COMMENTARIES

CARDIOVASCULAR DISEASE MORTALITY IN SUB-SAHARAN AFRICA AND THE CARIBBEAN

Hakeem Ayinde, MD; Richard F. Gillum, MD

Is there a full-blown stroke epidemic and a growing ischemic heart disease (IHD) epidemic in Sub-Saharan Africa? We aim to further understand the evolution of stroke and IHD in Sub-Saharan Africa with an analysis of the most recent Global Burden of Disease estimates of mortality for men of Sub-Saharan African descent in Africa and in the Caribbean and a review of recent studies found on PubMed and reference lists of published articles. Stroke is the most important cause of cardiovascular disease mortality in men aged 60–64 years in Africa and the Caribbean, but death rates and rank may vary by region. Ischemic heart disease is a leading cause in the Caribbean. (*Ethn. Dis.* 2014;24[4]:495–501)

Key Words: Ischemic Heart Disease, Stroke, CVD Risk Factors, Africa, Caribbean

INTRODUCTION

African Americans and European Americans are part of a global pandemic of ischemic heart disease (IHD) and stroke.[1–10] But, are Africans protected from IHD and predisposed to hypertensive disease and stroke?[1–6] In the 20th century, IHD became a leading cause of death among African Americans[5,6] with death rates eventually, like stroke, exceeding those in European Americans.[3] But, is there a full-blown stroke epidemic and a growing IHD epidemic in Sub-Saharan Africa?[9] In this commentary, we aim to expand the understanding of the evolution of stroke and IHD in Sub-Saharan Africa with an

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analysis of the most recent Global Burden of Disease estimates of mortality for men of Sub-Saharan African descent in Africa and in the Caribbean and provide a review of recent studies found on PubMed and reference lists of published articles.

ISCHEMIC AND HYPERTENSIVE HEART DISEASE

Among studies of the last decade,[11–20] the INTERHEART Africa study,[11] a case-control study between 1999 and 2003, explored risk factors for myocardial infarction across three different ethnicities. Despite having a better overall lipid profile compared to other ethnicities, Sub-Saharan African men with hypertension and diabetes were found to have a 2–3 times increased risk for myocardial infarction; hypertension was the most common cause of heart failure in Sub-Saharan African men. The Sub-Saharan Africa Survey of Heart Failure study found that heart failure was due to hypertension in 45.3% of cases, while IHD accounted for only 7.7%.[12] The Heart of Soweto study found that Blacks were more likely than other groups to have heart failure (54% vs 45%), and far less likely to have IHD (6% vs 38%), with 68% of heart failure caused by hypertension or dilated cardiomyopathy.[13] Hypertension prevalence rates were 25%–33% in rural, and up to 39% in urban Africa.[14–18] Among hypertensives, awareness was 15%–34%, with a 6%–8% control rate.[19,20] Urbanization and westernization contributed to the burden of hypertension.[21] Thus, studies in Africa have revealed low incidence of IHD but high hypertensive morbidity.

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STROKE

The Tanzania Stroke Incidence Project[22] met proposed criteria for stroke incidence studies[23] with community-based surveillance and verbal autopsies between 2003 and 2006. Hai (a rural setting) had an age-standardized stroke incidence rate of 108.6 per 100,000, similar to developed countries.[22] Dar-Es-Salaam (an urban setting) had an age-standardized incidence of 315.9 per 100,000.[22] For comparison, the Northern Manhattan Stroke Study of 1993 to 1996 found an incidence of 93 per 100,000 among Whites and 223 per 100,000 among Blacks aged ≥ 20 years.[24] Between August 2005 and July 2006 in Maputo, Mozambique, CT scans and autopsies were utilized in the diagnosis of 92.3% of incident strokes. 58.4% had ischemic stroke, 40.3% had hemorrhagic stroke and 1.3% had sub-arachnoid hemorrhage. Hemorrhagic stroke was associated with a 2–3 fold increase in case fatality.[20] Case fatality in Sub-Saharan Africa at one month has been reported at between 27% and 50% compared to 23% in the rest of the world[8,20,25–27] likely due to limited access to quality stroke care. Hypertension population attributable fraction is about 50% for stroke mortality.[28] Reducing the diastolic blood pressure by 10 mm Hg was associated with a 56% reduction in stroke incidence.[29] Hypertension prevalence was 86.6% and 96% respectively in an African ischemic stroke and hemorrhagic stroke

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cohort.[20] Thus, high rates of stroke mortality and morbidity were reported in Sub-Saharan African men.

THE GLOBAL BURDEN OF DISEASE STUDY 2010

The Global Burden of Disease, Injuries, and Risk Factors Study 2010 gathered mortality data from vital registration, verbal autopsy, surveillance systems, survey/census, police reports and research publications.[30–34] A systematic review of IHD literature from 1980 to 2008 and of stroke literature from 1990 to 2010 identified evidence for estimates of burden of IHD and stroke.[30–34] Using a special analytic technique (DisMod-MR), investigators calculated estimates of mortality for 21 regions. Data were sufficient for high-income regions, but missing or sparse in Sub-Saharan Africa. Only one country in Sub-Saharan Africa had >85% coverage in their death registration data.[35]

We examined the Global Burden of Disease 2010 online database for IHD and stroke death rates in 2010 and trends since 1990 for Sub-Saharan African men aged 60–64 years, a group susceptible to IHD and stroke, likely to have access to diagnostic services, and perhaps less affected by garbage codes (inappropriately assigned underlying causes of death) than older age groups or women.[36] See Appendix 1 for definitions of regions.

Table 1 shows the estimated death rate and percentage of death due to IHD. The estimated IHD death rate ranged from 168 per 100,000 in Eastern Africa to 365 in Central Africa. The

Table 1. Global Burden of Disease 2010 estimates of cardiovascular disease mortality for men of Sub-Saharan African origin

Region/Country	Ischemic Heart Disease		Stroke		Data Source
	Death Rate per 100,000 (UI)[a]	Death % (UI)[a]	Death Rate per 100,000 (UI)[a]	Death % (UI)	
East Sub-Saharan Africa	168 (142–220)	6.4 (5.1–8.6)	294 (206–355)	11.2 (7.9–13.9)	
Madagascar	323 (211–470)	12.0 (7.1–18.9)	550 (372–760)	20.3 (13.1–29.9)	Special reports for 1990–1995
Mauritius	468 (407–623)	21.3 (18.5–28.5)	230 (178–327)	10.5 (8.0–14.8)	Vital registration
Seychelles	766 (646–905)	18.1 (15.0–22.1)	373 (263–471)	8.8 (6.3–11.2)	Vital registration
West Sub-Saharan Africa	176 (145–227)	8.3 (6.5–10.7)	236 (178–286)	11.1 (8.1–14.2)	
Ghana	256 (182–360)	11.6 (8.0–17.0)	351 (250–477)	15.9 (10.6–22.3)	Vital registration for Accra
South Sub-Saharan Africa	209 (159–273)	8.5 (5.8–12.2)	219 (171–272)	9.0 (6.2–12.4)	
South Africa	210 (152–285)	9.6 (6.0–14.0)	198 (146–255)	9.1 (6.0–12.7)	Vital registration and verbal autopsy
Zimbabwe	175 (100–305)	5.0 (2.3–9.7)	285 (149–492)	8.0 (3.6–15.5)	Vital registration in 1995 only
Central Sub-Saharan Africa	365 (249–489)	10.6 (6.8–15.8)	356 (252–499)	10.3 (6.7–15.4)	Vital registration (all countries)
Caribbean	347 (308–391)	13.9 (10.7–16.8)	245 (191–295)	9.9 (7.3–12.4)	
African American[b]	320 (307–332)	16	97 (90–104)	4.9	

a UI, Global Burden of Disease 2010 uncertainty interval.
b Data from US Centers for Disease Control Vital registration: not comparable to Global Burden of Disease estimates.

a

Trends in IHD mortality rate, 1990-2010

◆ Central SSA ■ Eastern SSA ▲ Southern SSA ✕ Western SSA ✳ Caribbean

b

Trends in stroke mortality rate, 1990-2010

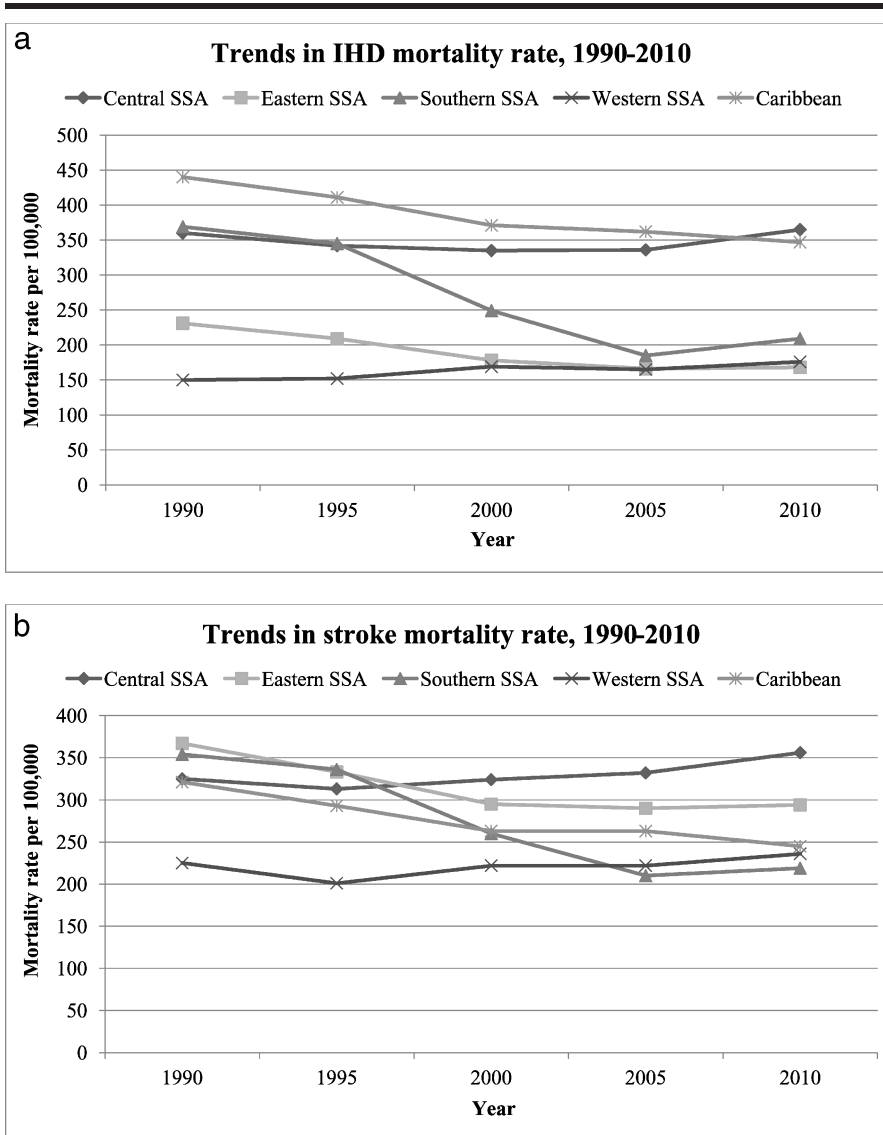◆ Central SSA ■ Eastern SSA ▲ Southern SSA ✕ Western SSA ✳ Caribbean

Fig 1. Global Burden of Disease 2010 estimates of death rate for Sub-Saharan African men aged 60–64 by region, 1990–2010 a. ischemic heart disease b. stroke

uncertainty intervals (UIs), although wide, do not overlap when comparing Central Africa or the Caribbean with Eastern Africa. The estimated death rates were similar in Central Africa and the Caribbean (347). For Sub-Saharan African men aged 50–69 years, an estimated 87% of IHD deaths were attributed to dietary risks, 27% to tobacco use, and 29% to physical inactivity (calculated one at a time; hence sum to > 100%).

The estimated death rate due to stroke was similar in Western and Southern Sub-Saharan Africa (Table 1). It appears slightly higher in Eastern Africa (294), and is highest in the Central sub-Saharan region (356). While the UI for death percent overlap for the contrast of Central with Eastern Africa, those for the Caribbean do not overlap with those for Eastern Africa. The estimated death rate from stroke appears to be similar between the Caribbean and the Western and Southern Sub-Saharan regions.

Compared to 1990, IHD maintained its rank in Sub-Saharan Africa

as the fourth leading cause of death in 2010. However, estimated number of deaths increased by 44% in all Sub-Saharan African men. In Central Africa, IHD rose from second to the leading cause, the number of deaths increasing by 70%. In Southern Africa, IHD fell from second to third leading cause with a decline in number of deaths of 6% (perhaps due to HIV/AIDS epidemic). In Western Africa and Eastern Africa, IHD maintained its fourth rank, although number of deaths increased by 90% and 23%, respectively. In the Caribbean, IHD fell to second rank, yielding to forces of nature (ie, the 2010 earthquake in Haiti), but with a 15% increase in number of deaths.

Trends in estimated age-specific IHD death rates for Sub-Saharan African men aged 60–64 years in Africa since 1990 failed to show consistent increases. In fact, estimated rates in most regions fell between 1990 and 2005. IHD death rates fell steadily in the Caribbean (Figure 1a). While the estimated age-specific stroke death rate declined in most regions between 1990 and 2010, Sub-Saharan African men in Central Africa had a steady increase in estimated death rate during the same period. In 2010 death rate from all causes in Africa was 14% lower than the 2914 per 100,000 in 1990.

Because of the greater availability of in-country data in the Caribbean than in African regions, we also examined the relationship of IHD mortality rate and gross domestic product (GDP) per capita only within that region. Estimates of IHD death rate in men aged 60–64 years ranged from 161 in Barbados to 719 in Guyana. GDP per capita ranged from $670 in Haiti to over $21,000 in the Bahamas. No clear relationship was apparent between the two variables, even if the several obvious outliers were ignored (not shown). Most countries had a per capita GDP between $5000 and $10,000 but IHD rates varied widely in this range. In contrast to IHD, higher GDP per capita was
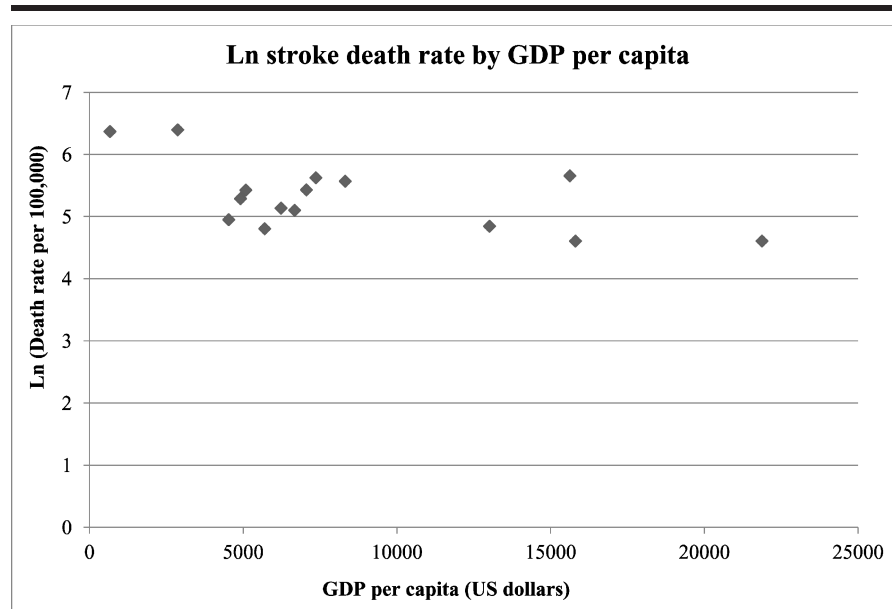
Fig 2. Relationship between stroke death rate and income level in the Caribbean

associated with an exponential decrease in stroke death rate as shown in the log-linear plot in Figure 2.

EVOLUTION OF THE CARDIOVASCULAR EPIDEMIC

Stages in the evolution of cardiovascular disease in populations of Sub-Saharan African origin have been postulated (Table 2).[5] The Global Burden of Disease study 2010 estimated IHD death rates in Sub-Saharan African men to range from quite low in Eastern Africa to very high in Central Africa, similar to those in the Caribbean or high-income North America. However, trends in estimated age-specific IHD death rates for Sub-Saharan African men aged 60–64 years in Africa since 1990 failed to show consistent increases that might be expected in the case of a growing IHD epidemic. Estimates for stroke death rates were more consistent with the postulated stages and negatively correlated with GDP, a marker of affluence (Tables 1 and 2). In Sub-Saharan African men aged 60–64, dietary risks and high blood pressure were likely the chief causes of IHD, with tobacco playing a lesser role; high blood pressure was the chief cause of stroke. The lack of long-term, life-long exposures to diets rich in saturated and trans fats and refined carbohydrates or tobacco in Sub-Saharan African men aged 60–64 years in 2010 may explain their persistent low estimated and observed death rates from IHD. In contrast, life-long exposure to high salt intake and the stressors of life in modern Africa in the absence of access to effective hypertension treatment likely explains the high stroke death rates.

Recently, researchers have published estimates for incidence and prevalence of ischemic and hemorrhagic stroke based on the Global Burden of Disease study 2010.[37,38] Compared to high income regions after controlling for age, Sub-Saharan Africa was found to have lower prevalence rates but higher mortality rates, higher ratio of mortality to incidence, and increasing mortality between 1990 and 2010. This pattern was attributed to more limited access to primary health care (e.g. hypertension treatment) and to stroke treatment and secondary prevention.

Consistent with previous studies of the US,[33] IHD death rates fell in the Caribbean since 1990 (Figure 1a). If true, the Global Burden of Disease estimates would suggest the possibility of a rapidly progressing IHD epidemic in Sub-Saharan African men in Central Africa, contrary to previous reports,[11–13,38–60] and a mature epidemic responding to intervention in the Caribbean. However the lack of country-specific data on cause of death renders the data from Central Africa suspect as indicated by wide uncertainty intervals. Global Burden of

Table 2. Stages in the evolution of patterns of cardiovascular disease among persons of Sub-Saharan African origin

	Risk Factors*						Cardiovascular Outcomes	
Stage	Westernization	Urbanization	Affluence	Fat Intake	Salt Intake	Smoking	Stroke	IHD
1	0	0	0	+	+	0	0	0
2	+	+	+	++	++	+	++	0
3	++	++	++	++	+++	++	++++	+
4	+++	+++	+++	+++	++++	+++	++++	++
5	+++	++++	+++	++++	++++	++++	++++	++++
6	++++	++++	++++	+++	+++	+++	++	+++

 * The degree to which each factor or disease is present in each stage is shown, with 0 denoting virtually absent and ++++ denoting present at highest reported level. Reproduced and modified with permission from Gillum RF.[5]

Disease estimates for IHD in Sub-Saharan African men aged 60–64 years seem to be "ahead of schedule," yielding rates consistent with Stage V or VI, when in fact, the limited epidemiologic and clinical data for Sub-Saharan African men suggest evolution of IHD no farther than Stage III at most (Table 2).[5,7] Some have suggested that Global Burden of Disease estimates were too high for Central and Southern regions of Africa.[7] Both the stages and the Global Burden of Disease IHD regional pattern should be considered hypotheses to be tested by future, repeated multi-center surveillance studies in Sub-Saharan African men.

Further research is needed to validate mortality estimates for Africa and render them adequate for testing hypotheses about IHD and stroke (Table 2) and forecasting for health facilities and manpower planning.[39] Since overestimation of IHD mortality is a real possibility in the Global Burden of Disease study, eg, in Central Africa, improvements in methods may be needed to gain a truly accurate picture of IHD and stroke in Sub-Saharan Africa. Moreover, the diversity of tribes, ethnicities and cultures in Africa makes it difficult to generalize findings, even within countries. For example, the burden of cardiovascular disease in Southern Nigeria, which is mostly suburban to urban and more westernized is expected to be higher than in the more rural North. Discussion of country-specific data, however, is beyond the scope of this article.

In conclusion, stroke is the most important cause of cardiovascular disease death in Sub-Saharan African men in Africa and the Caribbean, but death rates and rank may vary by region. Multicenter community surveillance and verbal autopsy studies are needed to confirm the validity of Global Burden of Disease estimates for Africa. Community-based surveys of the prevalence of cardiovascular risk factors would also shed light on the determinants of the cardiovascular disease burden in Africa.

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Appendix 1. List of countries by Global Burden of Disease 2010 region

Region	Countries
Central Sub-Saharan Africa	Angola, Central African Republic, Congo, Democratic Republic of the Congo, Equatorial Guinea, Gabon
Eastern Sub-Saharan Africa	Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Seychelles, Somalia, Sudan, Tanzania, Uganda, Zambia
Southern Sub-Saharan Africa	Botswana, Lesotho, Namibia, South Africa, Swaziland, Zimbabwe
Western Sub-Saharan Africa	Benin, Burkina Faso, Cameroon, Cape Verde, Chad, Cote d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Sao Tome and Principe, Senegal, Sierra Leone, Togo
Caribbean	Antigua and Barbuda, The Bahamas, Barbados, Belize, Cuba, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago