke occur in developing countries. Evidence in Sub-Saharan Africa (SSA) indicates that case fatality rates for stroke can be higher than those in industrialized societies. This can be related to limited healthcare facilities and uncontrolled risk factors such as hypertension. Race/ethnicity might also be a factor underlying the high incidence of stroke in Africa. Stroke mortality is indeed almost twice as high in male and female African Americans than whites in the United States. Importantly, stroke affects younger people in developing nations compared to developed countries, and in Africa, possibly 10 to 15 years earlier than in developed countries. The years of potential life lost from stroke are thus large, and have significant socioeconomic consequences in sub-Saharan Africa.

Stroke Burden in Africa and Rationale for Prevention

Of the estimated 32 million heart attacks and strokes that occur globally each year, about 12.5 million are fatal. By 2020, it is projected that there will be 25 million deaths annually from CVD worldwide, with 19 million in populations from developing countries. Approximately 30% of stroke patients die within the first 3 weeks, and up to 30% of survivors are permanently disabled. The geographic heterogeneity in patterns of stroke mortality remains poorly understood. Age-standardized rates vary by more than ten times among countries. While cerebral hemorrhage is the leading cause of fatal stroke in SSA, cerebral infarction is found more often in developed countries. A survey in Gambia, which enrolled 106 stroke inpatients, revealed that a first stroke resulted in death in 46 patients (61%); of the 25% who survived after 4 years, only 33% made a complete recovery. Moreover, even in regions where advanced technology and facilities exist, prognosis for stroke is poor, and 58% die or become dependent on their families and/or society. Hence, stroke places a huge burden on society in terms of premature death, disability, and cost of care.

The economic burden of stroke is considerable. The cost of stroke for the year 2002 was estimated to be as high as $49.4 billion in the United States, while costs after hospital discharge were estimated to amount to 2.9 billion euros in France. Clearly, even a fraction of such amounts can cause enormous economic damage to low-income countries. Given the high burden of disease and costs due to stroke, high priority should be...
given to prevention in developing nations in which high-cost case management is hardly a feasible option. However, the high rates of stroke (Table 1) and the rising expectations of affected people are likely to boost the needs for acute medical treatment for these diseases. This is likely to place enormous pressure on already fragile healthcare systems, and threaten the viability of poorly funded public health and primary healthcare services. In some developing countries, the health budget per capita does not exceed US$10 per year, which is severely insufficient to address the increasing burden of noncommunicable diseases, and which adds to the ongoing burden of infectious diseases.

Hypertension is the most consistent and powerful predictor of stroke and is causally involved in nearly 70% of all stroke cases. Treatment of hypertension reduces the risk of stroke by 35% to 40%. Population-based reduction in systolic blood pressure (BP) by quantities as small as 1 to 3 mmHg can decrease the relative risk of stroke by as much as 20% to 30%. Hence, choosing hypertension as an entry point for stroke prevention and control programs in SSA makes sense. Affordable and effective medications to treat hypertension such as thiazide-type diuretics are available. The combination of population-based prevention strategies coupled with hypertension detection, treatment, and control offer the best chance for effective stroke prevention in SSA.

### Increasing Awareness, Diagnosis, Prevention, and Treatment of Hypertension in Africa

Several surveys have demonstrated very low prevalence of hypertension control (BP <140/90 mmHg) in Africa (Table 2). In Tanzania, slightly <20% of hypertensive subjects were aware of their diagnosis, approximately 10% of them were treated, and <1% were controlled. A survey in Ghana among 1337 subjects with hypertension showed that 34% were aware of their condition, of whom 18% were treated and only 4% were controlled. In a study of treatment status for South African black males with hypertension, 20% were aware of their condition, 14% were treated, and only 7% controlled. These figures were respectively 47%, 29%, and 15% for women. The low prevalence of awareness, treatment, and control of hypertension poses a serious challenge for stroke prevention in SSA.

### Necessity for Community-Based Programs for the Prevention of Hypertension and Stroke

The emerging CVD epidemic in SSA and other developing countries is linked largely to the adoption of detrimental lifestyles such as unhealthy diet, tobacco use, and sedentary habits. These, in turn, relate to urbanization, globalization, and industrialization. Dietary factors have been associated with stroke. It can be speculated that regional variations in food preparation

### Table 1. Incidence and mortality rates of stroke in selected African countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Type of study</th>
<th>Study population size</th>
<th>Follow-up period (weeks)</th>
<th>Incidence</th>
<th>Mortality rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tanzania³</td>
<td>Community-based</td>
<td>307,820</td>
<td>144</td>
<td>—</td>
<td>5.5%</td>
</tr>
<tr>
<td>Gambia¹²</td>
<td>Community-based</td>
<td>106</td>
<td>24</td>
<td>—</td>
<td>44%</td>
</tr>
<tr>
<td>Nigeria²¹</td>
<td>Community-based</td>
<td>708</td>
<td>24</td>
<td>2.4%</td>
<td>46%</td>
</tr>
<tr>
<td>South Africa²²</td>
<td>Community-based</td>
<td>982</td>
<td>49</td>
<td>—</td>
<td>38/100,000</td>
</tr>
<tr>
<td>Zimbabwe⁶</td>
<td>Community-based</td>
<td>273</td>
<td>1</td>
<td>68/100,000</td>
<td>35%</td>
</tr>
<tr>
<td>Burkina Faso⁷</td>
<td>In-hospital and community-based</td>
<td>214,526</td>
<td>24</td>
<td>140/100,000</td>
<td>33.0%</td>
</tr>
</tbody>
</table>

### Table 2. Trends in awareness, treatment, and control of hypertension in selected African countries and in the United States

<table>
<thead>
<tr>
<th>Country</th>
<th>Study population</th>
<th>Awareness</th>
<th>Treatment</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tanzania³</td>
<td>1,698</td>
<td>&lt;20%</td>
<td>10%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Ghana³⁴</td>
<td>1,334</td>
<td>34%</td>
<td>18%</td>
<td>4%</td>
</tr>
<tr>
<td>South Africa³⁵</td>
<td>13,802</td>
<td>41% (men)</td>
<td>39% (men)</td>
<td>26% (men)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>67% (women)</td>
<td>55% (women)</td>
<td>38% (women)</td>
</tr>
<tr>
<td>Egypt³⁶</td>
<td>6,733</td>
<td>37.5%</td>
<td>23.9%</td>
<td>8.0%</td>
</tr>
<tr>
<td>Zimbabwe³⁷</td>
<td>749</td>
<td>26.1%</td>
<td>22.4%</td>
<td>48.8%</td>
</tr>
<tr>
<td>United States³⁸</td>
<td>5,448</td>
<td>68.9%</td>
<td>58.4%</td>
<td>31.0%</td>
</tr>
</tbody>
</table>

*Blood pressure ≥140/90 mmHg or being treated.

*Blood pressure ≥160/95 mmHg or over, or being treated.

*Blood pressure <140/90 mmHg with antihypertensive medication.
or consumption patterns may affect the relative intake of certain nutrients, and influence stroke mortality directly or through effects on recognized stroke risk factors such as hypertension. Physical inactivity can increase the risk of stroke by up to 50%, and both the intensity and duration of exercise are important factors to consider in interventions aimed at reducing CVD mortality. Population-based strategies aimed at shifting the levels of risk factors to lower values in the entire population are likely to lead to a substantial reduction of the global burden of stroke and other CVD. Indeed, there is good evidence that lifestyle changes such as reduction in salt intake, weight loss, increased physical activity, limited alcohol consumption, and nutritional factors can effectively decrease blood pressure and CVD risk.

A national CVD prevention program in Mauritius demonstrated substantial reductions in the prevalence of hypertension, smoking, and hypercholesterolemia. Similarly, a decrease in blood cholesterol levels in the population of Mauritius has been attributed to a government policy for substituting (unsaturated) soy for (saturated) palm oil in the cooking oil available to inhabitants. In China, a 3-year community-based intervention lowered the incidence of stroke by 29% and stroke mortality by 40%.

This evidence supports the conduct of population-based interventions aimed at promoting healthy lifestyles in the community and relevant health policies in other SSA countries. Such programs should typically include educational, fiscal, or environmental incentives to reduce salt intake, reduce tobacco use, limit alcohol consumption, increase physical activity, maintain a lean body weight, reduce the consumption of saturated fats, and increase the consumption of fruits and vegetables. A comprehensive approach is necessary to reach all segments of the population in healthcare settings, schools, work sites, churches, mosques, community centers, and other public health settings. Use of the radio and other mass media has a large potential for raising awareness on cardiovascular health. More generally, health policy has a large potential to enable the adoption of healthier lifestyles. The Framework Convention on Tobacco Control, and the regulatory changes that it can foster at international and national levels, is a good example of such policy that has large potential for significantly modifying health in populations.

Globally, reducing the stroke burden will require public health programs and health policy to increase awareness on the preventable nature of stroke, educate on the modifiable risk factors of stroke, enable environment changes enabling the adoption of healthy lifestyles, educate the public and healthcare workers about the warning symptoms of stroke and the need for rapid response, strengthen risk factor reduction among persons at high risk, and include population-based surveil-

lance of risk factors in the population to guide interventions.

**Comprehensive Risk Reduction for Stroke Prevention in Africa**

Cigarette smoking doubles the risk of stroke. While tobacco use is decreasing in developed countries due to strong tobacco control programs (tobacco prevalence in several Western countries varies between 15% and 29.9%), the opposite trend is observed in many developing countries (where, for instance, prevalence is >60% in Yemen and Kenya). Developing countries are becoming the main target of the transnational tobacco industry, which takes advantage of the weak or non-existent tobacco control programs in these countries. Urgent action needs to be taken in developing countries including effective implementation of the Framework Convention on Tobacco Control toward reducing the current overall prevalence of tobacco of 36% among men and 11% among women in SSA. Among children, the Global Youth Tobacco Survey indicates that >10% of 13- to 15-year-olds use tobacco in many SSA countries, and this prevalence can be as high as 33% in South Africa. Smoking cessation is therefore a central component for the prevention of stroke.

Diabetes and impaired glucose tolerance are becoming epidemic in both developed and developing countries. In Ghana, the prevalence of diabetes in urban areas is about 6.4%, while in Dar es Salaam, Tanzania, adult male mortality associated with diabetes is about 34 per 100,000. Diabetes is a well-recognized independent risk factor for stroke. The relative risk of stroke associated with diabetes has been estimated to be 1.5 to 3.0. However, it has been shown that tight control of blood glucose can substantially reduce the incidence of stroke. Much of the increase in diabetes is related to the rapid global epidemic of overweight and obesity. As the current estimates indicate that about 150 million people have type 2 diabetes globally, and this figure is expected to double by 2025 with a majority of these patients living in the developing world, prevention and control of diabetes is becoming a major public health priority in all countries, including in SSA. Control of overweight, including regular physical exercise and healthy diet, is central to the prevention of diabetes.

The high-risk approach for stroke prevention (i.e., control of risk factors among people with particularly high total risk) must address several challenges in SSA. First, screening and treatment programs must be cost-conscious in view of low-resource settings. This includes the use of inexpensive reagents for screening and treatment (e.g., generic drugs). Second, adherence to antihypertensive treatment must be ensured. This is a
difficult challenge in view of substantial cost of treatment, lack of symptoms of hypertension, common beliefs that abnormal conditions can be handled with short-term means, and sometimes disregard of modern medications versus traditional healing processes (e.g., witchcraft). Third, health care in SSA should be readjusted to better enable the diagnosis, follow-up, and treatment of noncommunicable diseases, including the development of locally sound guidelines for the diagnosis and treatment of these diseases. Fourth, emphasis should be placed on human resource development, including specific training of healthcare professionals regarding noncommunicable diseases and means to avoid brain drain from poor to rich countries. Fifth, new funding mechanisms should be developed so that all patients are able to sustain treatment of chronic conditions and relevant medical follow-up. This includes, among others, the need for healthcare systems to prioritize some chronic diseases, and ensure that treatment of such conditions is available and affordable.

Abundant observational and experimental evidence has demonstrated the strong relationship between BP and stroke, and the efficacy of BP treatment to lower stroke risk. A recent meta-analysis of clinical trials showed that BP reduction, and not the type of drug, is the main factor underlying risk reduction of fatal or nonfatal stroke. Moreover, both the Heart Outcomes Prevention Evaluation (HOPE) and Perindopril Protection Against Recurrent Stroke Study (PROGRESS) studies have demonstrated that reduction in the risk of stroke extends to patients with only moderately high levels of blood pressure. Thus, the recent guidelines for African countries recommend that all hypertensive patients should benefit from antihypertensive medication.

It is estimated that up to one half of all strokes could be prevented through risk detection and management. As stressed by the guidelines of International Forum for Hypertension Control and Prevention (IFHA), BP should not be managed according to total risk (and not in isolation), which implies assessment of other risk factors of CVD. In all cases, whenever possible, tobacco use, alcohol consumption, salt intake, fruit and vegetable consumption, physical activity, personal and family history of stroke, diabetes, and other CVD should be recorded, and a complete physical examination including height and weight should be performed. The conduct of investigations, particularly sophisticated ones such as cerebral computer tomography or magnetic resonance imaging, should be tailored to the available facilities and resources and in accordance with local standards of care.

**Stroke Treatment and Rehabilitation**

The occurrence of a stroke is always a clinical emergency. High BP is common after strokes, particularly after intracerebral hemorrhages, and is associated with poor functional outcome. In most situations, high BP in the acute management of stroke should be managed very carefully and slowly in the hospital. The aim is generally to progressively achieve a diastolic BP of \( \leq 100 \text{ mmHg} \) over a period of 48 to 72 hours. Indeed, brain arteries adapt only slowly to reduced BP (within days or weeks), and too rapid a BP decrease can aggravate stroke complications. However, the optimal management of BP in acute stroke remains unknown. Common antihypertensive drugs used for stroke patients include long-acting calcium channel blockers, angiotensin-converting enzyme (ACE) inhibitors, beta blockers, and diuretics. In view of the high risk of recurrence of stroke and the particularly strong relation with hypertension, long-term BP control is a particularly important therapeutic goal in stroke survivors.

Antiplatelet treatment is useful for the primary prevention of stroke in high-risk patients, or for secondary prevention. Aspirin, ticlopidine, clopidogrel, and dipyridamole are effective, but it is likely that aspirin is a drug of choice in SSA due to lower cost compared to other antiplatelet medications. A meta-analysis of secondary prevention indicated that low-dose aspirin significantly reduced the risk of stroke by 13%. The PROGRESS study has demonstrated the benefit of ACE inhibitors and diuretics for reducing stroke recurrence. These therapeutic options can be cost-effective since diuretics are inexpensive and a few generic ACE inhibitors are now available and affordable in SSA. In addition, it has been reported that cholesterol-lowering statins can further reduce strokes and other CVDs. Thus, whenever feasible, statins in high-risk patients should be emphasized, especially if inexpensive generic medications are available. As recommended by IFHA, the adoption of healthy lifestyle should be a crucial therapeutic component in all cases.

Stroke recurrence is high among survivors of a first stroke, of whom 50% will have permanent disability. To reduce the social and economic costs related to long-term care, early identification and management of all cases of stroke, including adequate rehabilitation, is recommended. Care for long-term disabled patients should combine proper medication, physiotherapy, and kinesitherapy, whenever this is feasible and affordable. Since home-based rehabilitation for stroke can have functional outcomes similar to patients who receive inpatient neuro-rehabilitation, the former is likely to be less costly and possibly more appropriate in SSA. Education and counseling of a stroke patient’s relatives can help maintain family functioning, and in turn leads to improved functional and social outcomes.
The incidence of stroke increases mainly with age. As populations in several SSA countries get older—as a consequence of better control of infectious diseases and improved socioeconomic conditions—the number of people who will experience a stroke will increase greatly in the near future. Primary prevention of stroke and hypertension in low-resource settings should therefore become a global health priority. Concerted efforts through international partnerships with the World Bank, European Union, World Health Organization, and other United Nations agencies have advanced the fight against scourges such as malaria, AIDS, and tobacco. It is likely that the same efforts and partnerships could help mobilize adequate financial, political, and scientific support to relieve the burden of stroke in Africa. In that regard, the IFHA, a nongovernmental organization, has been recently created with the mission to coordinate future efforts by various health and other organizations for CVD prevention in SSA.

Health education is essential when treating hypertensive patients. Given the generally poor BP control in many hypertensive patients, patient education programs should aim at empowering patients to actively participate in and take responsibility for high-quality antihypertension care. Patients should be educated on the entire concept of hypertension, especially with regard to the significance of the absence of symptoms in a majority of cases, and the possible complications such as stroke if BP is not appropriately controlled. Patients should also be educated on the signs and symptoms of a stroke. They should be encouraged to keep records of their own BP readings in the hospital or at home. Emphasis should be placed on lifestyle modifications, the need for lifelong treatment, and the importance of compliance in the use of medications.

**Political Commitment: Major Step for CVD Prevention**

The ongoing focus by governments and local health-care planners on poverty and other health priorities such as infectious diseases has resulted in an under-appreciation of the current and future impact of non-communicable diseases in Africa and subsequent lack of policy and action. However, there are many opportunities for effective intervention aimed at reducing stroke (and other CVD) while maintaining the same attention on other pressing health and developmental issues. Local authorities could use fiscal and legislative measures to promote the use of healthy products or discourage the use of unhealthy goods. Legislation for tobacco control and taxes on tobacco products are examples. In addition to health education and policies aimed at facilitating the adoption of healthy lifestyles by individuals, policymakers should also address measures to enhance investments in stroke-related health infrastructures (e.g., construction of rehabilitation hospitals) and specific human resources of (e.g., neurologists but also craftspeople able to build/repair splints or wheelchairs). This would facilitate the development of national prevention and control programs and their integration into existing healthcare systems.

**Summary and Conclusions**

Successful prevention and control of stroke in SSA will require a multipronged and sustained effort involving a broad array of interventions, key players, and innovative new resources. The establishment of practical guidelines for prevention, detection, treatment, and control of stroke in primary health settings is a concrete necessary step. A strong political commitment is necessary to foster the relevant policy and environmental changes to support adequate education and prevention programs. Primary, secondary, and appropriate tertiary health services need to be adjusted to better suit the care for noncommunicable diseases in low-resource settings of sub-Saharan Africa. The challenges are enormous, particularly in view of the ongoing burden of infectious and parasitic diseases, perinatal morbidity, and other problems often related to poverty. However, the high stroke burden in SSA and the preventable nature of this disease stress the need to place this major health problem high on the priority list of needed prevention and control programs to avoid a full-scale epidemic, which sub-Saharan Africa can least afford.

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**References**


