Recent advances in hypertension in sub-Saharan Africa

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ABSTRACT
Background Hypertension was once considered rare in sub-Saharan Africa (SSA), but currently it has become a widespread problem with immense socioeconomic importance. The purpose of this review is to summarise new information on hypertension in SSA that has been published since the last major review in 2008.

Methods and results A literature search was performed in PubMed, Embase, WHO Global Cardiovascular Infobase, African Journal On-Line, and African Index Medicus using the following search criteria: hypertension, high blood pressure, and Africa/SSA. Epidemiological surveys that used the WHO STEPS approach or similar methods were also included. The overall prevalence of hypertension in SSA was estimated at 16.2% (95% CI 14.2% to 20.3%) with an estimated number of hypertensive individuals to be 74.7 million. The prevalence of hypertension varies widely from country to country. It is projected that the number of affected individuals will increase by 68% (125.5 million) by 2025. Mass migration of rural Africans to urban areas affected individuals will increase by 68% (125.5 million) by 2025.

Conclusions Proactive public health interventions at a population level need to be introduced to control the growing hypertension epidemic, and there needs to be a major improvement in access to hypertensive care for the individual. There is an important need for better epidemiological data and hypertension related outcome trials in SSA.

INTRODUCTION
High blood pressure (BP) is the most common single risk factor for cardiovascular related events and deaths worldwide.1 In the analysis of the global burden of hypertension, Kearney et al2 estimated that the total number of people affected by the condition will increase between 2000 and 2025, resulting in an additional 560 million people being affected by high BP.

Although Kearney et al2 predicted that the prevalence of hypertension may not rise in sub-Saharan Africa (SSA) compared to other regions of the world, emerging data and recent projections do not support this view. In a recent systematic review it was observed that in the last 10 years systolic BP has risen highest in east, west, and central and southern Africa more than in any other region of the world.3

Hypertension is the most common risk factor for development of stroke, congestive heart failure (HF), chronic kidney disease, and coronary artery disease in SSA.4 Unfortunately, the prevention and control of non-communicable diseases such as hypertension are rarely on the agenda of countries in the region. Thus, the condition is largely under-detected and under-treated due to ignorance and poverty. Complications are often common and severe leading to chronic disability and premature mortality.5

The aim of this review is to update information on the epidemiology, pathophysiology, treatment, complications, control, and outcome of hypertension in the SSA region since the last major review in 2008.6

METHODS
A literature search was performed using the following search criteria: hypertension, high BP AND Africa/SSA. The following databases were searched: PubMed, Embase, WHO Global Cardiovascular Infobase, African Journal On-Line, and African Index Medicus.

The search criteria were limited to literature published between 1 January 2005 and 31 December 2012. Additional references were obtained through the review of references of articles obtained in the initial search.

Epidemiological surveys that used the WHO STEPS approach7 or similar methods were included in the analysis.

RESULTS
What is new on the epidemiology of hypertension in Africa?

New surveys and meta-analyses that have been published over the past 5 years and what they add to knowledge

Online supplementary file 1 depicts recent surveys of hypertension conducted in different regions/countries in SSA from January 2008 to December 2012.14–18 It is important to state that in most of the studies, the crude prevalences were presented.

We identified 38 publications from SSA mostly conducted in urban areas: two national surveys (Malawi and Mozambique), 14 in rural settings, 16 in urban communities, one each in semi-urban and semi-urban/rural settings, and four in both rural and urban communities (figure 1).

In the two national studies, the prevalence of high BP was about 31% (35.7% and 37% in men and 37% and 29% in women in Mozambique and Malawi, respectively). In studies carried out in rural areas, the prevalence ranged from 16% in rural Rwanda to as high as 46.4% in a rural community in Eastern Nigeria. The Nigerian study was conducted in a middle aged/elderly population (mean age of 61.2 years), which could explain the high prevalence. The values for urban studies ranged from 15.2% in the Democratic Republic of Congo to as high as 47.5% in Cameroon.
Data from studies carried out simultaneously in rural and urban communities show that the prevalence of high BP was generally greater in urban compared to rural settings.

The prevalence of hypertension is generally higher in men than women in most of the studies (see online supplementary file 1).

Recently Twagirumukiza et al published the estimates of the current and projected prevalence of hypertension in SSA from population based studies in the region. The authors pooled 15 studies conducted in 11 SSA countries from 1998 to 2008. This included three studies with urban and rural data, four studies with rural data alone, and eight studies with data only from urban areas. The studies were from Ethiopia, Gambia, Ghana, Ivory Coast, Mauritania, Nigeria, Democratic Republic of the Congo, and South Africa.

The overall prevalence of hypertension in SSA for 2008 was estimated at 16.2% (95% CI 14.2% to 20.3%). The estimated number of hypertensive individuals in the region was put at 74.7 million (95% CI 65.2 to 93.4 million). Furthermore, the overall prevalence of hypertension in SSA when adjusted to the WHO standard population was 23.3%.

The prevalence of hypertension varies from country to country and from one part of SSA to the other. The lowest national estimated prevalence was 10.3% in Ethiopia and the highest was 23.0% in Ghana.

The low prevalence of hypertension in Ethiopia may due to the diet, which is low in sodium but high in potassium. Country variation in the prevalence of hypertension may also be related to differences in the levels of urbanisation and acculturation, diets, cultural habits, and ethnicity. For example, the prevalence of hypertension in SSA is higher in urban than rural populations (22.4% vs 18.2% respectively), but showed pronounced regional differences. In Madagascar the odds ratio (OR) for urban versus rural populations was 1.40 (95% CI 1.04 to 2.17) while in Cameroon it was 2.66 (95% CI 1.90 to 3.74).

The prevalence of hypertension was higher in men than in women (16.8% vs 15.7%, respectively), which was more pronounced in urban areas.

The reasons for these differences are probably related to changes in risk with the adoption of a Western lifestyle, reduced physical activity, and increased salt consumption with reduced potassium intake in urban communities, but also increased sympathetic activity.

Projected prevalence of hypertension in SSA for 2025

Twagirumukiza et al used the United Nations Population Fund (UNFPA) data to predict the prevalence of hypertension in the region by 2025. The calculated number of hypertensive individuals living in SSA by 2025 was estimated at 125.5 million (95% CI 111.2 to 162.8 million), which corresponds to an increase of about 68% from 2008 to 2025. The prevalence of hypertension in SSA will rise from 16.2% to 17.4% (CI 15.4% to 22.6%).

Compared with the previous work by Kearney et al (which related to the year 2000), the latest report showed a lower age adjusted prevalence rate (27.6% vs 23.3%) and fewer affected individuals (79.8 vs 75 million), and a lower projected prevalence (150.7 vs 125.5 million).

![Map of sub-Saharan Africa (SSA) showing the crude prevalence of hypertension in 38 recent studies in different parts of SSA.](image-url)
The view of some authorities is that the earlier estimates by Kearney et al. and the latest by Twagirumukiza et al. are conservative since they did not allow for any age/gender stratified increases in the prevalence of high BP due to increased exposure to risk factors such as overweight/obesity, increased salt intake, reduced physical activity, reduced intake of fruits and vegetable, and increased alcohol and fat consumption—all of which are associated with development or urbanisation.

Accordingly the current WHO estimates are higher and range from 47.8% in Niger to 31.7% in Eritrea (table 1).

Recent data on hypertension awareness, treatment and control in SSA

Some recent data are available on the rate of awareness, treatment and control of hypertension in SSA. Table 2 shows the results of five publications. Like in most parts of the world, awareness, treatment and control of hypertension is still low in SSA. Hypertension awareness ranges from 10.6% among men in Mozambique to 40.3% in Nigerian men. Treatment rates range from as low as 3.5% in Mozambican men to about 60% in a recent study in Cameroon. BP control is also very low in the region, ranging from 1.0% in Mozambican men to 24.6% in an urban setting in the Cameroon.

What the THESUS-HF study has revealed about the contribution of hypertension to HF

The SSA Survey of Heart Failure (THESUS-HF) was a prospective, multicentre, observational survey of patients with acute HF admitted to 12 hospitals in nine countries in the sub-region. Data from the study show that hypertension is the strongest as well as an emerging risk factor for HF in Africa, being responsible for 45.4% of cases. This implies that the optimal strategy for the prevention of HF in SSA lies in the treatment and control of high BP. This is critically important as hypertension rates will rise in Africa by 89% between 2000 and 2025 compared to a 24% increase in more developed countries.

What INTERSTROKE has revealed about the contribution of hypertension to stroke

INTERSTROKE is an international, multicentre, case–control study designed to establish the relationship of traditional and emerging risk factors to stroke in 84 centres in 22 countries of the world. It is the first large standardised case–control study of the risk factors for stroke in which countries of middle and low income were included.

The initial report from this study shows that stroke occurs at a relatively younger age in Africa compared to other regions of the world (mean age 57.7±15.3 years for Africa, 58.5±11.6 years for South East Asia, 58.9±12.0 years for India, 65.6±13.4 years for South America, and 66.0±13.3 years for high income countries). The mean age for all the subjects in the initial report was 61.1±12.7 years.

On the whole a seventh of the subjects were aged 45 years or younger, with the highest proportion in Africa. The study also revealed that hypertension was more associated with stroke in individuals younger than 45 years, meaning therefore that hypertension is the strongest risk factor for stroke in SSA.

This has implications in population based approaches in controlling stroke prevalence in resource poor countries in SSA, because screening programmes require cheap/modest equipment and little expertise. Furthermore, BP can be controlled by cheap drug and non-drug approaches.

Table 1 Recent estimated prevalence of raised blood pressure in Africa according to countries by the WHO

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What the recent Global Burden of Disease study reveals about the burden of hypertension in Africa

In the 2012 comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk clusters in 21 regions of the world, high BP was reported as the leading risk factor for global disease burden (7.0%, 95% uncertainty interval 6.2% to 7.7% of global disability-adjusted life years (DALYS)).

A recent systematic analysis of data from 199 countries with 786 country-years and 5.4 million participants indicates that the mean systolic BP as well as the burden of hypertension has fallen between 1980 and 2008 in both men and women globally.

However, regional analysis of the same data indicates that in the last 10 years the mean systolic BP has risen in men and women from west, central and east Africa, and the highest mean rise in systolic BP was recorded in several SSA countries.

What is new on the pathogenesis of hypertension in Africa?

The Biafra study and developmental origins of hypertension in Africans

The impact of the Nigeria–Biafra civil war on the burden of cardiovascular disease (CVD) risk factors was recently studied by Hult et al. It was noted that children born during this period of starvation and famine were found to be more likely to have metabolic syndrome compared to those born before or after this period. Thus the civil strife and starvation/famine occurring in many places in Africa poses a great danger for the region in the coming years.

New insights on the genetics of hypertension in SSA

Epithelial sodium channel

Suppression of plasma renin activity is one of the major features of hypertension in black individuals and may be a surrogate of salt sensitivity. The epithelial sodium channel (ENaC), which is the final regulator of sodium balance in the kidney, is an attractive gene in the genetics of hypertension. There is an association of the T594M variant of the ENaC with low renin, low aldosterone hypertension, and hypertension within families, as well as early pre-eclampsia in black and coloured hypertensive populations of South Africa; 5.9% and 1.7% of hypertensive black and coloured South Africans, respectively, have this mutation (p<0.0005 for association with hypertension). It is often associated with resistant hypertension which responds dramatically to amiloride, a specific inhibitor of ENaC. It is also present in 20% of unselected Khoi-San (the original inhabitants of southern Africa), who are the presumed origin of the mutation as it is not present in other African diaspora. It is not associated with hypertension in the Khoi-San due to lower salt intake and may have had a survival advantage in the extremes of salt and water present in the arid regions of southern Africa.

Bochud et al showed that black South Africans had enhanced sodium absorption in the proximal convoluted tubules compared to whites. Single nucleotide polymorphisms (SNPs) of the G-protein receptor kinase-4 are linked to low renin hypertension and impaired sodium excretion on the proximal tubule.

Rayner et al demonstrated that these SNPs have a significantly higher prevalence in the black population of South Africa and are linked to natriuresis and BP response to salt restriction.

Is there any new information on the impact of HIV infection on BP in Africans?

At least two studies have looked at the impact of HIV status on the prevalence of hypertension in SSA at the community level.

In 2003–2004, Barnighausen and his co-workers studied the effect of HIV on body mass and BP in a large general population in a rural area in South Africa before antiretroviral treatment (ART) became widely available.

In a multiple regression analysis, after controlling for confounders such as age, gender, educational attainment, household wealth, marital status, and place of residence (urban or rural), HIV infection reduced systolic BP (SBP) by 3.0 mm Hg (p=0.005). The authors proposed that the possible reason for this finding may be due to HIV related hypoadrenalinism or side effects of traditional medicines against HIV/AIDS.

In another related survey in 2010, Malaza et al conducted a health survey based on the WHO STEPwise approach in 14 198 rural adult participants in South Africa to determine factors associated with hypertension and excess weight, including HIV infection and ART status. They reported that the prevalence of hypertension differed between HIV infected and HIV uninfected individuals (19.5% vs 27.9%, p=0.001). HIV uninfected women were significantly more likely to be hypertensive than HIV infected women (31.4% vs 20.1%, p=0.001), while there was no association of hypertension with HIV status among men (p=0.099).

Table 2  Recent studies on awareness treatment and control of hypertension in sub-Saharan Africa

<table>
<thead>
<tr>
<th>Serial number</th>
<th>Author</th>
<th>Year</th>
<th>Country</th>
<th>Awareness (%)</th>
<th>Treatment (%)</th>
<th>Control (%)</th>
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<td>Ghana (urban)</td>
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<td>2</td>
<td>Damasceno</td>
<td>2009</td>
<td>Mozambique (national)</td>
<td>10.6 (men)</td>
<td>3.5 (men)</td>
<td>1.0 (men)</td>
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<td>4</td>
<td>Ekwunife</td>
<td>2010</td>
<td>Nigeria (semi-urban)</td>
<td>30 (all)</td>
<td>21 (all)</td>
<td>9 (all)</td>
</tr>
<tr>
<td>5</td>
<td>Dzudie</td>
<td>2012</td>
<td>Cameroon (urban)</td>
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Furthermore, it was observed that in a univariate analysis, all explanatory variables (sex, age, HIV/ART status, wealth, place of residence area, educational attainment, and body mass index (BMI)) were significantly associated with hypertension.

However, in a multivariable analysis, sex, age, HIV and ART status, BMI, place of residence, and educational attainment remained significantly associated with hypertension, but not sex and wealth. “The adjusted odds ratio of hypertension increased by 5.3% (95% CI 5.0% to 5.7%) per age year. HIV infected persons on ART treatment had a reduced adjusted odds ratio of hypertension (aOR 0.60, 95% CI 0.49 to 0.75), compared to HIV negative persons. The adjusted odds ratio in HIV infected persons not on ART did not differ from HIV negative persons (p=0.158).”

With the advent of highly active ART, long term survival of HIV infected persons has been noted to be associated with cardiovascular and metabolic complications. HIV vasculopathy (occlusive and aneurysmal involvement of visceral, cerebral, and peripheral vessels) is well documented. Nel and Rayner recently reported “the unusual involvement of the renal artery by HIV vasculopathy resulting in severe hypertension with target organ damage requiring multiple antihypertensive drugs” in a young woman in South Africa.

Other new studies on the pathogenesis of hypertension

**Recent evidence for the effects of salt intake on BP in SSA**

There are emerging data which show that the lack of relationship between urinary indices of salt consumption and BP in Africans enrolled in the INTERSALT study may be because of the inability of these measures to fully reflect salt consumption.

The African programme on Genes in Hypertension (APOGH) study recently reported that in a black community in South Africa urinary index of salt intake was strongly and independently related to central (aortic) SBP and pulse pressure but not to diastolic BP (DBP) or brachial artery BP.

The authors concluded that the effect of salt intake on BP may have been previously underestimated in the region. They suggested that “salt intake will increase aortic SBP 1.45 times more than it will brachial BP. Hence if we assume that a reduction in Na+ intake of 100 mmol/day (3.7 g Na+ per day which equates to 9.2 g or about four teaspoons of table salt per day) reduces brachial SBP by –8.1 mm Hg in groups of African descent as suggested by the DASH study, then presumably aortic SBP may decrease by as much as –11.8 mm Hg in response to a decrease in Na+ intake”.

Their finding is consistent with the increasing evidence that central BP predicts cardiovascular events beyond brachial artery BP.

**Effect of increased adiposity on BP**

The APOGH study has also reported on the size effect of excess body fat on conventional BP and ABP. After adjusting for potential confounders, they showed that every 15 cm increase in waist circumference was associated with a 4.04 mm Hg increase in 24 h SBP and a 4.33 mm Hg increase in 24 h DBP. Every 15 cm increase in waist circumference was also associated with a 3.35 mm Hg increase in conventional SBP and a 3.27 mm Hg increase in DBP.

The implication of this finding according to the authors is that “even with a significant study sample for an ABP study, at least the independent impact of adiposity on BP in groups of African descent is remarkably small”.

The group has also previously demonstrated that the impact of excessive body fat on BP may be genetically predetermined.

The additive effect of obesity on cardiovascular injury has been explored in Africans. The deleterious effect of obesity has been shown to work in synergy with elevated BP. The APOGH study has reported that pronounced synergy between indices of obesity and BP (conventional, aortic and 24 h SBP or pulse pressure) is independently associated with left ventricular (LV) mass and LV wall thickness. This finding was also tested in an animal model of hypertension.

**What is new on the outcome of hypertension in Africa?**

**What can be learnt from the national mortality studies in South Africa?**

In a recent review on health in South Africa, Mayosi et al. reported on the quadruple burden of disease in the country and also showed the interaction of infectious diseases with chronic non-communicable diseases (NCDs), especially in rural and poor urban communities. According to the report, statistics on cause of death indicate that there has not been a change in the overall mortality from NCDs.

Hypertensive heart disease and other chronic conditions such as diabetes mellitus and renal diseases increased in all age groups. Interestingly, stroke did not increase after a peak in 2003 in people aged 65 years and above, but decreased in the younger age group.

**What is new on hypertensive target organ damage in SSA?**

Recent studies (table 3) on hypertensive target organ damage (TOD) show that hypertensive heart disease, hypertensive nephropathy, hypertensive retinopathy, stroke, and ischaemic heart disease are common, even at the first contact in healthcare facilities in SSA.

Studies using conventional and newer modalities for assessing LV diastolic dysfunction (tissue Doppler imaging (TDI)) have shown that abnormalities of LV and right ventricular (RV) diastolic function are common in African hypertensive subjects.

Ogah et al. studied 832 consecutive and unselected hypertensives in Abeokuta, Nigeria. They found LV systolic dysfunction (LVSD) to be present in 18.1% (mild LVSD in 9.6%, moderate LVSD in 3.7%, and severe LVSD in 4.8%). Male gender, BMI, and LV mass were reported as the predictors of LVSD.

Karaye et al. detected RV diastolic dysfunction (RVDV) and RV systolic dysfunction (RVSD) in, respectively, 61.7% and 32% of 128 hypertensives in Kano, Nigeria. Subjects with eccentric LV hypertrophy (LVH) had the highest RVSD. LV ejection fraction (LVEF) was the only determinant of RVSD while age was the only determinant of RVDD after controlling for confounders. Akintunde et al. documented RV morphological and functional abnormalities in a similar study and concluded that RVDD may be an early clue to hypertensive heart disease in Africans.

Akintunde et al. demonstrated that the combined index of global myocardial performance (Tei index) is significantly higher in hypertensive individuals with HF compared to normal controls. The Tei index also increased with the severity of hypertensive HF and is inversely related to LVEF, but is directly related to the E/A ratio and deceleration time.

Some workers have studied the prevalence and patterns of LVH and LV geometry in the SSA population. In a large population of hypertensive individuals, Adebiyi et al. reported the prevalence of LVH in hypertensives to range from 30.9–56.0%, depending on the partition values used in the definition.
Abnormal geometry was present in 61.1–74.0% and this was more common in women.

Ogah et al.\(^5^0\) showed that LV wall tensions, LV wall stress, left atrial size, DBP, alcohol consumption, and family history of hypertension were independent predictors of LVM.

### What is new on the management of hypertension in Africa?

**Insight from the NOAAH trial**
The Newer versus Older Antihypertensive Agents in African Hypertensive patients (NOAAH) trial\(^5^1\) was initiated to compare, in native African patients, a fixed combination of newer antihypertensive drugs not involving diuretics with a combination of older drugs including a diuretic in subjects aged 30–69 years with uncomplicated hypertension. The study has been conducted in six centres in four SSA countries since 1 September 2010 and is probably the first randomised multicentre trial of antihypertensive medications in hypertensive patients born and living in SSA.

An early report from this trial\(^5^2\) shows that BP control can be achieved rapidly in native Africans by using a simple regimen comprising a single pill combining two antihypertensive drugs. The study has also demonstrated that randomised clinical trials of cardiovascular drugs can be conducted among the indigenous populations of SSA by African investigators.

### Trials of salt reduction and their implications in SSA

In South Africa up to 46% of the salt that is consumed is added during preparation of food or at the table. Thus, much of the salt consumed is found in processed foods produced by industry.\(^5^3\) In a landmark collaboration between the Medical Research Council of South Africa and three food industry partners, the cation content of five commonly consumed foods—brown bread, brick margarine, soup mix, stock cubes, and a flavour enhancer—was altered by lowering the sodium content and increasing the potassium, magnesium, and calcium content. Black subjects with mild to moderate hypertension were randomised in a double blind controlled clinical trial to either a standard diet or to an identical but cation altered diet. Over an 8 week period there was a highly significant reduction in 24 h ambulatory SBP (\(-6.2\) mm Hg) in subjects on the altered diet. The trial diet was also found to be palatable. If this BP response was sustained, it would result in a 20% reduction in the number of deaths per year in South Africa. These findings suggest that appropriate policy interventions that will encourage or regulate the food industry to produce foods such as bread with reduced sodium content could have a major impact on the control of high BP in South Africa (and the rest of Africa). This is in line with the United Nations High Level resolution on non-communicable disease that was adopted by all countries in September 2012.

The UK was the first country to set voluntary sodium reduction targets for categories of foods through its Food Standards Agency, closely followed by Australia, the USA, and Canada. South Africa is the first country to adopt mandatory regulation for maximum sodium concentrations in food categories that are major contributors to salt intake in its population, namely bread, margarine and spreads, savoury snacks, processed meats, soup powders, and stock cubes.\(^5^3\) It is estimated that reducing the sodium content of bread by 50%, along with other proposed reductions in margarine, soups and gravies, would decrease salt intake by 0.85 g per day; this would result in 7000 fewer deaths due to CVD and 4000 fewer non-fatal strokes in the country per year, saving about US$40 million each year in healthcare costs associated with non-fatal strokes alone.\(^5^5\) It is important that other governments in SSA adopt similar legislation or standards for processed foods as recommended by the UN resolution.

The South African 2011 guideline and the International Forum for Hypertension control and prevention in Africa guideline for the management of hypertension and their relevance to the continent

The recent publication of the South African hypertension guideline 2011\(^5^6\) forms an important basis for the development of a new Pan-African hypertension guideline for SSA. The South African guideline reflects important changes in perspectives and advances in the management of hypertension compared to the International Forum for Hypertension control and prevention in Africa (IFHA) guideline published by Lemogoum et al.\(^5^7\) There are several key recommendations that may improve BP control in SSA if adopted by a Pan-African guideline. In the IFHA guideline, initial therapy outside the compelling indications was hydrochlorothiazide 12.5 mg daily. Recent evidence suggests that hydrochlorothiazide at this dose has a weak antihypertensive effect. In contrast the South African guideline recommends either a thiazide diuretic, ACE inhibitor (or angiotensin receptor blocker) or calcium channel blocker (CCB) as first line therapy; more importantly, if BP is >20/10 mm Hg above goal the guideline recommends starting with a fixed drug combination of two of the first line therapies. Diuretics and CCBs are also preferred in black patients. Another key difference is that the IFHA guideline recommends increasing the dose of the initial agent (eg, hydrochlorothiazide) if target BP is not achieved. It is well established that escalating monotherapy results in a small increment in BP lowering, but with more side effects, while the adoption of combination therapy even in low doses is five times more effective in lowering BP. In the ASTRAL study involving patients with essential hypertension from 36 centres in five SSA countries, treatment with a fixed drug

Table 3: Recent studies on hypertensive target organ damage in sub-Saharan Africa (SSA)

<table>
<thead>
<tr>
<th>Serial number</th>
<th>First author</th>
<th>Country</th>
<th>Year</th>
<th>Sample size</th>
<th>LVH</th>
<th>CCF</th>
<th>Microalbuminuria</th>
<th>Overt proteinuria/ CKD</th>
<th>Retinopathy</th>
<th>Stroke</th>
<th>IHD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Peer(^3^8)</td>
<td>South Africa</td>
<td>2008</td>
<td>403</td>
<td>35</td>
<td>–</td>
<td>–</td>
<td>26</td>
<td>–</td>
<td>–</td>
<td>49</td>
</tr>
<tr>
<td>2.</td>
<td>Ekore(^4^9)</td>
<td>Nigeria</td>
<td>2009</td>
<td>124</td>
<td>17.7</td>
<td>2.4</td>
<td>–</td>
<td>26.1</td>
<td>4.0</td>
<td>0.8</td>
<td>–</td>
</tr>
<tr>
<td>3.</td>
<td>Addo(^4^6)</td>
<td>Ghana</td>
<td>2009</td>
<td>219</td>
<td>33.3</td>
<td>–</td>
<td>–</td>
<td>13.4</td>
<td>Grade 1=56.5</td>
<td>Grade 2=12.9</td>
<td>Grade 3=1.0</td>
</tr>
<tr>
<td>4.</td>
<td>Stewart(^4^1)</td>
<td>South Africa</td>
<td>2009</td>
<td>761</td>
<td>39</td>
<td>54</td>
<td>–</td>
<td>24</td>
<td>–</td>
<td>–</td>
<td>16.2</td>
</tr>
<tr>
<td>5.</td>
<td>Oladapo(^4^2)</td>
<td>Nigeria</td>
<td>2010</td>
<td>415</td>
<td>27.9</td>
<td>4.6</td>
<td>12.3</td>
<td>15.2</td>
<td>2.2</td>
<td>6.3</td>
<td>1.7</td>
</tr>
</tbody>
</table>

CCF, congestive heart failure; CKD, chronic kidney disease; IHD, ischaemic heart disease; LVH, left ventricular hypertrophy.
combination of ramipril and hydrochlorothiazide resulted in a highly significant reduction in both SBP and DBP from baseline at 4 and 8 weeks (−24.7/−14.2 mm Hg, p<0.001 and −31.7/−17.9 mm Hg, p<0.001), respectively.58 The South African guideline also recommends spironolactone for the management of resistant hypertension, a strategy that has been shown to be effective in large studies such as the Anglo-Scandinavian Cardiac Outcomes Trial,59 but which lacks any definitive data from SSA.

What is the implications of the new information for prevention, treatment and research?

The National High Blood Pressure Programme adopted in the USA is a remarkable success story. Despite concerted efforts to persuade the population to adopt more healthy lifestyles, there has been a substantial increase in diabetes and obesity. However, there has been a dramatic decline in heart and stroke disease in both black and white patients through better BP control by more effective use of antihypertensive drugs, focusing on both patient and physician education.60 This is particularly evident in the south east region of the USA where there was the highest mortality for stroke. This means the campaigns to improve lifestyle changes in the USA have not had a major impact on the prevention and treatment of hypertension, and holds lessons for policies in Africa.

The initial results of the NOAAH study point to a similar outcome.52 Effective treatment with cheap generic fixed drug combinations leads to better and timely BP control. Guidelines need to reflect this reality, and policymakers need to focus their resources on improving access to primary care clinics, developing simple protocols for the pharmacological management of hypertension, and making available fixed drug combinations that are effective in black populations. Physicians and patients need to be educated, and where resources are limited nurse practitioners can be trained to implement these policies. In South Africa, for example, nurses were successfully trained to implement the 2006 guideline. However, there are considerable hurdles to overcoming these problems. Hypertension remains low on the agenda of most SAA countries. Furthermore in South Africa there are no fixed drug combinations for the treatment of hypertension on the essential drug list, despite the widespread availability of affordable generics. There are no indications that there will be a change of strategy despite the success of combination antiretroviral drugs in controlling HIV.

Another strategy to improve patient adherence is the use of cell (mobile) phone technology through the use of short message service alerts for patients to take their medication, attend clinics, and collect their medication. Most people in Africa carry cell phones and are the primary mode of communication. This strategy is currently under investigation in clinics in Cape Town.

The study by Charlton et al53 is an important exception in the battle to implement healthy lifestyles in the population. Their study showed that changes in the cation content of commonly used foodstuffs results in significant reductions in BP in black patients with mild to moderate hypertension, thus providing a basis for the prevention and treatment of hypertension at a population level. Most intake of dietary sodium is involuntary in the form of processed foods and can be modified by regulating the content in commonly used foodstuffs. The lead has been set by the South African government and may form a blueprint for the rest of SSA. The cost is minimal and the strategy is more feasible than trying to change attitudes to the types of food eaten to reduce obesity and blood lipids, which is far more difficult and controversial.

Another important implication of the new information is the possibility of developing a more physiological approach to the treatment of hypertension, especially in those with BP that is more difficult to control. It is well established that patients of African descent have low renin hypertension, and this may be related to SNPs of genes regulating sodium balance in the kidney like the ENaC. This provides a pharmacogenetic approach to treatment in a higher resource area such as Cape Town. However, the SNPs may be diverse and involve many of the pathways regulating sodium balance, so that identifying these genes is not feasible in the wider context of Africa. Thus, the screening of patients with difficult to control hypertension using aldosterone and plasma renin activity (especially if this is the point of care) may provide a physiological approach to treatment. For example, those with low renin and low aldosterone (the Liddle’s phenotype, suggesting an ENaC mutation) are treated with amiloride and those with low renin and higher aldosterone receive spironolactone. This approach will be tested in four centres in Africa in a prospective study.

CONCLUSION

This overview of hypertension in SSA suggests that hypertension is a dominant risk factor for CVD, and the prevalence is anticipated to rise dramatically. Unless decisive action is taken by governments and policymakers the negative health effects of uncontrolled hypertension will be severe. It is recommended that governments adopt the UN resolution on NCDs and in particular start regulating the sodium content of processed foods. In addition, resources need to be made available for effective pharmacological treatment of hypertension with cheap generic fixed combination drugs. An updated but simplified Pan-African guideline is also recommended.

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Recent advances in hypertension in sub-Saharan Africa

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