Improving Cardiovascular Disease Prevention and Management in Africa: Issues to Consider for the 21st Century

Ernest C. Madu, MD; Kelly D. Richardson, MSW; Obinna H. Ozigbo, MD; Dainia S. Baugh, MD

There is substantial evidence that cardiovascular diseases, and their associated risk factors, are becoming an increasing threat to the health of a large portion of the populace in many areas of Africa, particularly sub-Saharan Africa. If not adequately addressed, this epidemic will place an even greater burden on the poor economies and weak public health infrastructures of this continent. Important strategies for curtailing this epidemic will include primordial, primary, and secondary prevention, population-based prevention programs, improved research and surveillance, and increased governmental accountability for the adequate appropriation of public health. (*Ethn Dis*. 2003; 13[suppl2]:S2-71–S2-76)

Key Words: Africa, Cardiovascular Care, Trends, Prevention, 21st Century, Innovations, Epidemiologic Transition, Disease Burden, Noncommunicable Diseases, CVD

From the Division of Cardiovascular Diseases, Vanderbilt University Medical Center (ECM), Vanderbilt University Institute for Public Policy Studies, Center for Mental Health Policy (KDR), Nashville, Tennessee; Royal Albert Hospital, Lagos, Nigeria (OHO); Nashville Internal Medicine Associates, PC (DSB), Nashville, Tennessee.

Address correspondence and reprint requests to Ernest C. Madu, MD, FACC; Vanderbilt University Medical Center; Division of Cardiovascular Medicine; 315 MRB II; 2220 Pierce Avenue; Nashville, TN 37232-6300; 615-936-1720; 615-936-1872 (fax); ernest.madu@vanderbilt.edu

Introduction

The 21st century offers both opportunities and challenges in addressing cardiovascular health in Africa. Sadly, much of Africa, particularly sub-Saharan Africa (SSA), continues to face severe pressures, and to be vulnerable to many communicable and noncommunicable diseases (NCDs). The Global Burden of Disease (GBD) Project[1–5] developed the concept of disability-adjusted life expectancy (DALE), as a summary measure of a population's health, free of major disability. Except for Haiti, all 40 countries with the lowest DALE are in Africa.[6] Disability-adjusted life expectancy remains extremely low in Africa due to the devastating effects of poorly controlled communicable diseases. This is further compounded by the rising pandemic of NCDs, particularly cardiovascular diseases (CVDs).[7] The burden of disease in SSA is estimated to be about 5 times greater than that of established market economies.[1] Life expectancy in the developed world has increased over the past 30 years, mainly due to the containment of communicable diseases; the reverse is true in Africa. In fact, the scourge of communicable diseases has led to a dramatic decrease in life expectancy in many countries in Africa. Unfortunately, at a time when Africa is dealing with an epidemic of infectious and communicable diseases, another pandemic is looming. This new burden is facilitated in part, by an epidemiologic transition that has occurred in varying phases in many African countries over the past several decades. While NCDs are relatively more prevalent in developed countries (because of the near eradication of communicable disease), their impact is far more devastating in developing countries.[7,8] World Health Organization (WHO) data from 1990, indicate that of the nearly 30 million deaths caused by NCDs, 18.7 million occurred in developing countries vs 9.4 million in developed countries.[9] During the same period, 63% of the world mortality due to CVDs occurred in the developing world.[1]

In many African societies, the epidemiologic transition (from infectious diseases to NCDs) has been facilitated by the Westernization of indigenous cultures, increasing sedentary lifestyles, high fat Western diets, tobacco abuse, and psychosocial stress from urbanization.[7,10–13] In many parts of Africa, social upheavals and war have also contributed to the dismantling of existing health and social structures, which has limited the ability of communities to control communicable diseases and NCDs.[14] Most African countries, therefore, have had to use their already meager resources to confront what has been termed a "double burden" of disease.[14] The stark reality appears daunting. Risk factors for CVDs are rapidly rising in many African countries. Surveillance data from Tanzania indicate that between 15% and 33% of all adult deaths are due to NCDs,[15] and it is estimated that by the year 2015, the number of deaths due to NCDs in Africa will exceed the number of deaths due to communicable diseases.[16] The majority of this shift will occur in the emerging CVD pandemic. Current estimates indicate that between 1990 and 2020, SSA will experience an increase of 125% to 140% in ischemic heart disease mortality, compared to an increase of about 29% to 48% in developed countries.[7]

World Health Organization (WHO) data from 1990, indicate that of the nearly 30 million deaths caused by NCDs, 18.7 million occurred in developing countries vs 9.4 million in developed countries.[9]

EPIDEMIOLOGIC TRANSITION

There is sufficient evidence to suggest that SSA has begun to experience the effects of "epidemiologic transition," a term used to describe a shift in disease patterns associated with development. The hallmark of this transition is a shift in the predominance of infectious diseases and nutritional deficiencies to degenerative and chronic diseases, such as CVDs.[7,17] To add to the challenges and complexity of Africa's public health dilemma, this transition is occurring at a time when communicable diseases are yet to be controlled. The "double burden" of disease will pose unique challenges across the continent, where populations are already facing severe economic hardship, and healthcare systems are already overburdened.

Although there is a paucity of research and reliable empirical studies,[2,14] it is clear that the prevalence of CVDs is on the rise in Africa,[7,8,18,19] and we must respond with new initiatives and a plan of action to address the epidemic in a tangible manner. As daunting as the facts appear, a unique opportunity currently exists to review the vulnerability of different populations, assess the requirements and preparedness of various countries, reorder priorities, and identify bold sustainable initiatives to contain the impending pandemic of CVDs. Certain aspects of the epidemic must be clearly understood. Lessons learned from developed countries can influence direction in addressing CVD care and prevention in Africa in the 21st century.[19–21]

TRENDS IN CARDIOVASCULAR DISEASE AND RELATED RISK FACTORS IN AFRICA

Epidemiologic studies demonstrate a link between prolonged exposure to risk factors such as tobacco consumption, high cholesterol, high blood pressure, physical inactivity, obesity, poor diet and CVDs.[7,21,22] Additionally, changing lifestyles, the aging of the population, and urbanization, have led to the increase of CVDs in SSA.[10–13,23] Comprehension of the scope and relative burden is essential for effective management, prevention, and control of CVDs and related risk factors.

Due to its etiology, rheumatic heart disease is the most preventable and treatable of all the CVDs.[24] Hospital studies in 9 SSA countries indicate that rheumatic heart diseases account for 10%–35% of cardiac admissions,[25] but are a less significant cause of premature death, accounting for only 1% to 6% of all CVD deaths in the region. Ischemic heart disease, on the other hand, represents 26% of all CVD deaths in SSA. Hypertension related diseases (eg, stroke, heart failure, kidney failure) account for a large burden of disability and death. Although hypertension is easily diagnosed and treatable, the prevalence in SSA is approaching that of developed countries.[26] Surveillance and epidemiologic data indicate that between 10 and 20 million people in SSA may have hypertension, and that treatment could prevent approximately 250,000 deaths per year.[27] In a study of rural and urban Tanzanians, hypertension prevalence was about 30% in both men and women. In both areas, just under 20% of the study sample were aware of their diagnosis, only about 10% reported receiving treatment, and fewer than 1% were controlled.[28] A study of South African adults showed high levels of hypertension and inadequate levels of treatment with prevalence rates of 11% for men, and 14% for women.[11] Hypertension affects about 14% of the adult population in Mauritius,[9] 22% in Seychelles,[22] and 25% of the Zulus of South Africa.[29] Rates of more than 25% have been reported for some adult population groups.[30] In a study in Cameroon, the effects of urbanization are evident in the higher prevalence rate of hypertension in urban Cameroonians, compared to that of their rural counterparts, despite the younger ages of those from urban settings.[31]

Cerebrovascular accident or stroke (CVA) has become a leading cause of CVD death in SSA.[26] In a study of Nigerians, hypertension was the most common contributory factor for CVA in 35.8% of cases.[32] A study of rural South Africans reported CVA as second only to assault as cause of death, among persons aged 35 to 54 years.[33] In Tanzania, CVA has become an important cause of death, with age-matched death rates significantly higher than those in Britain.[9] By the year 2020, it is estimated that SSA will see CVD mortality prevalence rate increases of 126% in women, and 134% in men.[7]

Tobacco-related illnesses are becoming an increasingly important public health issue in Africa. As public policy and governmental regulations in established market economies put pressure on tobacco companies, they have shifted their marketing focus to developing countries, where regulations are lax,[34] and official corruption is high.[35] This has led to a remarkable increase in tobacco usage in developing countries. Eight hundred million of the world's estimated 1.1 billion smokers live in developing countries.[36] Among developing countries, those in Africa are experiencing the highest increase in the rate of

tobacco use, with use increasing by 4.3% per year.[37] In Kenya, tobacco is used by 6 of every 10 men, 3 of every 10 women, and 4 of every 10 secondary school adolescents.[38] Between 1970 and 1980, consumption of tobacco products increased 41.6% among African adults.[39] As these smokers age, it is expected that the effects of prolonged exposure to tobacco will become manifest, which will, among other things, include a rise in the incidence of CVDs.[37]

The incidence rates of diabetes will see the greatest increases in developing countries. It is projected that developing countries will experience a 170% increase in the prevalence of diabetes, from 84 million to 228 million, meaning that more than 75% of all those with diabetes will reside in developing countries by the year 2025.[40] In Mauritius, for example, the adult prevalence of diabetes is about 20%.[9] A study of dietary patterns among female Nigerian students found dietary habits similar to those observed in the United States, with 37% of daily calories coming from fat,[41] higher than WHO-recommended daily fat consumption of 30% of total caloric intake. With urbanization and increasingly sedentary lifestyles, Africa is witnessing a rising prevalence of obesity, a risk factor for diabetes, hypertension, and CVDs.[42] In a sample of urban Cameroonian school children, urbanization was associated with more sedentary lifestyles, consumption of higher fat foods, and lower intake of fruits and vegetables.[43]

IMPACT OF PUBLIC POLICY

Detailed epidemiological information, including morbidity and mortality statistics, are critical for effective planning designed to improve population health. Routine demographic and health surveillance contributes to data on stability, or changes in rates of mortality.[44] Vital registration data is poor, or nonexistent, in most of SSA.[14] Most morbidity and mortality data for Africa are estimates and extrapolations. Analysis of several credible research databases found only 99 randomized clinical trials relating to the CVD burden of disease and health needs of SSA. Of those trials, 40 were conducted after 1990, with fewer than 6000 participants in all studies.[45] There is great need, therefore, for clinical studies of CVDs in SSA. It is important that the epidemiology of the disease, and its socioeconomic impact, be adequately explored to aid policy efforts at containment.

Budgetary allocations for health care in many African countries are often inadequate, demonstrating a lack of governmental commitment to improving the health of the population. Often, the budgetary allocations by national governments in Africa indicate misplaced priorities. The 2003 Nigerian government budget allocated only 2.5% to health, the same percentage allocated to sports and social development. For a population of 120 million people, the projected healthcare spending for 2003 was a meager $1.13 per person.[46] In contrast, the healthcare spending per person in the United States is >$3000.[47] A breakdown of healthcare budgets in several African countries also reveals a disturbing trend in resource allocation, compared to other nations. In South Korea, for example, 10.5% of the 1996 national budget was allocated to health care, with 18% of that being earmarked for public health education, 26% for communicable disease control, and 30% for chronic and mental disease control. Cameroon, on the other hand, allocated 3% of the 1996 budget for health care, with a whopping 55% going toward salaries, 41% for buildings and equipment, and 4% for pharmaceuticals; no funding was provided specifically for disease control, prevention or treatment.[47]

Clearly, in addition to increasing healthcare spending, African nations must realign their budgetary priorities to include sustainable efforts at preventing and managing chronic diseases, such as CVDs.

Low literacy levels, weak public health infrastructure, poor governance, and insufficient public expenditures on health, all contribute to the "double burden" of disease in Africa. Access to health care is a problem for the poorest in Africa. In South Africa, as in many African countries, patients travel many miles and long hours to obtain even the most basic medical care.[48] There is also a dearth of trained health professionals in many rural areas, where the majority of the population reside. These locations are often unattractive to doctors and nurses because of the absence of the most basic amenities and social services. Wages are often low, with few opportunities to supplement income. In many SSA countries, the majority of the available healthcare providers are only available in the larger cities. Despite the urban concentration, the national physician/patient ratio is often abysmal. Ethiopia, Niger, and Malawi, all have physician/patient ratios of about .03/1000.[48] In SSA, limited availability of lifesaving medications, poorly trained staff with inadequate skills, poor funding, lack of equipment, and substandard maintenance of healthcare facilities, are all factors that promote the "double burden" of disease, and, therefore, must be addressed. Additionally, the bulk of healthcare dollars are allocated to tertiary care hospitals instead of to primary care facilities, where most of the poor receive treatment.[49] For example, tertiary hospitals in Ghana received 66% of the healthcare budget, over 50% in Madagascar and Kenya, and 89% in South Africa. Reallocation of some of these dollars would likely improve services in the primary care arena.[14,37,49] Inadequate care also contributes to the poor outcomes experienced by many in the healthcare system. In a study of diabetic care in Nigeria, the mean score for all items of care (eg, assessment of CVD risk, foot care, lab tests, monitor-

ing blood glucose, and referrals) was significantly lower than the American Diabetic Association minimum standards of care.[50]

FUTURE DIRECTION

Prevention programs for CVDs may be difficult to implement, especially in regions with low prevalence rates; however, it would be unfortunate for countries with already burdened healthcare budgets to ignore the opportunity to address this imminent problem. The experiences of established market economies can provide lessons regarding effectively decreasing CVD prevalence, with their successes primarily due to prevention efforts. Screening and intervention are effective population-wide prevention strategies. Epidemiological evidence supports the connection between CVDs and the established risk factors, including high blood pressure, cigarette smoking, high blood cholesterol, physical inactivity, poor nutrition, and diabetes. Cost effective efforts that lower CVD risks, such as regular physical activity, weight management, heart healthy diets, low dietary salt intake, and smoking cessation, should be encouraged.[12,23,36,51]

It is imperative that tobacco usage be significantly curtailed as part of a global program to contain CVDs, and other tobacco-related NCDs. The data linking tobacco to many health problems, including CVDs, are irrefutable. Tobacco greatly increases the societal burden of disease, disability, and death, thereby imposing an additional economic burden through lost wages and decreased productivity from disability and premature death. In addition, the increased health-related spending due to tobacco-related illnesses diverts limited public health resources from prevention and care of CVDs and other NCDs.[36]

Therefore, African countries must proactively address the scourge of tobacco abuse by enacting measures that will discourage tobacco use in society. Some policies and control measures[6,7,21,22,34,37] that have been successful in developed countries can be effectively implemented in Africa, including:

- Increasing the price of tobacco through taxation;
- Prohibiting tobacco advertising;
- Including clear, informative health warnings on every pack of tobacco-related products;
- Protecting nonsmokers from tobacco smoke by banning tobacco use in public places (as was recently done in South Africa, 1999)[51,52];
- Putting a stop to false advertising claims that some cigarettes are safer than others, or that cigarette smoking is "cool" and glamorous;
- Increasing corporate taxes on tobacco manufacturers and distributors, and using the money raised through such taxation to address public health problems related to tobacco; and
- Imposing stiff civil and criminal penalties for marketing tobacco products to minors and school children.

Secondary prevention should include using aspirin and beta blockers as low-cost, yet effective, methods of decreasing morbidity.[47] Primordial prevention strategies are the most promising. Strategists, however, cannot haphazardly apply intervention and prevention methods from developed countries, attempt to generalize research findings, or immediately discard methods because they do not seem cost-effective by the standards of industrialized nations. Programs must be contextualized to the communities they are designed to serve. Cultural norms, mores, and expectations, must be factored into the design of effective prevention programs, just as clinical effectiveness is considered. Promising recommendations for NCD community-based prevention programs include the following:[14,21,22,35]

- Understand the community and collaborate closely with community organizers;
- Improve governance and bureaucratic efficiency;
- Support programs that lead to economic and human development in Africa as a means of increasing the standard of living;
- Invest in well-planned media and communication messages, and provide wide dissemination of data for larger impact;
- Apply effective "dose" of preventive interventions;
- Emphasize changes in the social and physical environments that are necessary to support healthy lifestyle choices; and
- Support reliable monitoring and evaluation systems.

Community-based programs designed to utilize employees and school children as messengers for disseminating health messages can also be effective. School children can be especially effective in delivering messages regarding healthy living, because they are a captive audience, and are often eager to share what they have learned at school. It cannot be taken for granted that people understand the link between disease and risk factors. In a study of CVA patients interviewed 12–14 weeks post-discharge from Soweto Baragwanath Hospital, only 27.5% knew that smoking was a risk factor for CVA.[53]

Additionally, to maximize effectiveness, elements of community prevention programs should include community analysis covering demographic, epidemiological, and healthcare service information, disease detection and follow-up, investigations of disease prevalence, health education of medical professionals, patients, and the public, and research and development.[54] Accomplishing this will require that immediate attention be paid to the important issues outlined below, many of which have been previously identified by other scholars.

Table 1. Critical issues to address in preventing CVD in Africa in the 21st century

1. Each nation must develop and maintain a national CVD surveillance mechanism to continually examine trends in both levels of CVD mortality and morbidity, and in the use of preventive services by vulnerable populations.[19]
2. Nations must review their internal systems and clearly define and coordinate programs aimed at CVD control and prevention to ensure maximal benefit.
3. Encourage collaboration between all leadership and advocacy groups (religious, political, cultural, business, and medical).
4. It is important that we understand and manage modifiable and non-modifiable CVD risk factors (eg, dietary indiscretion, physical inactivity, tobacco use, lipids, blood pressure, obesity, diabetes, and genetics). An aggressive tobacco control effort must be initiated across the continent.[19]
5. The internal capacity for CVD health services, including primordial prevention, primary prevention, secondary prevention, treatment, and rehabilitation, needs to be assessed for each country.[20]
6. It will be necessary to identify areas in which new and better surveillance, morbidity and mortality, and other data are needed, including strategic research agendas for the 21st century.[20]
7. Each country should develop internal cost-effective and sustainable mechanisms for cooperation between the public and private sectors in combating this epidemic, including building capacity and infrastructure.[15,18,19]
8. Certain issues must be addressed, such as social, educational, environmental,[21] and other topics that lead to social unrest and upheaval across the continent, in order to engender a conducive environment for economic growth and human development.
9. Finally, we must develop a more effective strategic agenda for CVD prevention programs and health policies for the 21st century.

CONCLUSION

If left unaddressed, the pandemic of CVDs in Africa, will create a significant economic burden on society, and will adversely affect the quality and length of life across the continent. The task set for the leadership of many African nations is enormous, but not insurmountable, while the price of inaction is potentially devastating. This is the time for purposeful and visionary leadership. Community, religious, medical, business, and political leaders, all have roles to play in turning the tide of this epidemic. It can be accomplished, if the lessons learned from other countries are used to influence the future for Africa.

REFERENCES

1. Murray CJL, Lopez AD, eds. *The Global Burden of Disease: A Comprehensive Assessment of Mortality and Disability from Diseases, Injuries, and Risk Factors in 1990 and Projected to 2020.* Cambridge, Mass: Harvard University Press; 1996. *Global Burden of Disease and Injury Series*; vol 1.
2. Murray CJL, Lopez AD. Mortality by cause for eight regions of the world: Global Burden of Disease Study. *Lancet.* 1997;349:1269–1276.
3. Murray CJL, Lopez AD. Regional patterns of disability-free life expectancy and life-adjusted life expectancy: Global Burden of Disease Study. *Lancet.* 1997;349:1436–1442.
4. Murray CJL, Lopez AD. Alternative projections of mortality and disability by cause 1990–2020: Global Burden of Disease Study. *Lancet.* 1997;349:1498–1504.
5. Murray CJL, Lopez AD. Global mortality, disability, and the contribution of risk factors: Global Burden of Disease Study. *Lancet.* 1997;349:1347–1352.
6. Mathers CD, Sadana R, Salomon JA, Murray CJL, Lopez AD. Health life expectancy in 191 countries, 1999. *Lancet.* 2001;357:1685–1691.
7. Yusuf S, Reddy S, Ôunpuu S, Anand S. Global burden of cardiovascular diseases. Part I: General considerations, the epidemiologic transition, risk factors, and impact of urbanization. *Circulation.* 2001;104:2746–2753.
8. Reddy KS, Yusef S. Emerging epidemic of cardiovascular disease in developing countries. *Circulation.* 1998;97:596–601.
9. Alberti G. Noncommunicable diseases: tomorrow's pandemics. *Bull World Health Organ.* 2001;79(10):907.
10. Yusuf S, Reddy S, Ôunpuu S, Anand S. Global burden of cardiovascular diseases. Part II: Variations in cardiovascular disease by specific ethnic groups and geographic regions and prevention strategies. *Circulation.* 2001; 104:2855–2864.
11. Steyn K, Gaziano TA, Bradshaw D, Laubscher R, Fourie J. Hypertension in South African adults: results from the Demographic Health Survey, 1998. *J Hypertens.* 2001;19: 1717–1725.
12. Cooper RS, Rotimi C. Establishing the epidemiologic basis for prevention of cardiovascular disease in Africa. *Ethn Dis.* 1993;3:S13–S23.
13. Vorster HH. The emergence of cardiovascular disease during urbanization of Africans. *Public Health Nutr.* 2002;5(1A):239–243.
14. Sen K, Bonita R. Global health status: two steps forward, one step back. *Lancet.* 2000; 356:577–582.
15. Unwin N, Mugusi F, Aspray T, Whiting D, et al. Tackling the emerging pandemic of noncommunicable diseases in sub-Saharan Africa: the essential NCD health intervention project. *Public Health.* 1999;113:141–146.
16. Bulatao RA. Mortality by cause, 1970 to 2015. In: Gribble A, Preston S, eds. *The Epidemiological Transition.* Washington, DC: National Academy of Sciences Press; 1993: 42–68.
17. Omran AR. The epidemiologic transformation: a theory of the epidemiology of population change. *Milbank Memorial Fund Q.* 1971;49:509–538.
18. Unwin N, Setel P, Rashi S, et al. Noncommunicable diseases in sub-Saharan Africa: where do they feature in the health research agenda? *Bull World Health Organ.* 2001; 79(10):947–995.
19. Howson CP, Reddy KS, Ryan TJ, Bale JR, eds. Control of cardiovascular disease in developing countries: research, development, and institutional strengthening [online book]. Washington, DC: National Academy Press; 1998;16–22, 39–42. Available at: http://books.nap.edu/books/0309061377/html/R13.html. Accessed December 31, 2002.
20. Cooper R, Cutler J, Desvigne-Nickens P, et al. Trends in coronary heart disease, stroke, and other cardiovascular disease in the United States. Findings of the National Conference on Cardiovascular Disease Prevention. *Circulation.* 2000;102:3137–3147.
21. Nissinen A, Berrios X, Puska P. Community-based noncommunicable disease interventions: lessons learned from developed countries for developing ones. *Bull World Health Organ.* 2001;79(10):963–970.
22. Seedat YK. Hypertension in developing nations in sub-Saharan Africa. *J Hum Hypertens.* 2000;94:739–747.
23. Chapman S. Recent advances: tobacco control. *BMJ.* 1996;313:97–100.
24. World Health Organization. Attacking the attacker: WHO steps up its fight against rheumatic fever. *WHO Press Releases.* December 3, 1999;73.
25. Hutt MSR. Cancer and cardiovascular diseases. In: RG Feachem, Jamison DT, eds. *Disease and Mortality in Sub-Saharan Africa.* New York, NY: Oxford University Press for the World Bank; 1991:221–240.
26. MacLean DR, Chockalingham A. Canadian Cardiovascular Society 1998 Consensus Conference on the Prevention of Cardiovascular Disease: the role of the cardiovascular specialist. Available at: http://www.ccs.ca/society/conferences/archives/1998/1998coneng-06.cfm. Accessed December 31, 2002.
27. Cooper RS, Rotimi CN, Kaufman JS, Muna

WFT, Mensah GA. Hypertension treatment and control in sub-Saharan Africa: the epidemiological basis for policy. *BMJ.* 1998;316: 614–617.
28. Edwards R, Unwin B, Mugasi F, Whiting D, et al. Hypertension prevalence and care in an urban and rural area of Tanzania. *J Hypertens.* 2000;18:145–152.
29. World Health Organization. Noncommunicable diseases. WHO experts warn against inadequate prevention, particularly in developing countries. Fact Sheet N 106. March 1996. Available at: http://www.who.int/inf-fs/en/fact106.html. Accessed January 5, 2003.
30. Muna WFT. The importance of cardiovascular research in Africa today. *Ethn Dis.* 1993; 3:S8–S12.
31. Cruickshank JK, Mbanya JC, Wilks R, Balkau B, et al. Hypertension in four African-origin populations: current 'Rule of Halves,' quality of blood pressure control and attributable risk of cardiovascular disease. *J Hypertens.* 2001;19:41–46.
32. Nwosu CM, Nwabueze AC, Ikeh VO. Stroke at the prime of life: a study of Nigerian Africans between the ages of 16 and 45 years. *E Afr Med J.* 1992;69:384–390.
33. Kahn K, Tollman SM. Stroke in rural South Africa: contributing to the little known about a big problem. *S Afr Med J.* 1999;89:63–65.
34. Global Analysis Project Team. Political economy of tobacco control in low-income and middle-income countries: lessons from Thailand and Zimbabwe. *Bull World Health Organ.* 2000;78(7):913–919.
35. Tsai T, ed. Africa's contradiction: Nigeria on the path to democracy. *Harv Int Rev.* 2002; 24(3):32–35.
36. World Health Organization. Tobacco Free Initiative. Available at: http://www.afro.who.int/tfi/index.html. Accessed January 3, 2003.
37. Ebrahim S, Smith GD. Exporting failure? Coronary heart disease and stroke in developing countries. *Int J Epidemiol.* 2001;30: 201–205.
38. Ogwell AEO. Tobacco under the microscope. The Tobacco Control Resource Center 2002 [Doctors Manifesto website]. Available at: http://www.doctorsmanifesto.org/manifesto/tax.php. Accessed January 5, 2003.
39. Masironi R, Rothwell K. Trends in and effects of smoking in the world. *World Health Stat Q.* 1988;41(3–4):228–241.
40. King H, Aubert RE, Herman WH. Global burden of diabetes, 1995–2025. Prevalence, numerical estimates, and projections. *Diabetes Care.* 1998;21:1414–1431.
41. Adams-Campbell LL, Agurs TD, Ukoli FA. Dietary assessment in Nigerian women: a pilot study. *Ethn Dis.* 1993;3:S62–S66.
42. Motala AA. Diabetes trends in Africa. *Diabetes Metab Res Rev.* 2002;18:S14–S20.
43. Proctor M, Moore LL, Singer MR, et al. Risk profiles for noncommunicable diseases in rural and urban schoolchildren in the republic of Cameroon. *Ethn Dis.* 1996;6:235–243.
44. Tollman SM, Zwi AB. Health system reform and the role of field sites based upon demographic and health surveillance. *Bull World Health Organ.* 2000;78(1):125–134.
45. Isaakidis P, Swingler GH, Piernaar E, Volmink J, Ioannidis JPA. Relation between burden of disease and randomized evidence in sub-Saharan Africa: survey of research. *BMJ.* 2002;324:1–5.
46. Abiodun A, Abuja AO. Obasanjo presents N765b budget for 2003. *The Guardian.* Available at: http://nigeriaworld.com/news/source/2002/nov/headlines/21/26-news.html. Accessed January 4, 2003.
47. Howson CP, Reddy KS, Ryan TJ, Bale JR, eds. Control of cardiovascular disease in developing countries: research, development, and institutional strengthening [online book]. Washington, DC: National Academy Press; 1998:37–38. Available at: http://books.nap.edu/books/0309061377/html/R13.html. Accessed December 31, 2002.
48. Peters DH, Elmendorf AE, Kandola K, Chellaraj G. Benchmarks for health expenditures, services, and outcomes in Africa during the 1990s. *Bull World Health Organ.* 2000;78(6): 761–769.
49. Castro-Leal F, Dayton J, Demery L, Mehra K. Public spending on health care in Africa: do the poor benefit? *Bull World Health Organ.* 2001;78(1):66–74.
50. Okoro EO, Adejumo AO, Oyejolo BA. Diabetic care in Nigeria: report of a self-audit. *J Diabetes Complications.* 2002;16:159–164.
51. Lenfant C. Can we prevent cardiovascular diseases in low- and middle-income countries? *Bull World Health Organ.* 2001;79:980–987.
52. Steyn K, Bradshaw D, Norman R, Laubscher R, Saloojee Y. Tobacco use in South Africans during 1998: the first demographic and health survey. *J Cardiovasc Risk.* 2002;9(3): 161–170.
53. Hale LA, Fritz VU, Eales CJ. Do stroke patients realize that a consequence of hypertension is stroke? *S Afr Med J.* 1998;88:451–454.
54. Pobee JOM. Community-based high blood pressure programs in sub-Saharan Africa. *Ethn Dis.* 1993;3:S38–S45.