Prevalence and risk factors for hypertension and association with ethnicity in Nigeria: results from a national survey

GUDLAVALLETI VS MURTHY, SAMANTHA FOX, SELVARAJ SIVASUBRAMANIAM, CLARE E GILBERT, ABDULL M MAHDI, ABDULLAHI U IMAM, GABRIEL ENTEKUME, on behalf of the Nigeria National Blindness and Visual Impairment study group

Abstract

Background: Non-communicable diseases are now a global priority. We report on the prevalence of hypertension and its risk factors, including ethnicity, in a nationally representative sample of Nigerian adults recruited to a survey of visual impairment.

Methods: A multi-stage, stratified, cluster random sample with probability proportional to size procedures was used to obtain a nationally representative sample of 13 591 subjects aged ≥ 40 years. Of these, 13 504 (99.4%) had a blood pressure measurement.

Results: The prevalence of hypertension was 44.9% [95% confidence interval (CI): 43.5–46.3%]. Increasing age, gender, urban residence and body mass index were independent risk factors (p < 0.001). The Kanuri ethnic group had the highest prevalence of hypertension (77.5%, 95% CI: 71.0–84.0%).

Conclusions: The high prevalence of hypertension in Nigeria is a cause for concern and suggests that it is inevitable that the impact of hypertension-related ill health is imminent, with the accompanying financial and societal costs to families and the state of Nigeria.

Keywords: hypertension, ethnicity, Nigeria, survey

Hypertension is increasingly being recognised as an important public health problem in sub-Saharan Africa, with 26.9% of men and 28.4% of women in 2000 being estimated to have hypertension.1 Although lower than the prevalence in high-income countries (37.4% in men and 37.2% in women), in terms of numbers of people affected, the burden of hypertension in low- and middle-income countries is greater due to the large population.1

It has been emphasised that urbanisation is a key reason for the increasing rates of hypertension, as evidenced by the higher
prevalence of hypertension in urban areas.14 Urban lifestyles, characterised by sedentary living, increased salt intake, obesity and stress contribute to these differences.3 With the urban population in sub-Saharan Africa projected to increase, a greater risk of hypertension is anticipated.

Studies on the association between ethnicity and hypertension in high-income countries have documented a higher prevalence of hypertension in black ethnic groups compared to white ethnic groups.14 15 Reasons for this association are complex, unclear and much debated, reflecting genetic and biochemical mechanisms, and environmental and socio-economic factors.10 11 There is limited evidence regarding differences in the prevalence of hypertension between ethnic groups within the broader classification of black ethnicity.14 15 18

Studies in Nigeria and sub-Saharan Africa have mainly involved specific geographical areas or have focused on sub-groups of the population.13 14 Surveys from Nigeria report prevalence estimates ranging from 20.2 to 36.6%, but all have involved participants with different age ranges.16 18 To plan services for hypertension in Nigeria, it is essential to have accurate prevalence estimates for the whole population and to identify populations at risk.

Nigeria, which is the most populous country in sub-Saharan Africa, is home to over 250 different ethnic groups. Nigeria is experiencing rapid urbanisation of the population, which is likely to increase the population at risk for hypertension.19 The present study is one of the largest population-based surveys in the region and is able to provide a nationally representative estimate of hypertension for Nigeria.

Methods

As part of the Nigerian national blindness and visual impairment survey of adults aged 40 years and older, data were collected on blood pressure. A detailed description of the sampling, enumeration, visual acuity and ocular examination procedures has been published previously.20

Nigeria is divided into six administrative zones, which are called geo-political zones (GPZ), 36 states and the federal capital territory of Abuja. Each state is subdivided into local government authorities (LGA), which are the smallest administrative unit. There are 774 LGAs in the country.

A nationally representative sample was achieved through a multi-stage, stratified (by urban/rural location and GPZ), cluster random sampling with probability proportional to size procedures. A total of 310 clusters were identified, 226 were in rural areas and 84 in urban populations. The sample covered all 36 states. Fifty adults aged 40 years or older, who were normal residents (defined as being continually resident for at least the last three months) were randomly identified in each cluster.

These people were identified by the enumeration team who, having found the centre of the cluster, spun a bottle and approached the first household in the direction the bottle pointed. The team, using an established protocol, travelled from house to house to identify eligible adults, until the quota was achieved. If fewer than 50 were identified, the search continued into the last three months) were randomly identified in each cluster.

Respondents were invited to attend a clinical station which was set up in each cluster. Enumerated individuals not reporting to the clinical station were followed up three times and offered an examination at their house. If they still did not take part they were deemed non-respondents and were not replaced.

At the clinical station, individuals were interviewed to collect data on socio-demographic variables, including ethnic group, and history of disease and medication. All had anthropometric measures taken and their blood pressure was measured prior to ophthalmic examination. Each of the two survey teams had two qualified ophthalmologists and two ophthalmic nurses, who were recruited from each GPZ, so that they would know the main local languages.

Hypertension was measured by a qualified ophthalmic nurse trained in the procedure, using an Omron wrist instrument (UB322, Omron Healthcare Ltd, Milton Keynes, England), with the occluding cuff being placed around the volar surface of the wrist. The instrument was calibrated every morning. A total of three readings were taken by a trained nurse, at least five minutes apart after at least 10 minutes’ rest in a sitting position. The nurses’ performance was regularly monitored by the senior investigators. The mean of the three readings was calculated as the individual’s blood pressure.

Initial training was undertaken over two weeks and training sessions were repeated for each GPZ (two weeks each). A pilot study was conducted before the field work started in each GPZ. Inter-observer agreement studies were conducted periodically throughout the study for the ophthalmic nurses and the ophthalmologists. Data were collected over a 30-month period from January 2005 to July 2007.

Height and weight were measured using a Tanita measurement scale (Model 1536, Tanita Corporation, Tokyo, Japan). The weight measure was calibrated every morning and checked for error using a standard weight.

The World Health Organisation’s (WHO) classification of hypertension was used. Hypertension is defined as diastolic blood pressure (DBP) of 90 mmHg or greater, or a systolic blood pressure (SBP) of 140 mmHg or greater. The WHO grading system of hypertension to profile risk was also used. This defines grade 1 hypertension as SBP 140–159 mmHg or DBP 90–99 mmHg; grade 2 as SBP 160–179 mmHg or DBP 100–109 mmHg; and grade 3 as SBP ≥ 180 or DBP ≥ 110 mm Hg. These grades are used to assess the risk in individuals for a cardiac event in the context of other additional risk factors.21

Body mass index (BMI) was calculated from weight (kg) divided by height (m) squared. World Health Organisation categories of BMI were used in the analysis.22

Socio-economic status (SES) was calculated by assigning one of eight occupational categories, ranging from 0 (not in gainful employment) to 7 (professional), and a grade for the highest level of school attended, from 0 (no schooling) to 4 (university) for each person. The sum of the scores was calculated, with a higher score signifying a more affluent socio-economic status. The ranked SES scores were then divided into tertiles.

Data on ethnic group were categorised such that groups with more than 100 participants were analysed separately, with all other ethnic groups combined into an ‘other’ group. Ethnic groups were classified based on the father’s ethnic status.

Ethical approval for the study was provided by the London School of Hygiene and Tropical Medicine and the Federal Government of Nigeria. The study adhered to the tenets of the
Declaration of Helsinki. Written informed consent was obtained from participants after an explanation of the nature of the study.

Statistical analysis

A customised database was created in Microsoft Access and two trained data-entry clerks entered the data. Data entered by one operator were checked by the second operator and corrections were made when necessary. Quality assurance procedures included a random verification of filled forms completed in the field and at the project office. The data were cleaned and analysed using a statistical package (Stata 11; StataCorp, College Station, TX).

Prevalence estimates together with 95% confidence intervals (CI) for hypertension are presented. Multiple logistic regression analysis was performed to identify risk factors for hypertension and to estimate adjusted odds ratios (OR). All the analyses accounted for clustering (design effect) due to the cluster sampling design adopted for the study. Missing values were excluded from all the analyses; p-values < 0.05 were considered statistically significant.

Results

A total of 13 591 people took part in the study, 13 504 (99.4%) of whom had a valid blood pressure measurement. The mean age of participants was 55.9 years (± 12.4) (men: 56.8; women: 55.2 years). The mean age of respondents in the south-east geo-political zone was the highest (58.6 ± 12.8 years) and it was the lowest in the north-east zone (53.8 ± 11.6 years). The mean age in the north-west was 54.2 years (± 11.8), in north-central it was 55.8 years (± 12.7), in south-south it was 56 years (± 12.2) and in south-west, 57.8 years (± 11.8). Over 60% of those surveyed were under the age of 60 years.

There were more females in the sample (54.1%) than males, and rural respondents constituted 77.6% of the sample (Table 1). Over 50% of the study population belonged to the four most populous ethnic groups in Nigeria: Hausa, Igbo, Yoruba and Fulani.

The overall prevalence of hypertension was 44.9% (95% CI: 43.5–46.3%). The prevalence of grade 3 hypertension (the

### TABLE 1. DEMOGRAPHIC CHARACTERISTICS AND MEAN BLOOD PRESSURE OF THE STUDY POPULATION

| Parameters | Frequency (n) | Percent (%) | Mean systolic BP (mm Hg) (SD) | Mean diastolic BP (mm Hg) (SD) |
|------------|--------------|-------------|------------------------------|------------------------------|
| Age group (years) | 13 504 | | | |
| 40–49 | 4 858 | 36.0 | 130.2 (21.8) | 81.9 (14.2) |
| 50–59 | 3 554 | 26.3 | 139.3 (26.0) | 85.1 (15.4) |
| 60–69 | 2 758 | 20.4 | 144.0 (27.0) | 85.2 (15.8) |
| 70–79 | 1 643 | 12.2 | 146.7 (26.6) | 84.4 (16.3) |
| ≥ 80 | 691 | 5.1 | 146.3 (28.6) | 84.4 (16.6) |
| Sex | | | | |
| Male | 7 301 | 54.1 | 139.3 (26.6) | 84.4 (16.6) |
| Female | 6 203 | 45.9 | 136.8 (24.6) | 83.5 (15.0) |
| Residence | | | | |
| Rural | 10 478 | 77.6 | 137.2 (25.5) | 83.1 (15.0) |
| Urban | 3 026 | 22.4 | 141.6 (27.1) | 86.6 (16.1) |
| Literacy | | | | |
| Literate | 7 691 | 56.4 | 139.5 (26.5) | 84.0 (15.3) |
| Illiterate | 5 891 | 43.6 | 136.4 (25.1) | 83.7 (15.3) |
| Geo-political zone | | | | |
| North-east (1 707) | 1 707 | 12.6 | 144.4 (27.7) | 90.4 (16.5) |
| South-east (1 657) | 1 657 | 12.3 | 138.4 (28.0) | 79.0 (14.8) |
| South-south (1 845) | 1 845 | 13.7 | 133.1 (25.9) | 77.9 (14.8) |
| North-west (3 577) | 3 577 | 26.5 | 140.3 (24.3) | 87.5 (13.7) |
| North-west (7 080) | 7 080 | 20.1 | 137.1 (26.4) | 81.9 (15.0) |
| North-central (2 010) | 2 010 | 14.9 | 135.0 (23.4) | 83.9 (14.5) |
| Socio-economic status | | | | |
| Most affluent | 4 383 | 32.5 | 135.2 (24.5) | 82.5 (14.7) |
| Moderately affluent | 4 676 | 34.6 | 137.2 (25.4) | 82.9 (14.9) |
| Least affluent | 4 445 | 32.9 | 142.1 (27.4) | 86.3 (16.1) |
| Body mass index | | | | |
| Underweight | 1 495 | 11.1 | 134.3 (25.9) | 81.2 (15.8) |
| Normal | 8 156 | 60.4 | 136.1 (25.1) | 82.7 (14.9) |
| Overweight | 2 588 | 19.2 | 142.3 (26.1) | 86.5 (15.2) |
| Obese | 1 113 | 8.2 | 147.9 (27.5) | 89.8 (15.4) |
| Missing data | 152 | 1.1 | | |

### TABLE 2. PREVALENCE OF HYPERTENSION AND ASSOCIATION WITH SOCIO-DEMOGRAPHIC FACTORS

| Parameters | Hypertension prevalence (%) | 95% CI | p-value |
|------------|----------------------------|--------|---------|
| Age group (years) | | | |
| 40–49 (4 858) | 44.7 | 43.5–46.3 | 0.0001 |
| 50–59 (3 554) | 47.1 | 44.9–49.2 | 0.0001 |
| 60–69 (2 758) | 54.2 | 52.1–56.3 | 0.0001 |
| 70–79 (1 643) | 57.1 | 54.2–59.9 | 0.0001 |
| ≥ 80 (691) | 58.2 | 54.6–61.9 | 0.0001 |
| Sex | | | |
| Male (6 203) | 42.6 | 40.9–44.4 | 0.0001 |
| Female (7 301) | 46.8 | 45.3–48.4 | 0.0001 |
| Residence | | | |
| Rural (10 478) | 43.0 | 41.3–44.6 | 0.0001 |
| Urban (3 026) | 51.6 | 48.4–54.9 | 0.0001 |
| Literacy | | | |
| Literate (7 691) | 47.2 | 45.5–48.9 | 0.0001 |
| Illiterate (5 891) | 42.0 | 40.0–43.9 | 0.0001 |
| Geopolitical zone | | | |
| North-east (1 707) | 60.5 | 55.1–65.8 | 0.0001 |
| South-east (1 657) | 41.0 | 38.0–44.0 | 0.0001 |
| South-south (1 845) | 34.2 | 31.2–37.2 | 0.0001 |
| North-west (3 577) | 51.5 | 48.7–54.2 | 0.0001 |
| North-west (2 708) | 40.7 | 37.1–43.2 | 0.0001 |
| North-central (2 010) | 39.5 | 35.7–43.3 | 0.0001 |
| Socio-economic status | | | |
| Affluent (4 383) | 39.2 | 37.4–41.0 | 0.0001 |
| Moderately affluent (4 676) | 43.5 | 41.4–45.2 | 0.0001 |
| Least affluent (4 445) | 52.1 | 49.9–54.2 | 0.0001 |
| Body mass index | | | |
| Underweight (1 495) | 39.6 | 36.6–42.6 | 0.0001 |
| Normal (8 156) | 41.7 | 40.1–43.2 | 0.0001 |
| Overweight (2 588) | 50.9 | 48.7–53.2 | 0.0001 |
| Obese (1 113) | 59.8 | 56.3–63.2 | 0.0001 |
The prevalence of hypertension increased with age, ranging from 32.1% in 40–49 year olds to 58.2% in those aged ≥ 80 years (Table 3). The prevalence was higher in females (46.8%) and in urban participants (51.6%). The prevalence was also higher among illiterate respondents (47.2%). There was a wide variation in prevalence according to GPZ, the lowest being in the south-south GPZ (34.2%), and highest in the north-east GPZ (60.5%).

The prevalence of hypertension increased from the most affluent (39.2%) to the least affluent (52.1%). The prevalence of hypertension also increased with BMI category; 39.6% of those who were underweight had hypertension compared with 59.8% in those who were obese. The same trends were noted with grades 2 and 3, and grade 3 hypertension.

With univariate analysis, age, female gender, living in an urban area and being illiterate were strongly associated with all grades of hypertension (p < 0.001) (Table 3). Using the south-south GPZ as the baseline, associations with GPZ were more variable. Socio-economic status was inversely associated with hypertension (p < 0.001); the odds ratio of hypertension were inversely associated with affluence. Compared with those with a normal BMI, being overweight, obese or underweight were all associated with hypertension.

Multivariate analysis was undertaken using the same set of variables, excluding literacy due to its correlation with the measure of SES (Table 4). In this analysis, older age, female gender, urban area of residence and high and low BMI were independently associated with hypertension at the p < 0.001 level, with the same trends within categories as in the univariate analysis. Findings with regard to GPZ showed that in relation to the south-south,
participants living in all other GPZs had a significantly higher odds ratio of hypertension, apart from those in the south-west. Ethnicity data were missing for 58 participants and they were excluded from this analysis. The prevalence of hypertension varied by ethnic group, with the highest prevalence being in the Kanuri group (77.5%) and lowest in the Gbagyi group (25.9%) (Table 5). Adjusting for age, gender, place of residence and socio-economic status, the Kanuri, Nupe, Tiv, Fulani, Anang, Hausa and Edo ethnic groups had statistically significantly greater odds ratios of hypertension than the ‘other’ group. The Yoruba group had statistically significantly lower odds ratios of hypertension than the ‘other’ group.

Discussion

The prevalence of hypertension reported in this survey was higher than in other smaller studies carried out in Nigeria, where the prevalence ranged from 20.2 to 36.6%. The prevalence reported in this survey was 45.9%, and a recent systematic review of surveys from African countries reported that use of hypertensive medication was very low, and so this is unlikely to have significantly impacted on our prevalence estimate or the findings of association in the present study. If there was any bias, our estimate would be an under-estimate.

We observed that women had a higher prevalence of hypertension than men in Nigeria. This corroborates the findings of many, but not all studies in Africa.

A unique feature of the present study is that it provides estimates of the prevalence of hypertension among indigenously resident ethnic groups at a national level. Only one other study examined the association of ethnicity with hypertension in Nigeria but it was limited to one region of the country.

Some evidence of ethnic variation has been reported in Kenya where statistically significant differences between ethnic groups were reported after adjusting for socio-demographic and

| Author (year) | Place of study | Sample size | Age range (years) | Prevalence (definition 1) (%) | Prevalence (definition 2) (%) |
|---------------|----------------|-------------|-------------------|-------------------------------|-------------------------------|
| Present study | Nigeria, nationwide | 13 504 | 40+ | 45.9* | 24.3* |
| Isezuo et al. (2011) | Nigeria (rural and urban) | 782 | 15–65 | 24.5 |
| Ogadipo et al. (2010) | Nigeria (rural) | 2 000 | 18–64 | 20.8 |
| Amedooyin et al. (2008) | Nigeria (semi-urban) | 2 097 | 20+ | 36.6* |
| Onyeagwata et al. (2007) | Nigeria (rural) | 590 | 15+ | 20.2* |
| Otunboun et al. (2007) | Nigeria, (urban) | 998 | 16–70 | 10.4 |
| Coopert al. (1997) | Nigeria (rural and urban) | 1 171 | 25+ | 14.5* |
| Andy et al. (2012) | Nigeria (rural) | 3 869 | 15+ | 23.6 |
| Ogah et al. (2013) | Nigeria (rural) | 2 999 | 18+ | 31.8 |
| Ekpenyong et al. (2010) | Nigeria (rural and urban) | 2 780 | 18–60 | 25 |
| Mahet al. (2011) | Uganda (rural) | 6 678 | All | 22.5* |
| De Ramirez et al. (2010) | Malawi, Rwanda, Tanzania (rural) | 1 485 | 18+ | 22 |
| Mathenge et al. (2010) | Kenya (rural and urban) | 4 396 | 50+ | 50.1 |
| Damasceno et al. (2009) | Mozambique (rural and urban) | 3 323 | 25–64 | 33.1 |
| Tesfaeye et al. (2009) | Ethiopia (urban) | 3 173 | 25–64 | 31 |
| Addo et al. (2008) | Ghana (urban) | 1 015 | 25+ | 30.3 |
| Kengne et al. (2007) | Cameroon (urban) | 2 559 | 15+ | 20.8 |
| Steyn et al. (2001) | South Africa, nationwide | 13 802 | 15+ | 23.9 |
| Van der Sande (2000) | Gambia | 5 369 | 15+ | 19 |
| Dewhurst et al. (2011) | Tanzania (rural and urban) | 2 223 | 70+ | 69.9 |
| Houmato et al. (2008) | Benin | 6 853 | 25–64 | 27.9 |
| Hendriks et al. (2009–11) | F2 (rural), Tanzania, Namibia (urban) | 7 568 | 18+ | Nigeria: 19.3, Kenya: 21.4, Tanzania: 23.7, Namibia: 38 |

*Medication details not available

Definition 1: Diastolic BP 140 mmHg or SBP 90 mmHg
Definition 2: Diastolic BP 160 mmHg or SBP 95 mmHg

| Ethnic group | n | Mean age ± SD (years) | Prevalence (%) | 95% CI Adjusted OR | 95% CI p-value |
|--------------|---|-----------------------|---------------|--------------------|---------------|
| Other group  | 2 024 | 54.7 ± 12.1 | 41.5 | 37.5–45.5 | 1 |
| Kanuri       | 333 | 54.4 ± 11.7 | 77.5 | 71.0–84.0 | 3.51 | 2.33–5.29 | <0.001 |
| Nupe         | 208 | 53.9 ± 10.8 | 50.5 | 43.9–57.1 | 1.95 | 1.14–3.0 | 0.01 |
| Tiv          | 342 | 55.9 ± 13.7 | 44.4 | 37.5–51.2 | 1.65 | 1.14–2.38 | 0.01 |
| Igbe         | 143 | 54.8 ± 12.1 | 37.8 | 24.8–50.7 | 1.64 | 0.97–2.77 | 0.06 |
| Fulani       | 832 | 54.1 ± 11.3 | 54.6 | 49.4–59.7 | 1.47 | 1.11–1.95 | 0.01 |
| Ibibio       | 210 | 52.6 ± 11.5 | 38.6 | 30.1–47.0 | 1.45 | 0.99–2.13 | 0.06 |
| Anang        | 132 | 54.2 ± 11.1 | 34.1 | 27.5–40.6 | 1.45 | 1.06–1.98 | 0.02 |
| Hausa        | 3 361 | 54.4 ± 11.9 | 52.4 | 49.5–55.2 | 1.42 | 1.14–1.76 | <0.001 |
| Igala        | 183 | 56.6 ± 12.9 | 41.5 | 35.5–49.6 | 1.38 | 0.83–2.30 | 0.22 |
| Edo          | 218 | 56.6 ± 12.4 | 39.0 | 35.8–42.2 | 1.32 | 1.01–1.72 | 0.05 |
| Igbirra      | 163 | 56.7 ± 13.9 | 42.3 | 36.4–48.2 | 1.22 | 0.83–1.8 | 0.30 |
| Ijaw         | 251 | 58.3 ± 12.9 | 39.4 | 28.8–50.1 | 1.07 | 0.69–1.67 | 0.75 |
| Igbo         | 2 017 | 57.5 ± 12.7 | 40.4 | 37.6–43.1 | 1.04 | 0.77–1.40 | 0.78 |
| Ekoi         | 103 | 57.3 ± 11.0 | 31.1 | 27.1–35.0 | 1.04 | 0.79–1.36 | 0.80 |
| Urbobo       | 266 | 57.9 ± 13.4 | 36.1 | 27.1–45.0 | 0.94 | 0.58–1.53 | 0.81 |
| Yoruba       | 2 525 | 58.5 ± 12.4 | 39.3 | 36.4–42.1 | 0.79 | 0.63–0.99 | 0.04 |
| Gbogyi       | 135 | 54.8 ± 14.3 | 25.9 | 18.3–33.6 | 0.73 | 0.42–1.26 | 0.26 |

*Adjusted for age, gender, place of residence and socio-economic status.
other cardiovascular risk factors, but a study from Nigeria and Cameroon did not find any association of hypertension with ethnicity. A review of existing studies to estimate the prevalence of hypertension in 11 sub-Saharan African countries found clear differences by country, which the authors suggested may be partly explained by ethnicity and other socio-demographic factors. The very high prevalence of hypertension among some ethnic groups such as the Kanuri in Nigeria needs further investigation as this ethnic group is concentrated in one localised region of the country.

Our results show that the prevalence of hypertension in Nigeria is similar to that in high-income countries and is therefore a public health challenge. A review of published studies from Nigeria observed that the pooled prevalence of hypertension increased from 8.6% over the period 1970–1979 to 22.5% over the period 2000–2011. A national survey on non-communicable diseases in Nigeria documented that the prevalence of hypertension using a cut-off value of 160/95 mmHg was 11.2% (age-adjusted prevalence was 9.3%).

The observed trend shows that Nigeria is at high risk of a significant increase in rates of hypertension in the near future. Recent evidence documents that hypertension is the commonest condition seen at medical centres in Nigeria. This has implications on mortality of people during the productive years of their lives. A study by Ekpenyong et al. estimated that five million Nigerians would die of non-communicable diseases (NCDs) in Nigeria alone. A significant proportion of these deaths may be contributed to by hypertension.

Conclusion

The increase in NCDs in sub-Saharan Africa will mean that additional resources will be required for the detection and control of NCDs, which would compete with the resources being allocated for the control of communicable diseases, such as the neglected tropical diseases, malaria and HIV. Strategies and interventions will also be required to improve adherence to life-long medication. It is inevitable that hypertension and its consequences will lead to financial and societal costs to families and the states in sub-Saharan Africa and governments will need to respond to this emerging challenge.

The authors thank the Federal Ministry of Health, state governments and the local government authorities in Nigeria for providing accommodation to the survey teams and other administrative and logistical support during the survey. We also thank Dr Brendan Dineen for his epidemiological input, members of the technical advisory group, Mrs Oye Quaye for managing the finances, Auwal Shehu and Dania Charles for data entry, the teams of ophthalmologists, ophthalmic nurses, enumerators, interviewers, liaison officers, drivers and cooks, Mr Pak Sang Lee for technical support, and the staff in the Sightsavers country office for their financial, managerial and administrative support, without which this survey could not have been undertaken.

Financial support was provided by Sightsavers International, UK (http://www.sightsavers.org/), Velux Stiftung, Germany (http://www.veluxstiftung.ch/home/index.php) and CBM, Germany (http://www.cbm.org/). The funders had no role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript. The grant code of the London School of Hygiene and Tropical Medicine was ITCRBY61 (The grant closed in 2010).

References

1. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. Lancet 2005; 365(9455): 217–223.
2. Chobanian AV, Bakris GL, Black HR, et al. The seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. J Am Med Assoc 2003; 289(19): 2560–2572.
3. LopezAD, Mathers CD, Ezzati M, Jamison DT, Murray CJI. Measuring the global burden of disease and risk factors. In: Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJI, eds. Global Burden of Disease and Risk Factors. Washington: The World Bank and Oxford University Press, 2006: 1–13.
4. Seedat YK. Hypertension in developing nations in sub-Saharan Africa. J Hum Hypertens 2000; 14(10): 739–747.
5. Addo J, Smeeth L, Leon DA. Hypertension in sub-Saharan Africa: a systematic review. Hypertension 2007; 50(6): 1012–1018.
6. Mathenge W, Foster A, Kuper H. Urbanization, ethnicity and cardiovascular risk in a population in transition in Nakuru, Kenya: a population-based survey. BMC Public Health 2010; 10: 569.
7. Harris MM, Stevens J, Thomas N, Schreiner P, Folsom AR. Associations of fat distribution and obesity with hypertension in a bi-ethnic population: the ARIC study. Atherosclerosis Risk in Communities Study. Obes Res 2000; 8(7): 516–524.
8. Kramer H, Han C, Post W, et al. Racial/ethnic differences in hypertension and hypertension treatment and control in the multi-ethnic study of atherosclerosis (MESA). J Hum Hypertens 2004; 18(10): 963–970.
9. Chiu M, Austin PC, Manuel DG, Tu JV. Comparison of cardiovascular risk profiles among ethnic groups using population health surveys between 1996 and 2007. Can Med Assoc J 2010; 182(8): 18.
10. Oparil S, Wright JT Jr. Ethnicity and blood pressure. J Clin Hypertens (Greenwich) 2005; 7(6): 357–364.
11. Jamerson KA. The disproportionate impact of hypertensive cardiovascular disease in African Americans: getting to the heart of the issue. J Clin Hypertens (Greenwich) 2004; 6(4 Suppl 1): 4–10.
12. De Ramirez SS, Enquobahrie DA, Nyadzi G, et al. Prevalence and correlates of hypertension: a cross-sectional study among rural populations in sub-Saharan Africa. J Hum Hypertens 2010; 24(12): 786–795.
13. Cooper R, Rotimi C, Atamann S, et al. The prevalence of hypertension in seven populations of west African origin. Am J Public Health 1997; 87(2): 160–168.
14. Twagirumukiza M, de Bacquer D, Kips JG, de Bacquer G, Stichele RV, van Bortel LM. Current and projected prevalence of arterial hypertension in sub-Saharan Africa by sex, age and habitat: an estimate from population studies. J Hypertens 2011; 29(7): 1243–1252.
15. Andy JJ, Peters EJ, Ekripsi UE, Akpan NA, Unadkic BC, Eckott JU. Prevalence and correlates of hypertension among the Ibibo/Annang, Efik and Obolos: a cross sectional community survey in rural South-South Nigeria. Ethn Dis 2012; 22(3): 335–339.
16. Ogah OS, Okpechi I, Chukwuonye II, et al. Blood pressure, prevalence of hypertension and hypertension related complications in Nigerian Africans: a review. World J Cardiol 2012; 4(12): 327–340.
17. Obuahckwa AC, Mezie-Okyoe MM, Babatunde S. Prevalence of hypertension in Kegbara-Dere, a rural community in the Niger Delta region, Nigeria. Ethn Dis 2012; 22(3): 340–6.17.
18. Ogah OS, Madukwe OO, Onyeonora UU, Chukwuonye II, Ikegbu AU, Akhimen MO, Okpechi IG. Cardiovascular risk factors and non-communicable diseases in Abia State, Nigeria: report of a community based survey. Int J Med Biomed Res 2013; 2(1): 57–68.
19. Akinbami JFK, Fadare SO. Strategies for sustainable urban and transport development in Nigeria. Transport Policy 1997; 4: 237–224.
20. Dineen B, Gilbert CE, Rabiu M, et al. The Nigerian national blindness and visual impairment survey: Rationale, objectives and detailed methodology. BMC Ophthalmol 2008; 8: 17.
21. Whitworth JA, World Health Organization, International Society of Hypertension writing group. 2003 World Health Organization (WHO)/ International Society of Hypertension (ISH) statement on management of hypertension. J Hypertens 2003; 21(11): 1983–1992.
22. World Health Organization. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. World Health Organ Tech Rep Ser 1995; 854: 1–452.
23. Isezuo SA, Sahir AA, Ohwovoriolue AE, Fasanmade OA. Prevalence, associated factors and relationship between prehypertension and hypertension: a study of two ethnic African populations in Northern Nigeria. *J Hum Hypertens* 2011; 25(4): 224–230.

24. Oladapo OO, Salako L, Sodiq O, Shoyinka K, Adebayo K, Falase AO. A prevalence of cardiometabolic risk factors among a rural Yoruba southwestern Nigerian population: a population-based survey. *Cardiovasc J Afr* 2010; 21(1): 26–31.

25. Adebayo RA, Mhada CE, Balogun MO, et al. Prevalence and pattern of hypertension in a semiurban community in Nigeria. *Eur J Cardiovasc Prev Rehabil* 2008; 15(6): 683–687.

26. Omoume VO, Okojie OH, Omoueme CE. Awareness of high blood pressure status, treatment and control in a rural community in Edo State. *Niger J Clin Pract* 2007; 10(3): 208–212.

27. Van der Sande MA, Milligan PJ, Nyan OA, et al. Blood pressure patterns and cardiovascular risk factors in rural and urban Gambian communities. *J Hum Hypertens* 2000; 14(8): 489–496.

28. Damasceno A, Azvedo A, Silva-Matos C, Prista A, Diogo D, Lunet N. Hypertension prevalence, awareness, treatment, and control in Mozambique: urban/rural gap during epidemiological transition. *Hypertension* 2009; 54(1): 77–83.

29. Steyn K, Gazzano TA, Bradshaw D, Laubscher R, Fourie J. Hypertension in South African adults: results from the Demographic and Health Survey, 1998. *J Hypertens* 2001; 19(10): 1717–1725.

30. Maher D, Waswa L, Baisley K, Karabarinde A, Unwin N, Grosskurth H. Distribution of hyperglycaemia and related cardiovascular disease risk factors in low-income countries: a cross-sectional population-based survey in rural Uganda. *Int J Epidemiol* 2011; 40(1): 160–171.

31. Tesfaye F, Byass P, Wall S. Population based prevalence of high blood pressure among adults in Addis Ababa: uncovering a silent epidemic. *BMC Cardiovasc Disord* 2009; 23: 9–39.

32. Addo J, Smeeth L, Leon DA. Prevalence, detection, management, and control of hypertension in Ghanaian civil servants. *Ehn Dis* 2008; 18(4): 505–511.

33. Kengne AP, Awah PK, Fezeu L, Mbanya JC. The burden of high blood pressure and related risk factors in urban sub-Saharan Africa: evidences from Douala in Cameroon. *Afr Health Sci* 2007; 7(1): 38–44.

34. Olatunbosun ST, Kaufman JS, Cooper RS, Bella AF. Hypertension in a black population: prevalence and biosocial determinants of high blood pressure in a group of urban Nigerians. *J Hum Hypertens* 2000; 14(4): 249–257.

35. Opie LH, Seedat YK. Hypertension in sub-Saharan African populations. *Circulation* 2005; 112(23): 3562–3568.

36. Akinkugbe OO. Non-communicable diseases in Nigeria – final report of a national survey. Lagos: Federal Ministry of Health – National Expert Committee on Non-Communicable Diseases, 1997: 1–12.

37. Ogah OS. Hypertension in sub-Saharan African populations: the burden of hypertension in Nigeria. *Ethn Disc* 2006; 16: 765.

38. Ekpenyong CE, Udokang NE, Akpan EE, Samson TK. Double burden, non communicable diseases and risk factors evaluation in sub-Saharan Africa: The Nigerian experience. *Eur J Sustain Develop* 2012; 1(2): 249–270.

39. Dewhurst MJ, Dewhurst F, Gray WK, Chaote P, Orega GP, Walker RW. The high prevalence of hypertension in rural-dwelling Tanzanian older adults and the disparity between detection, treatment and control: a rule of sixth? *J Hum Hypertens* 2013; 27(6): 374–380.

40. Hounato DS, Gbary AR, Houehanou YC, Djrolo F, Amoussou M, Segnon-Agueh J, Kouzehouen A, Salamon R. Prevalence of hypertension and associated risk factors in Benin. *Rev Epidemiol Sante Publique* 2012; 60(2): 95–102.

41. Hendriks ME, Wit FW, Roos MT, Brewster LM, Akande TM, de Beer IH, Mfinanga SG, Kahwa AM, et al. Hypertension in sub-Saharan Africa: cross-sectional surveys in four rural and urban communities. *PLoS One* 2012; 7(3): e32638.

Birthday wishes

The newly appointed director of Clinics Cardive Publishing, Prof Paul Brink, celebrated his 60th birthday in October. This milestone was celebrated with a theme party ‘a trip down memory lane’. The guests dressed up for the occasion and much fun was had by all.

While enjoying the fruits of his labours so far, at this turning point in his life, we also wish Prof Brink great success for the future in his new endeavours.

The editorial team