

## Blood pressure, prevalence of hypertension and hypertension related complications in Nigerian Africans: A review

Okechukwu S Ogah, Ikechi Okpechi, Innocent I Chukwuonye, Joshua O Akinyemi, Basden JC Onwubere, Ayodele O Falase, Simon Stewart, Karen Sliwa

Okechukwu S Ogah, Ministry of Health, Nnamdi Azikiwe Secretariat, Umuahia 440233, Abia State, Nigeria

Ikechi Okpechi, Division of Nephrology and Hypertension, Department of Medicine, E13, Renal Unit, Grootes Schuur Hospital, Observatory 7925, Cape Town, South Africa

Innocent I Chukwuonye, Division of Renal Medicine (Nephrology), Department of Medicine, Federal Medical Centre, Umuahia 440233, Abia State, Nigeria

Joshua O Akinyemi, Department of Epidemiology and Medical Statistics, College of Medicine, University of Ibadan, Ibadan 200211, Oyo State, Nigeria

Basden JC Onwubere, Division of Cardiology, Department of Medicine, University of Nigeria Teaching Hospital, Enugu 400001, Nigeria

Okechukwu S Ogah, Ayodele O Falase, Division of Cardiovascular Medicine, Department of Medicine, University College Hospital, PMB 5116, Dugbe GPO, Ibadan 200211, Oyo State, Nigeria

Simon Stewart, NHMRC Centre of Research Excellence to Reduce Inequality in Heart Disease Baker IDI Heart and Diabetes Institute, 75 Commercial Road, Melbourne, VIC 3004, Australia

Karen Sliwa, Hatter Cardiovascular Research Institute, Faculty of Health Sciences, University of Cape Town, Cape Town, Private Bag X3, Observatory 7935, South Africa

**Author contributions:** Ogah OS, Okpechi I, Chukwuonye II and Onwubere BJC conceived of this review; Ogah OS and Chukwuonye II drafted the manuscript; Ogah OS, Okpechi I and Akinyemi JO reviewed the papers; Ogah OS, Okpechi I, Chukwuonye II and Akinyemi JO participated in the data acquisition; Falase AO, Stewart S and Sliwa K revised the manuscript; and all authors read and approved the final manuscript.

**Correspondence to:** Dr. Okechukwu S Ogah, MD, Msc, FWACP, Ministry of Health, Nnamdi Azikiwe Secretariat, Umuahia 440233, Abia State, Nigeria. [osogah56156@yahoo.com](mailto:osogah56156@yahoo.com)

Telephone: +234-806-7747121 Fax: +1215-975-6817

Received: April 13, 2012 Revised: October 23, 2012

Accepted: October 30, 2012

Published online: December 26, 2012

treatment and complications. Following our search on Pubmed, African Journals Online and the World Health Organization Global cardiovascular infobase, 1060 related references were identified out of which 43 were found to be relevant for this review. The overall prevalence of hypertension in Nigeria ranges from 8%-46.4% depending on the study target population, type of measurement and cut-off value used for defining hypertension. The prevalence is similar in men and women (7.9%-50.2% vs 3.5%-68.8%, respectively) and in the urban (8.1%-42.0%) and rural setting (13.5%-46.4%). The pooled prevalence increased from 8.6% from the only study during the period from 1970-1979 to 22.5% (2000-2011). Awareness, treatment and control of hypertension were generally low with attendant high burden of hypertension related complications. In order to improve outcomes of cardiovascular disease in Africans, public health education to improve awareness of hypertension is required. Further epidemiological studies on hypertension are required to adequately understand and characterize the impact of hypertension in society.

© 2012 Baishideng. All rights reserved.

**Key words:** Blood pressure; Hypertension; Prevalence; Non-communicable disease; Nigeria

**Peer reviewers:** Giuseppe Mule, MD, Department of Medicina Interna, Malattie Cardiovascolari e Nefrourologiche, Chair of Internal Medicine, European Society of Hypertension Centre of Excellence, University of Palermo, Via del Vespro, 129, 90127 Palermo, Italy; Wei-Chuan Tsai, MD, Department of Internal Medicine, National Cheng Kung University Hospital, 138 Sheng-Li Road, Tainan 704, Taiwan, China

Ogah OS, Okpechi I, Chukwuonye II, Akinyemi JO, Onwubere BJC, Falase AO, Stewart S, Sliwa K. Blood pressure, prevalence of hypertension and hypertension related complications in Nigerian Africans: A review. *World J Cardiol* 2012; 4(12): 327-340 Available from: URL: <http://www.wjgnet.com/1949-8462/full/v4/i12/327.htm> DOI: <http://dx.doi.org/10.4330/wjc.v4.i12.327>

### Abstract

To review studies on hypertension in Nigeria over the past five decades in terms of prevalence, awareness and

## INTRODUCTION

Hypertension is a common, important and major global public health problem<sup>[1]</sup>.

Its prevalence has been found to be 44% in Western Europe and 28% in North America. It has been documented as a threat to the health of people in sub-Saharan Africa and a major contributor to morbidity and mortality in the sub-region<sup>[2-4]</sup>. There is emerging evidence to show that the pattern of diseases in sub-Saharan Africa is changing, with non-communicable diseases (NCD) responsible for about 22% of the total deaths in the region in 2000, cardiovascular disease alone accounting for 9.2% of the total mortality [World Health Organization (WHO) 2002]. According to Kearney *et al*<sup>[5]</sup>, by 2025 about 75% of the world hypertensive population will be in developing countries. In Nigeria for example, it is the number one risk factor for stroke, heart failure, ischemic heart disease, and kidney failure. With an increasing adult population as well as rising prevalence of hypertension, Nigeria will experience economic and health challenges due to the disease if the tide is not arrested. As far back as the early 60s a lot of interest has been shown by workers on the blood pressure of Nigerian Africans. The essence of this work is to review studies on hypertension as well as hypertension research in the country.

## COUNTRY PROFILE

Nigeria is classified as a low-middle income country with a Gini Index of 43.7 and income per capita of \$1490. 49% of the population is living in urban areas, the gross national income per capita is \$2070. Life expectancy at birth is 51 years for both sexes (53 for men and 54 for women). The probability of dying between 15 and 60 years for men and women (per 1000 population) is 377 and 365 respectively. The mortality rate for under 5s is 138/1000 and the maternal mortality ratio is 840/10<sup>5</sup> live births. Non-communicable diseases contribute about 14% of the number of years of life lost. The number of doctors/10 000 population is about 4. Five point one percents of men and 9.0% of women aged 20 years and above are obese; 11.9% of men and 1.0% of women aged 15 years and above smoke cigarettes.

The prevalence of HIV (per 1000 adults aged 15-49 years) is 36 while the prevalence of tuberculosis (per 100 000 population) is 497<sup>[6-8]</sup>.

## METHODS

The Pubmed scientific database was searched from 1950-2011 for studies of blood pressure and hypertension in the country. The search criteria were "Hypertension", "High Blood Pressure" and "Nigeria". Studies conducted mainly on adult subjects were included.

Additional references were sought from retrieved publications. The African index medicus, African Journal Online and WHO Global cardiovascular infobase were

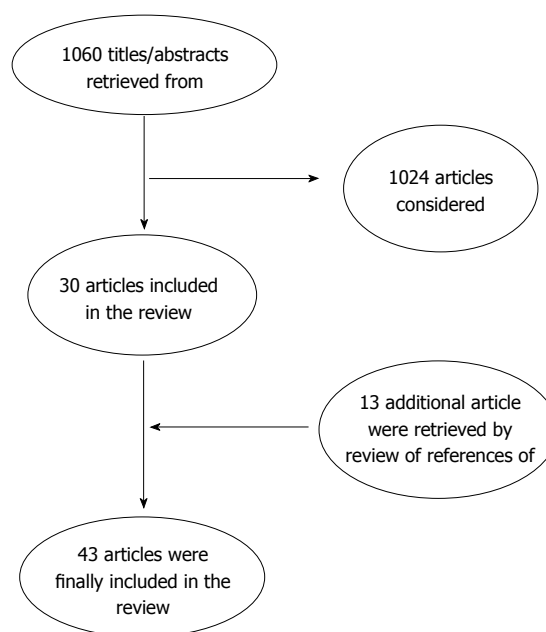


Figure 1 Selection process.

also searched.

All the data collected were entered into an excel spreadsheet. Information collected include: first author's name, year of publication, place of study, study design, population, sample size, mean age range, proportion of women enrolled, mean age, and prevalence of hypertension in the sample population as well as in men and women.

The pooled prevalence rate of hypertension was computed for the period 1970-1979, 1990-1999, and 2000-2011 from community-based studies.

## RESULTS

Our search yielded a total of 1060 references. However 30 publications were found to be useful for this review. An additional 13 articles were retrieved through the review of the bibliography of the earlier obtained articles. Figure 1 is a summary of the selection process. These cross-sectional studies were published between 1960 and 2012 in 12 of the 36 states of Nigeria: Oyo<sup>[9-22]</sup>, Enugu<sup>[23-27]</sup>, Lagos<sup>[28,29]</sup>, Osun<sup>[30,31]</sup>, Edo<sup>[32-35]</sup>, Cross-River<sup>[36,37]</sup>, Akwa-Ibom<sup>[37]</sup>, Rivers<sup>[38]</sup>, Kastina<sup>[39]</sup>, Sokoto<sup>[40]</sup>, Borno<sup>[41]</sup> and Abia<sup>[42]</sup>. Three of the studies involved more than one state<sup>[37,43]</sup>.

In terms of geopolitical spread, the majority of studies were conducted in the Southwestern part of the country; some of the studies were conducted before 1990 while the majority were after 1990.

### Historical vignette

Many years ago it was generally believed that high blood pressure was rare in native Africans. This was based on reports mainly by workers on the eastern coast of the continent such as Cooke<sup>[44]</sup>, Donnison<sup>[45]</sup>, Jex-Blake<sup>[46]</sup> and Vint<sup>[47]</sup>.

The earliest report of hypertension in Nigerian Africans was probably by Callander<sup>[48]</sup>. He commented on the blood pressure of army recruits and Nigerian soldiers at routine medical examination. He noted that in 100 healthy soldiers, 52 had a systolic blood pressure > 140 mmHg, and 23 had a diastolic blood pressure (BP) > 90 mmHg.

His observations from the army recruits were more remarkable. In 400 recruits aged between 19-24 years, 42.5% were rejected on account of elevated blood pressure and “this after an hour’s rest and amytal sedation before the pressure was recorded”.

In two reports in 1956, hypertension was documented as a cause of cardiovascular disease in Nigerians.

Beet *et al*<sup>[49]</sup> noted that it was responsible for 34% of cases of heart failure in Northern Nigeria while Nwokolo *et al*<sup>[50]</sup> also documented some cases in Enugu in the Eastern part of the country. Also Lambo *et al*<sup>[51]</sup> reported on the association of high blood pressure and mental disorder in elderly psychiatric patients in the Western region.

The earliest and first large scale study of blood pressure in Nigerians was by Abrahams *et al*<sup>[11]</sup>. The study was conducted in a rural town of Ilora which is about 50 km north of Ibadan. They noted, like most other studies conducted during that period, in Caucasians and American Blacks that blood pressure rose with age in both men and women. However, they did not document any clear relationship between blood pressure, weight climate and diet. This was followed by studies by Smith<sup>[28]</sup> in Lagos, Akinkugbe *et al*<sup>[9]</sup> in Ibadan, Johnson<sup>[52]</sup> in Lagos, Oviyasu *et al*<sup>[32-35]</sup> in Benin city and Oyediran in Epe near Lagos.

Akinkugbe is generally regarded as the father and doyen of blood pressure and hypertension research in Nigeria because of his seminal work in this field in the late 60s and 70s<sup>[9,10,53-62]</sup>. He documented that: (1) Systolic blood pressure rose with age in both sexes and in all age groups from 12-70 years. This trend was less marked in diastolic blood pressure; (2) Blood pressure levels were similar in women from rural and urban areas but seemed much higher in urban than in rural men; (3) The rate of rise of pressure was more rapid in earlier decades than subsequently; (4) There was little correlation with weight and much less so with height after 40 years of age; (5) The incidence of proteinuria was highest in the early teenage group years, but did not relate to blood pressure trends; and (6) Casual systolic and diastolic pressure differed in no important respects from those in Negro populations in the Caribbean, but systolic and diastolic values are marginally higher in United States Negroes than in West Indian or West African Negroes”.

Cole *et al*<sup>[63]</sup> was the first to conduct a drug trial on hypertensive patients and this was followed by a series of work by Salako *et al*<sup>[64-69]</sup>. Falase *et al*<sup>[70-72]</sup> demonstrated the lack of effect of low doses of prazosin in the treatment of hypertension in Nigeria.

A series of studies by Salako and Falase showed that Nigerians responded well to thiazide diuretics and cal-

cium channel antagonists when these drugs were used as monotherapy. Other classes of drugs, such as beta adrenergic blockers, require the use of high doses before they are effective in Nigerian hypertensives. The use of high doses of these drugs often causes unacceptable side effects. These classes of antihypertensive drugs are, however, effective in low doses when they are combined with either thiazide diuretics or calcium channel antagonists or both. Effective management of hypertension in Nigerians therefore requires the use of thiazide diuretics or calcium channel antagonists as monotherapy or in combination with other classes of antihypertensive agents.

Osuntokun *et al*<sup>[73-76]</sup> first studied hypertension in diabetic subjects in the country and showed in many seminal research studies the contribution of hypertension as a risk factor for stroke in hospital based and population based studies. Akerele documented hypertension in Nigerian children in 1974. The relation of renal disease, hypertension and schistosomiasis was explored by Soyannwo *et al*<sup>[77-81]</sup>.

Table 1 shows the hypertension research from 1961-1981.

### Diagnosis of hypertension

Earlier studies used 160/95 mmHg as the benchmark for the diagnosis of hypertension. The vast majority of studies which were conducted in the last 20 years used 140/90 mmHg as the cut off.

Twenty of the studies were carried out in urban populations, 11 in rural communities, while the remaining 6 were conducted both in urban and rural populations. The majority of the population based studies used multi-stage cluster sampling.

Sampling in five of the studies was by convenience (during free medical programmes).

The sample size in the studies ranged from 132 to 4930 subjects. The proportion of women who participated ranged from 24.9% to 71.2% while the mean age of the population ranged from 31.6 years to 61.2 years.

### Prevalence of hypertension

The prevalence of hypertension in both men and women ranged from 8% to 46.4%; with regards to gender, the prevalence of hypertension ranged from 7.9% to 50.2% and 3.5% to 6.8.8% in men and women, respectively. The reported prevalence in rural areas ranged from 13.5%-46.4% in both sexes, 14.7%-49.5% in men and 14.3-68.8% in women. Data from urban studies revealed a range of 8.1%-42.0% in both men and women, 7.9%-46.3% for men and 3.5%-37.7% for women. In general hypertension prevalence was higher in urban than rural areas (Table 2).

**Pooled prevalence and trend:** A prevalence of 8.9% was estimated from the only community-based study available for 1970-1979. For 1990-1999, the pooled prevalence of hypertension was 15.0% (CI 13.7-16.3). The pooled prevalence increased significantly to 22.5% (CI 21.8-23.2) from 2000 to 2009.

**Table 1** Events in the first 21 years of blood pressure and hypertension research in Nigeria (1961-1981)

No.	Author	Year	Comments
1	Abrahams <i>et al</i> <sup>[11]</sup>	1961	First population based study of blood pressure in the country. Studied the systemic blood pressure of rural Nigerians resident in Ilora
2	Monekosso <sup>[82]</sup>	1964	Reported some cases in a clinical survey of a village in South West Nigeria
3	Smith <sup>[28]</sup>	1966	Studied blood pressure of urban inhabitants in Lagos
4	Akinkugbe <sup>[56]</sup>	1968	Documented the rarity of hypertensive retinopathy in Nigerians
5	Akinkugbe <i>et al</i> <sup>[57]</sup>	1968	Reported on the rarer causes of hypertension in Nigeria
6	Akinkugbe <i>et al</i> <sup>[9]</sup>	1968	Wrote on arterial blood pressure in rural Nigerians in Eruwa
7	Akinkugbe <sup>[58]</sup>	1969	Reported on the hypertensives diseases in Ibadan, Nigeria
8	Akinkugbe <sup>[60]</sup>	1969	Wrote on antihypertensive therapy in the African context
9	Ojo <i>et al</i> <sup>[83]</sup>	1969	Studied hypertension in pregnancy
10	Akinkugbe <sup>[59]</sup>	1969	Reported on the result of his survey of blood pressures in school children
11	Cole <i>et al</i> <sup>[63]</sup>	1970	First documented drug trial (Declinox) in hypertensive Nigerians
12	Brockington <sup>[84]</sup>	1971	Reported on postpartum hypertensive heart failure
13	Johnson <sup>[52]</sup>	1971	Reported on his study of blood pressure in rural areas around Lagos
14	Carlisle <sup>[85]</sup>	1971	Reported on the remission of hypertension in some Nigerians
15	Salako <sup>[64]</sup>	1971	First trial of oral thiazides
16	Salako <sup>[65]</sup>	1971	Reported on serum electrolytes in hypertensive Nigerians
17	Salako <sup>[66]</sup>	1972	Reported on electrolyte changes following thiazide therapy in hypertensive Nigerians
18	Osuntokun <i>et al</i> <sup>[73,74]</sup>	1972	Seminal work on hypertension in diabetic Nigerians
19	Salako <i>et al</i> <sup>[67]</sup>	1973	Evaluated the usefulness of Moduretic in the treatment of hypertension in Nigerians
20	Akinkugbe <i>et al</i> <sup>[61]</sup>	1974	Reported on the experience with beta blockers in hypertension management
21	Aderele <sup>[86]</sup>	1974	Documented on hypertension in Nigerian children
22	Akinkugbe <sup>[87]</sup>	1976	Studied blood pressure in non-pregnant women
23	Falase <i>et al</i> <sup>[70]</sup>	1976	Demonstrated lack of effect of low dose prazosin in hypertensive Nigerians
24	Etta <i>et al</i> <sup>[88]</sup>	1976	Assessed the relation of blood pressure to indices of obesity
25	Olatunbosun <i>et al</i> <sup>[89]</sup>	1976	Evaluated the relation of blood pressure to heavy metals
26	Jain <i>et al</i> <sup>[90]</sup>	1977	Reported on the incidence of hypertension in Abuth Zaria
27	Akinkugbe <i>et al</i> <sup>[62]</sup>	1977	Conducted a biracial study of blood pressure in school children
28	Olatunde <i>et al</i> <sup>[91]</sup>	1977	Trial of beta blockers in hypertensive Nigerians
29	Osuntokun <i>et al</i> <sup>[75,76]</sup>	1977	Demonstrated through hospital registry and population based studies that hypertension is a major risk factor for stroke in Nigeria
30	Abdurrahman <i>et al</i> <sup>[92]</sup>	1978	Studied blood pressure in school children in Northern Nigeria
31	Mabadeje <sup>[93]</sup>	1979	Conducted a trial of chlorthalidone in hypertensive Nigerians

32	Falase <i>et al</i> <sup>[71,72]</sup>	1979	Documented poor response of hypertensive Nigerians to Beta blockers monotherapy
33	Alakija <sup>[94]</sup>	1979	Pilot study of hypertension in Benin City
34	Abengowe <i>et al</i> <sup>[95]</sup>	1980	Reported on the pattern of hypertension in Northern Savannah
35	Oviasu <i>et al</i> <sup>[32-35]</sup>	1980	Document on blood pressure and hypertension in urban city of Benin/ Occupational factors in hypertension
36	Ladipo <sup>[96]</sup>	1981	Carried out a study on hypertensive retinopathy in Ile-Ife

**Impact of blood pressure cut-off threshold on the prevalence of hypertension:** In a study of the prevalence and patterns of hypertension in a semi-urban community in South Western Nigeria, Adedoyin *et al*<sup>[31]</sup> demonstrated that with a cut-off value of  $\geq 140/90$  mmHg for the diagnosis of hypertension, the prevalence was 36.6% (isolated systolic hypertension (ISH) in 22.1% and isolated diastolic hypertension (IDH) in 14.5%).

On the other hand when the threshold was increased to 160/95 mmHg, only 13.35% were found to be hypertensive (6.63% had both ISH and IDH).

A male:female ratio of 1.7:1 and 1:5 was documented for blood pressure of  $\geq 140/90$  mmHg and  $\geq 160/90$  mmHg, respectively.

**Impact of age:** In all the studies, the most likely determinant of blood pressure and presence of high blood pressure was age. BP was shown to increase steadily with age from the youngest to the oldest age brackets, irrespective of gender.

It appears that population mean blood pressure has increased over the years since the first survey by Abrahams *et al*<sup>[11]</sup>. This may be due to an increase in detection rather than a temporal increase as the observation is limited by a lack of serially conducted studies in any of the populations.

**Comparison of prevalence of hypertension in Nigeria with some other parts of Sub-Saharan Africa:** Figure 2 shows the comparison of prevalence of hypertension in different parts of Sub-Saharan Africa, including Nigeria, as estimated for 2008 by Twagirumukiza *et al*<sup>[97]</sup>. The overall prevalence of hypertension was put at 18.4% for Nigeria compared with a prevalence of 10.35% for Ethiopia and 23.0% for Ghana (Figure 3).

#### **Hypertension awareness, treatment and control**

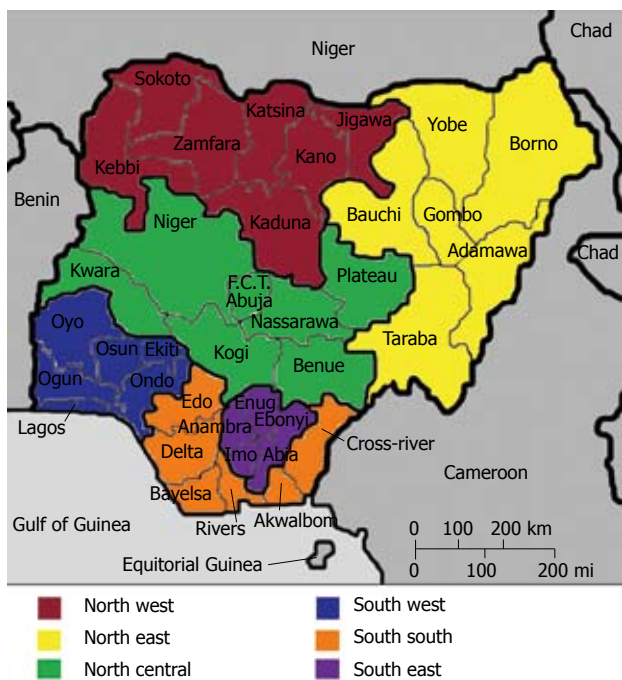
As in many populations of the world, the awareness of hypertension is low in Nigeria. In four of the studies, the reported awareness rates were 14.2% in rural areas by Oladapo *et al*<sup>[22]</sup>, 18.5% in Edo State<sup>[98]</sup>, and 29.4% and 30.0% in semi-urban and urban populations in Enugu State<sup>[25,26]</sup>.

The proportion of hypertensives on treatment was reported to be 21% (23.7% men, 17.5% women) by Ekwunife *et al*<sup>[99]</sup> and 18.6% (19.0% men, 18.4% women) by Oladapo *et al*<sup>[22]</sup>.

Table 2 Prevalence of hypertension in 38 studies in Nigeria (1960-2011)

No.	First author	Year	Study location	State	Region	BP cut off	Target population	Setting	Sample size	% all	% men	% women
1	Abrahams <i>et al</i> <sup>[111]</sup>	1960	Ilorin	Oyo	SW	160/90	Community based	Rural	457	13.3	NA	NA
2	Smith <sup>[28]</sup>	1961	Lagos	Lagos	SW	160/95	Hospital based	Urban	207	8.8	9.5	7.9
3	Akinkugbe <i>et al</i> <sup>[9,10]</sup>	1968	Eruwa	Oyo	SW	140/90	Community based	Rural	3602	10.1	9.1	11.2
4	Johnson <sup>[52]</sup>	1971	Lagos	Lagos	SW	160/95	Community based	Urban	1392	8.9	7.9	9.9
5	Jain <i>et al</i> <sup>[90]</sup>	1977	Kaduna	Kaduna	NW	160/95	Hospital based	Urban	2950	3.8	2.9	4.9
6	Oviasu <i>et al</i> <sup>[32,33]</sup>	1978	Isi-uwa	Edo	SS	160/100	Community based	Rural	1482	2.1	2.8	0.5
7	Oviasu <i>et al</i> <sup>[34,35]</sup>	1980	Benin city	Edo	SS	140/90	Civil servants	Urban	1265	13.3	14	10
8	Idahosa <sup>[110]</sup>	1987	Benin city	Edo	SS	140/90	Civil servants	Urban	1450	15.1	NA	NA
9	Ogunlesi <i>et al</i> <sup>[12]</sup>	1991	Ibadan	Oyo	SW	160/95	Male factory workers	Urban	541	8		
10	Ekpo <i>et al</i> <sup>[36]</sup>	1992	Calabar	Cross river	SS	160/95	Civil servants, factory workers, plantain workers	Urban	4382	8.1	8.9	3.5
11	Bunker <i>et al</i> <sup>[111]</sup>	1992	Benin city	Edo	SS	140/90	Civil servants	Urban	559	20-43	21.6	12.5
12	Kaufman <i>et al</i> <sup>[16]</sup>	1996	Ibadan	Eyo	SW	140/90	Community based	Urban	205	11		
13	Kaufman <i>et al</i> <sup>[17]</sup>	1996	Ibadan	Oyo	SW	140/90 (160/95)	Rural farmers/urban poor/retired railway workers	Rural/urban	598	14,25,29 (3,11,14)	-	-
14	Cooper <i>et al</i> <sup>[112]</sup>	1997	National	National	National	140/90	Community based	Rural	2509	14.5	14.7	14.3
15	Akinkugbe <sup>[113]</sup>	1997	National	National	National	160/95	Community based	Rural/urban	4930	10.7		
16	Owoaje <i>et al</i> <sup>[14]</sup>	1997	Ibadan	Oyo	SW	140/90	Community based	Urban	247	23.4	22.2	24.3
17	Kadiri <i>et al</i> <sup>[114]</sup>	1999	Ibadan	Oyo	SW	160/95	Civil servants	Urban	917	9.3	9.8	8
18	Olatunbosun <i>et al</i> <sup>[13]</sup>	2000	Ibadan	Oyo	SW	160/95	Civil servants	Urban	998	10.3	13.9	5.3
19	Lawoyin <i>et al</i> <sup>[20]</sup>	2002	Ibadan	Oyo	SW	140/90	Community cohort	Urban	2144	12.4	12.1	12.7
20	Onyemelukwe <sup>[115]</sup>	2003	Lagos	Lagos	SW	140/90	Community based	Rural/urban	1082	SHT 22.5, DHT 24.7	NA	NA
21	Akinkugbe <sup>[116]</sup>	2003	Lagos	Lagos	SW	140/90	Community based	Rural/urban	1018	34.8	36.2	33.5
22	Erhun <i>et al</i> <sup>[117]</sup>	2005	Ile-ife	Osun	SW	140/90	University community	Urban	1000	21	23.3	16.4
23	Oghagbon <i>et al</i> <sup>[118]</sup>	2008	Ilorin	Kwara	NC	140/90	Factory workers	Urban	281	27.1	28.4	22.9
24	Omuemu <i>et al</i> <sup>[98]</sup>	2007	Udo	Edo	SS	140/90	Community based	Rural	590	20.2	26.2	13.2
25	Ukoh <sup>[119]</sup>	2007	Benin city	Edo	SS	140/90	Hospital based	Urban	2852	20.2	NA	NA
26	Nwankwo <i>et al</i> <sup>[41]</sup>	2008	Maiduguri	Borno	NE	140/90	Community based	Rural/urban	224	40 (urban), 27.8 (rural)		
27	Adedoyin <i>et al</i> <sup>[31]</sup>	2008	Ile-ife	Osun	SW	140/90	Community based	Rural	2250	18.7	15.5	21
28	Ekore <i>et al</i> <sup>[21]</sup>	2009	Ibadan	Oyo	SW	140/90	Hospital based	Urban	405	30.6	34.4	28.2
29	Ulasi <i>et al</i> <sup>[26]</sup>	2010	Njodo Nike, Enugu	Enugu	SE	140/90	Community based	Semi-urban/rural	1939	35.4 (urban), 25.1 (rural)	NA	NA
30	Ekwunife <i>et al</i> <sup>[99]</sup>	2010	Nsukka	Enugu	SE	140/90	Community based	Urban	756	30	40.3	24.7
31	Sani <i>et al</i> <sup>[39]</sup>	2010	Katsina	Katsina	NW	140/90	Hospital based	Urban	300	25.7	27.9	24
32	Adegoke <i>et al</i> <sup>[30]</sup>	2010	Ile-ife	Osun	SW	140/90	Community based	Rural	132			
33	Oladapo <i>et al</i> <sup>[22]</sup>	2010	Egbeda	Oyo	SW	140/90	Community based	Rural	2000	20.8	21.1	20.5
34	Ahaneku <i>et al</i> <sup>[27]</sup>	2011	NA	Enugu	SE	140/90	Community based	Rural	218	44.5	49.5	42.3
35	Onwubere <i>et al</i> <sup>[24]</sup>	2011	Ezeagu	Enugu	SE	140/90	Community based	Rural	858	46.4	31.2	68.8
36	Ejim <i>et al</i> <sup>[23]</sup>	2011	Imezi owa,	Enugu	SE	140/90	Community based	Rural (middle age/elderly)	858	50.2		44.8
37	Ulasi <i>et al</i> <sup>[25]</sup>	2011	Enugu	Enugu	SE	140/90	Traders	Urban	731	42	46.3	37.7
38	Hendriks <i>et al</i> <sup>[120]</sup>	2011	Afon and Ajasse Ipo	Kwara	NC	140/90	Community based	Rural	2678	19.3	NA	NA
39	Isezuo <i>et al</i> <sup>[40]</sup>	2011	Sokoto	Sokoto	NW	140/90	Community based	Rural	782	24.8	25.9	23.6
40	Andy <i>et al</i> <sup>[37]</sup>	2012	CRS/AK	CRS/AK	SS	140/90	Community Based	Rural	3869	23.6	31.2	18.1
41	Onwuchekwa <i>et al</i> <sup>[38]</sup>	2012	Kegbara-Dere	Rivers	SS	140/90	Community based	Rural	1078	18.3	-	-
42	Odugbemi <i>et al</i> <sup>[121]</sup>	2012	Lagos	Lagos	SW	140/90	Traders	Urban	400	34.8	-	-
43	Ogah <i>et al</i> <sup>[42]</sup>	2012	Abia	Abia	SE	140/90	Community	Rural/urban	2983	SHT 31.4, DHT 22.5	Rural: SHT 33.5, DHT 23.4; Urban: SHT 33.6, DHT 20.6	Rural: SHT 30.5, DHT 25.4; Urban: SHT 26.4, DHT 18.4

SW: South west; SE: South east; SS: South south; NW: North west; NE: North east; NC: North central; NA: Not available; SHT: Systolic hypertension; DHT: Diastolic hypertension; BP: Blood pressure.



**Figure 2** Map of Nigeria showing the 36 states and federal capital territory as well as the 6 geopolitical zones.

Blood pressure control was poor; it was reported as 9% (5% in men and 17.5% in women) by Ekwunife *et al.*<sup>[99]</sup>.

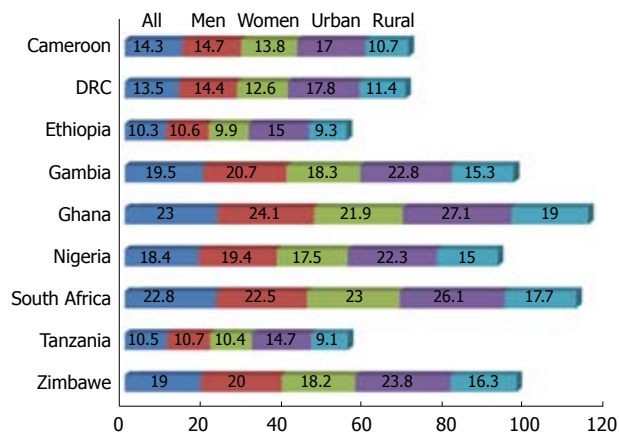
**Studies on pathophysiology of hypertension in Nigeria**

Osoimehin *et al.*<sup>[100]</sup> estimated plasma Na<sup>+</sup>-K<sup>+</sup> ATPase inhibitor by a technique in which it competes with ouabain for binding on red cells in normotensives without a family history of hypertension, normotensives with a family history of hypertension and hypertensive individuals. They observed that plasma levels of the inhibitor were significantly higher in the last two groups and that this correlated positively with urinary sodium excretion in the three groups.

In another study, the author demonstrated low renin activity in hypertensive Nigerians<sup>[101]</sup>.

Ogunlesi *et al.*<sup>[102]</sup> and Aderounmu *et al.*<sup>[103]</sup> studied intracellular sodium and blood pressure and showed that erythrocyte sodium (ENa) was higher in hypertensives compared with normal controls. ENa also correlated with systolic and diastolic blood pressure. Obasohan *et al.*<sup>[104]</sup> went further to demonstrate higher sodium-lithium counter-transport (SLC) activity and ENa levels both in hypertensive subjects and their offspring.

In a more recent study, Adebisi *et al.*<sup>[105]</sup> showed that plasma noradrenaline level was higher in hypertensive subjects compared to control subjects. Hypertensive Nigerians also have lower levels of plasma renin, angiotensin converting enzyme (ACE) and atrial natriuretic peptide (ANP). Systolic blood pressure positively correlated with plasma noradrenaline but negatively with renin, ACE and ANP. This finding of high noradrenaline levels in hypertensive Nigerians supports the hypothesis that activation of the sympatho-adrenergic system might play



**Figure 3** Comparison with other countries.

a dominant role in the pathophysiology of hypertension in Nigerians.

Several workers have also demonstrated higher salt taste and salt taste threshold in hypertensive individuals as well as their offspring compared to their normotensive counterparts<sup>[106-108]</sup>.

However such a relationship was not demonstrated in adolescent school children<sup>[109]</sup>.

**Hypertension related admissions in Nigeria**

In a review of the prevalence of hypertension and its complications among medical admissions in Enugu, South Eastern Nigeria, 18% (1360 subjects out of the 7399 admissions in the period between December 1998 and November 2003) had hypertension related diseases. Hypertensive congestive cardiac failure accounted for 26.5% of cases and 46.1% of hypertension related complications. Hypertension with its complications accounted for more than two-thirds (69.6%) of the cardiovascular system admissions<sup>[122,123]</sup>.

In a three year review of adult hypertensive admissions in Benin city (South-South Nigeria), Ukoh<sup>[119]</sup> reported that 575 out of the total of 2852 adult medical admissions in Benin were as a result of high blood pressure related morbidities. The most common hypertensive complications were stroke, congestive cardiac failure and chronic kidney failure.

In another report from the same region, stroke was the commonest cause of death at the medical emergency room of the University of Portharcourt teaching hospital<sup>[124]</sup>.

In a review of 424 hypertension related admissions in the same hospital (173 males and 251 females, aged 18-100 years with a mean of 56.5 ± 16.2); stroke was responsible for 169 (39.9%) hypertensive complications. "Heart failure occurred in 97 (22%) cases while renal failure and encephalopathy accounted for 40 (9.4%) and 7 (1.7%) hypertensive complications, respectively. There were 99 deaths out of which 51 (51.5%) were due to stroke, 14 (14.12%) were due to heart failure, and 12 (12.1%) were due to renal failure"<sup>[125]</sup>.

During the same period, 191 of the hypertension

related admissions died giving a case fatality of 42.9%. Eighty six (45%) of the deaths occurred during acute hypertensive crises such as stroke, hypertensive encephalopathy and acute renal failure. Other important complications leading to death included heart failure (17.3%) and renal failure (16.8%)<sup>[125]</sup>.

High blood pressure also contributed to the burden of adult medical admissions in Uyo (Southern Nigeria): hypertension related heart failure, stroke or severe uncontrolled hypertension. This was shown to be commoner in the wet seasons of the year<sup>[126]</sup>.

In Sokoto (Northwestern Nigeria), Isezuo *et al*<sup>[127]</sup> documented hypertension related admissions in 440 subjects admitted in a tertiary centre between 1995 and 2000. Hypertension related morbidities included heart failure (36.4%), stroke (34.8%) and chronic renal failure in 7.1% and other conditions in 21.7%. Hospital admissions for hypertension related morbidities were more generally higher in the rainy season than the dry season.

Kolo *et al*<sup>[128]</sup> studied hypertension related admissions and outcomes in a tertiary hospital in Bauchi (North Eastern Nigeria). They documented that out of the 3108 admissions into the medical ward of the hospital, 735 (23.7% were related to hypertension with an excess mortality of 42.9%. Stroke was the commonest complication, accounting for 44.4% of cases and had the highest mortality (39.3%). This was followed by chronic kidney disease (36.6%), hypertensive emergencies (30.9%) and heart failure which had the least intrahospital mortality of 27.5%.

### **Hypertensive target organ damage in Nigeria**

Hypertensive target organ damage (TOD) is common in Nigeria. Because of low awareness of hypertension in the country, hypertensive TOD is often what brings patients to healthcare facilities.

Oladapo *et al*<sup>[129]</sup> recently reported the results of the study of the prevalence and pattern of TOD and associated clinical conditions in 415 hypertensive individuals in a rural community in Southwestern Nigeria. 179 (43.1%) of the participants had evidence of TOD and 45 (10.8%) had established cardiovascular disease. Left ventricular hypertrophy (LVH) was present in 27.9%, atrial fibrillation in 16.4%, microalbuminuria in 12.3% and overt proteinuria in 15.3%.

Furthermore stroke was present in 6.3%, heart failure in 4.6%, retinopathy in 2.2%, ischaemic heart disease in 1.7% and peripheral vascular disease in 3.6%. TOD was significantly higher in those with severe hypertension and diabetes mellitus. In a related study but in younger subjects aged 18-44 years, Ekore *et al*<sup>[21]</sup> examined 124 individuals for TOD. LVH was present in 22 (17.7%), chronic cardiac failure in 3 (2.4%), retinopathy in 5 (4.0%), nephropathy in 12 (26.1%) and transient ischaemic attacks in one patient (0.8%)

Ayodele *et al*<sup>[130]</sup> examined 203 patients in an outpatient clinic in Abeokuta and documented LVH in 31%, heart failure in 10.8%, chronic kidney disease (CKD) in

18.2% and stroke in 8.9%.

### **Hypertensive heart disease**

Various aspects of hypertensive heart disease (HHD) have been studied in the country - such as LVH, LV geometry, left atrial structure, function and dysfunction, LV diastolic function and dysfunction, LV systolic function and right ventricular function. The burden of arrhythmias and conduction abnormalities has also been reported in compensated and asymptomatic hypertensives in the country.

**Left ventricular hypertrophy:** The prevalence of ECG LVH in hypertensive subjects varies from 18%-56% depending on the criteria used. Sokolow-Lyon-Rappaport voltage criteria have the best sensitivity (80%) and area under the receiver operating characteristic curve. Romhilt-Estes score was reported to have the best specificity<sup>[131]</sup>.

In another Nkado *et al*<sup>[132]</sup> noted a significant correlation of ECG voltage with echocardiographically determined LV mass.

ECG LVH with strain pattern has also been shown to have a worse LV structure and systolic function in hypertensive Nigerians<sup>[133]</sup>.

**Left ventricular diastolic dysfunction:** LV diastolic dysfunction has been demonstrated in hypertensive Nigerians by various workers<sup>[134-138]</sup>. Furthermore it has also been demonstrated in offspring of hypertensive individuals. Adamu *et al*<sup>[137]</sup> reported LV diastolic dysfunction in 62% of hypertensive subjects compared to 11.3% in age and sex-matched controls. Impaired relaxation was the commonest LV filling pattern.

Adebayo *et al*<sup>[139]</sup> demonstrated early diastolic dysfunction in hypertensives using a newer method of evaluation (tissue doppler imaging). In another study, the authors evaluated left atrial structural and functional alterations in hypertension which was found to be statistically different compared to age and sex-matched apparently normal individuals<sup>[140]</sup>.

**LV systolic dysfunction:** In a study of 832 unselected hypertensive subjects, Ogah *et al*<sup>[141]</sup> documented LV systolic dysfunction (LVSD) in 18.1% of the participants (mild LVSD = 9.6%, moderate LVSD = 3.7% and severe LVSD = 4.8%).

LV mass, body mass index and male gender were found to be independent predictors of LVSD in the study.

The Tei index (index of global myocardial performance) was found to be significantly higher in hypertensives compared to controls. This index also increased with severity of hypertensive heart failure. It was found to be inversely related to LV ejection fraction and directly related to some indexes of diastolic function such as E/A ratio and deceleration time<sup>[142]</sup>.

**Echocardiographic LVH and LV geometric patterns:** Adebiji *et al*<sup>[143]</sup> studied the prevalence and pattern

of LVH in a large population of hypertensive Nigerians seen at the University College Hospital, Ibadan. The prevalence of LVH ranged from 30.9%-56.0% depending on the method of indexation employed.

Abnormal LV geometry was documented in 61.1%-74.0% and was commoner in the female gender.

**Correlates of LV mass in hypertensive Nigerians:**

Ogah *et al*<sup>[144]</sup> assessed the correlates and determinants of LV mass in 285 hypertensive individuals. The authors found that diastolic blood pressure, family history of hypertension, alcohol consumption, left atrial size; LV wall stress and tension were the independent predictors of LV mass (LVM) in these hypertensive subjects.

**Right ventricular function and dysfunction:**

Karaye *et al*<sup>[145]</sup> reported right ventricular diastolic dysfunction (RVDD) and right ventricular systolic dysfunction (RVSD) in 61.7% and 32%, respectively, of 128 individuals with high blood pressure in Kano. RVSD was highest in those with eccentric LVH. Age was found to be the only determinant of RVDD while LV ejection fraction was a predictor of RVSD after adjusting for confounding variables. In a similar study, Akintunde *et al*<sup>[146]</sup> reported RV structural and functional alteration in hypertension and concluded that RVDD may be an early precursor of HHD in Nigerians.

**The burden of arrhythmias in hypertensive Nigerians:**

Hypertension and LVH are both risk factors for atrial fibrillation and ventricular arrhythmias.

Okeahialam *et al*<sup>[147]</sup> studied 1547 ECG tracings obtained from well compensated hypertensive patients over a 5-year period in Jos to determine the burden of arrhythmias. About 10% of patients had one form of arrhythmia or another. The common arrhythmias were ventricular ectopic (133, 86.9%) atrial ectopic (21, 13.7%) and atrial fibrillation (10, 6.5%). Others included sinus arrhythmia in 3 (1.9%), sinus escape beats in 3 (1.9%), wandering pacemaker in 3 (1.9%) and Wolf Parkinson White in 1 (0.7%). Factors associated with the presence of arrhythmias include: age, presence of ECG LVH and left atrial enlargement.

**Conduction abnormalities:**

In the same study, Okeahialam *et al*<sup>[147]</sup> noted the following conduction abnormalities in 1547 well compensated hypertensive patients. First degree AV block was present in 7 while 6 subjects had right bundle branch block and left bundle branch block.

**Hypertension as a risk factor for heart failure in Nigeria:**

Hypertension is by far the commonest risk factor for congestive heart failure in Nigeria. In the Abeokuta heart failure (HF) registry, hypertension was responsible for 78.7% of HF in the city. It was also responsible for 62.6%, 56.3%, 57% and 44.1% of heart failure cases in Abuja<sup>[148]</sup>, Port Harcourt<sup>[149]</sup>, Jos<sup>[150]</sup> and Uyo<sup>[126]</sup> respectively. In the recently published transnational study

of HF in sub-Saharan Africa, hypertension was clearly shown as the predominant cause of HF in the region, especially in Nigeria. Ogah *et al*<sup>[151]</sup> recently described the characteristics of 197 subjects with hypertensive HF in the Abeokuta HF registry. The mean age of the subjects was 58.4 years which is 15-20 years younger than the mean age of patients with HF in the developed world. The male to female ratio was 1.4:1. HF in hypertensive Nigerians was characterized by severe LV systolic dysfunction (65.5%) and abnormal LV geometry (concentric and eccentric LVH). Intrahospital mortality was 3.6%.

It has also been noted that most of the patients diagnosed as having dilated cardiomyopathy in Nigeria are cases of hypertensive heart failure with poor myocardial failure because of poor or no control<sup>[152,153]</sup>.

**Hypertension as a major risk factor for stroke in Nigeria**

Stroke is currently a major public health problem in Nigeria. As in many developing countries of the world it has some peculiarities. It occurs at a younger age with associated high mortality and disability adjusted life years.

Available hospital based studies in Nigeria suggest there are rising rates of stroke in the country<sup>[154]</sup>.

Available data, at least from hospital based studies, show that stroke accounts for 0.23%-4.0% of all hospital admissions, 0.5%-45% neurological admissions and 5%-17% of deaths on medical wards. It is the commonest cause of neurological admission in Lagos, the largest city and the commercial nerve centre of Nigeria. Cerebral infarction, intracerebral hemorrhage and subarachnoid haemorrhage, respectively, are responsible for 64%, 19% and 6% of strokes in the country<sup>[154]</sup>.

In a community based study in Lagos<sup>[155]</sup>, stroke prevalence was estimated as 1.14 per 1000 (1.51/1000 in men, 0.69/1000 in women and 24.1/1000 in those older than 65 years).

The mortality associated with stroke in Nigeria is high with 30 d case fatality ranging from 28% to 40%<sup>[154]</sup>.

In a 10-year review of stroke in Sagamu, Ogun State, stroke accounted for 2.4% of all emergency admissions. Forty nine percent had cerebral infarction, 45% intracerebral haemorrhage and 6% SAH. The studies further showed that 1.8% of all deaths at the emergency room were due to stroke. Case fatality at 24 h, 7 d, 30 d and 6 mo were 9%, 28%, 40% and 46%, respectively<sup>[154]</sup>. In the year 2007, mortality from stroke in the country was put at 126/100 000 population<sup>[156]</sup>.

In Nigeria, as in most developing countries, hypertension is the most important modifiable risk factor for stroke. It is present in almost 80% of cases. Unfortunately most victims are unaware of their blood pressure status prior to the event<sup>[157]</sup>.

**Hypertension as a risk factor for chronic kidney disease in Nigeria**

Hypertension is a major cause of CKD and chronic renal failure (CRF) in Nigeria. In Enugu (South East) and Benin City (South South), hypertension is the commonest



cause of CKD and CRF<sup>[158,159]</sup>. It is only second to chronic glomerulonephritis in the South West<sup>[160-163]</sup>. Hypertension induced CRF in Nigeria is four times commoner in men than women with a male: female ratio of 4.3:1. Severe throbbing frontal headache and nocturia are common. The duration of hypertension is usually between 2-15 years. It is associated with a history of cigarette smoking, poor compliance to anti-hypertensive medications, family history of hypertension, severe/accelerated hypertension and severe uraemia. The presence of other hypertension related TOD, such as heart failure and retinopathy, is common. Mortality is high, 51% within the first 12 mo of diagnosis. Renal histological findings include glomerular sclerosis, malignant arteriolar changes and absence of glomerular cellular proliferation<sup>[164,165]</sup>.

### **Hypertension and coronary artery disease in Nigeria**

Hypertension is a major risk factor for coronary artery disease (CAD) in Nigeria. Anjorin *et al*<sup>[166]</sup> recently reviewed 87 patients with CAD seen over a period of 22 years (1983-2004) at the University of Maiduguri teaching hospital. Hypertension was identified as a risk factor in 53%, diabetes in 41%, cigarette smoking in 39%, hypercholesterolemia in 29% and obesity in 20%.

### **Hypertensive retinopathy in Nigeria**

In a review of 407 patients with retinal diseases in Ile-Ife (Southwest) by Onakpoya *et al*<sup>[167]</sup>, hypertensive retinopathy was responsible for 12% of cases. In Ibadan, hypertensive retinopathy is the 9th commonest cause of retinal diseases and responsible for 4.6% of cases<sup>[168]</sup>. It is also responsible for 7.7% of all retinal/optic nerve disorders and 0.1% of ocular disorders in a rural community in northern Nigeria. In Enugu (South East), hypertensive retinopathy is responsible for 13% of vitreo-retinal diseases in a tertiary healthcare facility<sup>[169]</sup>.

## **DISCUSSION**

Since the creation of the Nigerian state in 1960, a lot of studies have been undertaken to provide information on the burden of hypertension in the country. This includes a national survey which was conducted in 1997<sup>[113]</sup>. It is pertinent, however, to note that most studies provided crude prevalence of the condition in the country. In addition, there are a lot of variations in the studies in terms of target population as well as criteria for diagnosis. Earlier studies used 160/95 mmHg (occasionally 160/90 mmHg) while the most recent ones used 140/90 mmHg as a cut off mark for the diagnosis of hypertension. The age structure in most of the studies is essentially middle age and represents the age structure of the Nigerian population, except in few studies that purely targeted middle age or elderly populations<sup>[15,23]</sup>. In many of the studies, the prevalence of hypertension was higher in men than in women at least up to the age of 40 years when the prevalence equalized<sup>[9,10,26,32]</sup>. This picture is similar to findings in other Africans, African Americans

and in Blacks in the Caribbean<sup>[112]</sup>.

The higher prevalence in the urban population may indicate differences in lifestyle. Urban populations are more likely to eat processed foods which are high in salt and fat content. Obesity which is a risk factor for hypertension is also higher in urban areas than in rural areas because of reduced physical activity.

In a few of the studies, especially in the Eastern part of the country, hypertension was found to be as high in the rural population as it is in the urban population<sup>[27]</sup>. This picture has been documented in some United States and European studies<sup>[170-173]</sup>. It is likely that those rural populations may be older as most old people move to rural areas after retirement from active service.

Hypertension awareness range from 3.5% in Sokoto to 30% in Nsukka<sup>[22,25,26,40,99]</sup>. There was no remarkable gender difference. Treatment ranged from 11.9%-21%<sup>[40,99]</sup>. In two studies the treatment rate was slightly higher in men than in women; however the control rate was significantly higher in women than in men (17.5% and 5%, respectively).

The higher detection rate in men than women is at variance with data from most parts of Africa and other parts of the world. Women are more likely to be detected during antenatal visits and are also more likely to accept the diagnosis of hypertension.

On the other hand, the blood pressure control rate is better in women than in men. Women are more likely to attend clinics for follow-up.

In general, hypertension and other chronic diseases awareness, treatment and control is generally low in the country as in most developing countries. These diseases are often asymptomatic and in most cases presentation is when complications have set in.

Emerging data from hospital studies show that hypertension or its complications is the commonest NCD in Nigeria. In 1961, hypertension related illnesses contributed to 8.8% of all medical admission in Lagos<sup>[28]</sup>. Abengowe *et al*<sup>[95]</sup> reported 9.3% in Kaduna in 1980. Recent data from the country indicated a rate of 28% in Port-Harcourt<sup>[124]</sup> and 21% in Benin City<sup>[119]</sup>. This is comparable to a rate of 30% from Tanzania<sup>[174]</sup>.

In conclusion, hypertension in Nigeria today is the commonest risk factor for stroke, heart failure, ischemic heart disease and chronic kidney disease<sup>[175]</sup>.

There is, therefore, a need to encourage health promotion in the population as means of primary prevention. There is also a need for increased public health education to increase the awareness of hypertension and the sequelae. Hypertension control programmes need to be established in communities in the country and more community based screening programmes for cardiovascular disease risk factors and NCDs need to be carried out. There is also a need to carry out research on the reasons for regional differences in prevalence of hypertension as well as reasons for lack of urban-rural differences in some areas in the country. The lack of scientific data to measure trends in the country should also be addressed.

## REFERENCES

- 1 **Wolf-Maier K**, Cooper RS, Banegas JR, Giampaoli S, Hense HW, Joffres M, Kastarinen M, Poulter N, Primatesta P, Rodríguez-Artalejo F, Stegmayr B, Thamm M, Tuomilehto J, Vanuzzo D, Vescio F. Hypertension prevalence and blood pressure levels in 6 European countries, Canada, and the United States. *JAMA* 2003; **289**: 2363-2369
- 2 **Cooper R**. Cardiovascular mortality among blacks, hypertension control, and the reagan budget. *J Natl Med Assoc* 1981; **73**: 1019-1020
- 3 **Cooper R**, Rotimi C. Hypertension in blacks. *Am J Hypertens* 1997; **10**: 804-812
- 4 **Cooper RS**, Liao Y, Rotimi C. Is hypertension more severe among U.S. blacks, or is severe hypertension more common? *Ann Epidemiol* 1996; **6**: 173-180
- 5 **Kearney PM**, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. *Lancet* 2005; **365**: 217-223
- 6 World Bank. Nigeria. 2012. Available from: URL: <http://data.worldbank.org/country/nigeria>
- 7 IMF. Report for Selected Countries and Subjects. 2012. Available from: URL: <http://www.imf.org/external/pubs/ft/weo/2012/01/weodata/weorept.aspx?pr.x=21&pr.y=3&sy=2009&ey=2012&scsm=1&ssd=1&sort=country&ds=.&br=1&c=694&s=NGDPD,NGDPDPC,PPPGDP,PPPPC,LP&grp=0&a=>
- 8 CIA. Nigeria. 2012. Available from: URL: <https://www.cia.gov/library/publications/the-world-factbook/geos/ni.html>
- 9 **Akinkugbe OO**, Ojo AO. The systemic blood pressure in a rural Nigerian population. *Trop Geogr Med* 1968; **20**: 347-356
- 10 **Akinkugbe OO**, Ojo OA. Arterial pressures in rural and urban populations in Nigeria. *Br Med J* 1969; **2**: 222-224
- 11 **Abrahams DG**, Alele CA, Barnard BG. The systemic blood pressure in a rural West African community. *West Afr Med J* 1960; **9**: 45-58
- 12 **Ogunlesi A**, Osotimehin B, Abbiyessuku F, Kadiri S, Akinkugbe O, Liao YL, Cooper R. Blood pressure and educational level among factory workers in Ibadan, Nigeria. *J Hum Hypertens* 1991; **5**: 375-380
- 13 **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**: 249-257
- 14 **Owoaje EE**, Rotimi CN, Kaufman JS, Tracy J, Cooper RS. Prevalence of adult diabetes in Ibadan, Nigeria. *East Afr Med J* 1997; **74**: 299-302
- 15 **Kadiri S**, Salako BL. Cardiovascular risk factors in middle aged Nigerians. *East Afr Med J* 1997; **74**: 303-306
- 16 **Kaufman JS**, Durazo-Arvizu RA, Rotimi CN, McGee DL, Cooper RS. Obesity and hypertension prevalence in populations of African origin. The Investigators of the International Collaborative Study on Hypertension in Blacks. *Epidemiology* 1996; **7**: 398-405
- 17 **Kaufman JS**, Owoaje EE, James SA, Rotimi CN, Cooper RS. Determinants of hypertension in West Africa: contribution of anthropometric and dietary factors to urban-rural and socioeconomic gradients. *Am J Epidemiol* 1996; **143**: 1203-1218
- 18 **Kaufman JS**, Rotimi CN, Brieger WR, Oladokun MA, Kadiri S, Osotimehin BO, Cooper RS. The mortality risk associated with hypertension: preliminary results of a prospective study in rural Nigeria. *J Hum Hypertens* 1996; **10**: 461-464
- 19 **Kaufman JS**, Tracy JA, Durazo-Arvizu RA, Cooper RS. Lifestyle, education, and prevalence of hypertension in populations of African origin. Results from the International Collaborative Study on Hypertension in Blacks. *Ann Epidemiol* 1997; **7**: 22-27
- 20 **Lawoyin TO**, Asuzu MC, Kaufman J, Rotimi C, Owoaje E, Johnson L, Cooper R. Prevalence of cardiovascular risk factors in an African, urban inner city community. *West Afr J Med* 2002; **21**: 208-211
- 21 **Ekore RI**, Ajayi IO, Arije A. Case finding for hypertension in young adult patients attending a missionary hospital in Nigeria. *Afr Health Sci* 2009; **9**: 193-199
- 22 **Oladapo OO**, Salako L, Sodiq O, Shoyinka K, Adedapo K, Falase AO. A prevalence of cardiometabolic risk factors among a rural Yoruba south-western Nigerian population: a population-based survey. *Cardiovasc J Afr* 2010; **21**: 26-31
- 23 **Ejim EC**, Okafor CI, Emehel A, Mbah AU, Onyia U, Egwunwu T, Akabueze J, Onwubere BJ. Prevalence of cardiovascular risk factors in the middle-aged and elderly population of a Nigerian rural community. *J Trop Med* 2011; **2011**: 308687
- 24 **Onwubere BJ**, Ejim EC, Okafor CI, Emehel A, Mbah AU, Onyia U, Mendis S. Pattern of Blood Pressure Indices among the Residents of a Rural Community in South East Nigeria. *Int J Hypertens* 2011; **2011**: 621074
- 25 **Ulasi II**, Ijoma CK, Onwubere BJ, Arodiwe E, Onodugo O, Okafor C. High prevalence and low awareness of hypertension in a market population in enugu, Nigeria. *Int J Hypertens* 2011; **2011**: 869675
- 26 **Ulasi II**, Ijoma CK, Onodugo OD. A community-based study of hypertension and cardio-metabolic syndrome in semi-urban and rural communities in Nigeria. *BMC Health Serv Res* 2010; **10**: 71
- 27 **Ahaneku GI**, Osuji CU, Anisiuba BC, Ikeh VO, Oguejiofor OC, Ahaneku JE. Evaluation of blood pressure and indices of obesity in a typical rural community in eastern Nigeria. *Ann Afr Med* 2011; **10**: 120-126
- 28 **Smith AJ**. Arterial hypertension in the Lagos University Teaching Hospital. *West Afr Med J* 1966; **15**: 97-104
- 29 **Smith AJ**. Hypertension in the African. *Lancet* 1969; **1**: 372
- 30 **Adegoke OA**, Adedoyin RA, Balogun MO, Adebayo RA, Bisiriyu LA, Salawu AA. Prevalence of metabolic syndrome in a rural community in Nigeria. *Metab Syndr Relat Disord* 2010; **8**: 59-62
- 31 **Adedoyin RA**, Mbada CE, Balogun MO, Martins T, Adebayo RA, Akintomide A, Akinwusi PO. Prevalence and pattern of hypertension in a semiurban community in Nigeria. *Eur J Cardiovasc Prev Rehabil* 2008; **15**: 683-687
- 32 **Oviasu VO**. Arterial blood pressures and hypertension in a rural Nigerian community. *Afr J Med Med Sci* 1978; **7**: 137-143
- 33 **Oviasu VO**, Okupa FE. Occupational factors in hypertension in the Nigerian African. *J Epidemiol Community Health* 1979; **33**: 274-278
- 34 **Oviasu VO**, Okupa FE. Arterial blood pressure and hypertension in Benin in the equatorial forest zone of Nigeria. *Trop Geogr Med* 1980; **32**: 241-244
- 35 **Oviasu VO**, Okupa FE. Relation between hypertension and occupational factors in rural and urban Africans. *Bull World Health Organ* 1980; **58**: 485-489
- 36 **Ekpo EB**, Udofia O, Eshiet NF, Andy JJ. Demographic, life style and anthropometric correlates of blood pressure of Nigerian urban civil servants, factory and plantation workers. *J Hum Hypertens* 1992; **6**: 275-280
- 37 **Andy JJ**, Peters EJ, Ekrikpo UE, Akpan NA, Unadike BC, Ekott JU. Prevalence and correlates of hypertension among the Ibibio/Annangs, Efiks and Obolos: a cross sectional community survey in rural South-South Nigeria. *Ethn Dis* 2012; **22**: 335-339
- 38 **Onwuchekwa AC**, Mezie-Okoye MM, Babatunde S. Prevalence of hypertension in Kegbara-Dere, a rural community in the Niger Delta region, Nigeria. *Ethn Dis* 2012; **22**: 340-346
- 39 **Sani MU**, Wahab KW, Yusuf BO, Gbadamosi M, Johnson OV, Gbadamosi A. Modifiable cardiovascular risk factors among apparently healthy adult Nigerian population - a cross sectional study. *BMC Res Notes* 2010; **3**: 11
- 40 **Isezuo SA**, Sabir AA, Ohwovorilole 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**: 224-230
- 41 **Nwankwo EA**, Ene AC, Biyaya B. Some Cardiovascular Risk Factors in Volunteers for health checks: A Study Of Rural And Urban Residents In The Northeast Nigeria. *The Internet Journal of Cardiovascular Research* 2008; **5**
  - 42 **Ogah OS**, Madukwe OO, Chukwuonye II, Onyeonoro UU, Ukaegbu AU, Akhimien MO, Onwubere BJC, Okpechi IG. Prevalence and determinants of hypertension in Abia State Nigeria: Results from the Abia State Non-Communicable diseases and Cardiovascular Risk factors Survey. *Ethn Dis* 2012; In press
  - 43 **The National Expert Committee**. Non-Communicable Disease in Nigeria. Report of a National Survey. Ibadan: Federal Ministry of Health, 1997
  - 44 **Cooke AR**. Notes on the disease met with in Uganda, Central Africa. *J Trop Med* 1901; **4**: 175-178
  - 45 **Donnison CP**. Blood pressure in the African natives: its bearing upon aetiology of hyperplasia and arteriosclerosis. *Lancet* 1929; **1**: 6-7
  - 46 **Jex-Blake AJ**. High blood pressure. *East Afr Med J* 1934; **10**: 286-300
  - 47 **Vint FW**. Postmortem findings in natives of Kenya. *East Afr Med J* 1937; **13**: 332-340
  - 48 **Callander WH**. Blood pressure in Nigerian soldiers and army recruits. *West Afr Med J* 1953; **2**: 02-103
  - 49 **Beet EA**. Rheumatic heart disease in Northern Nigeria. *Trans R Soc Trop Med Hyg* 1956; **50**: 587-592
  - 50 **Nwokolo C**. Endomyocardial fibrosis and other obscure cardiopathies in eastern Nigeria. *West Afr Med J* 1955; **4**: 103-116
  - 51 **Lambo TA**. Psychiatric syndromes associated with cerebrovascular disorders in the African. *J Ment Sci* 1958; **104**: 133-143
  - 52 **Johnson TO**. Arterial blood pressures and hypertension in an urban African population sample. *Br J Prev Soc Med* 1971; **25**: 26-33
  - 53 **Akinkugbe OO**, Brown WC, Cranston WI. Pressor effects of angiotensin infusions into different vascular beds in the rabbit. *Clin Sci* 1966; **30**: 409-416
  - 54 **Akinkugbe OO**, Brown WC, Cranston WI. The direct renal action of angiotensin in the rabbit. *Clin Sci* 1966; **30**: 259-266
  - 55 **Akinkugbe OO**, Brown WC, Cranston WI. Response to angiotensin infusion before and after adrenalectomy in the rabbit. *Am J Physiol* 1967; **212**: 1147-1152
  - 56 **Akinkugbe OO**. The rarity of hypertensive retinopathy in the African. *Am J Med* 1968; **45**: 401-404
  - 57 **Akinkugbe OO**, Jaiyesimi F. The rarer causes of hypertension in Ibadan. (An eleven-year study). *West Afr Med J Niger Pract* 1968; **17**: 82-85
  - 58 **Akinkugbe OO**. Hypertensive disease in Ibadan, Nigeria. A clinical prospective study. *East Afr Med J* 1969; **46**: 313-320
  - 59 **Akinkugbe OO**. School survey of arterial pressure and proteinuria in Ibadan, Nigeria. *East Afr Med J* 1969; **46**: 257-261
  - 60 **Akinkugbe OO**. Antihypertensive treatment in the African context. *Practitioner* 1969; **202**: 549-552
  - 61 **Akinkugbe OO**, Carlisle R, Olatunde IA. Proceedings: Beta-adrenergic blockers in the treatment of hypertension: experience with propranolol at the U.C.H. Ibadan, Nigeria. *West Afr J Pharmacol Drug Res* 1974; **2**: 63P-64P
  - 62 **Akinkugbe OO**, Akinkugbe FM, Ayeni O, Solomon H, French K, Minear R. Biracial study of arterial pressures in the first and second decades of life. *Br Med J* 1977; **1**: 1132-1134
  - 63 **Cole TO**, Adadevoh BK. Clinical evaluation of Declinax in Nigerian hypertensives. *Br J Clin Pract* 1970; **24**: 245-249
  - 64 **Salako LA**. Oral thiazide diuretics in the treatment of hypertension in Nigeria. *West Afr Med J Niger Pract* 1971; **20**: 320-323
  - 65 **Salako LA**. Serum electrolytes in hypertension in Nigerians. *Clin Chim Acta* 1971; **34**: 105-111
  - 66 **Salako LA**. Serum electrolytes during long term treatment of hypertension with thiazide diuretics in Nigerians. *West Afr Med J Niger Med Dent Pract* 1972; **21**: 104-105
  - 67 **Salako LA**, Falase AO. Clinical evaluation of moduretic in the treatment of arterial hypertension. *Niger Med J* 1973; **3**: 150-155
  - 68 **Salako LA**, Falase AO, Aderounmu AF. Comparative beta-adrenoreceptor-blocking effects and pharmacokinetics of propranolol and pindolol in hypertensive Africans. *Clin Sci (Lond)* 1979; **57** Suppl 5: 393s-396s
  - 69 **Salako LA**, Falase AO, Aderounmu AF. Placebo-controlled, double-blind clinical trial of alprenolol in African hypertensive patients. *Curr Med Res Opin* 1979; **6**: 358-363
  - 70 **Falase AO**, Salako LA, Aminu JM. Lack of effect of low doses of prazosin in hypertensive Nigerians. *Curr Ther Res Clin Exp* 1976; **19**: 603-611
  - 71 **Falase AO**, Salako LA. Clinical experience with Timolol maleate (Blocadren, MSD) in Nigerian hypertensives. *Niger Med J* 1979; **9**: 453-459
  - 72 **Falase AO**, Salako LA. beta-Adrenoceptor blockers in the treatment of hypertension. *Afr J Med Med Sci* 1979; **8**: 13-18
  - 73 **Osuntokun BO**, Akinkugbe FM, Francis TI, Reddy S, Osuntokun O, Taylor GO. Diabetes mellitus in Nigerians: a study of 832 patients. *West Afr Med J Niger Pract* 1971; **20**: 295-312
  - 74 **Osuntokun BO**. Hypertension in Nigerian diabetics: a study of 832 patients. *Afr J Med Sci* 1972; **3**: 257-265
  - 75 **Osuntokun BO**. Stroke in the Africans. *Afr J Med Med Sci* 1977; **6**: 39-53
  - 76 **Osuntokun BO**, Bademosi O, Akinkugbe OO, Oyediran AB, Carlisle R. Incidence of stroke in an African City: results from the Stroke Registry at Ibadan, Nigeria, 1973-1975. *Stroke* 1979; **10**: 205-207
  - 77 **Soyannwo MA**, Ayeni O, Lucas AO. Studies on the prevalence of renal disease and hypertension in relation to schistosomiasis. IV. Systemic blood pressure hypertension and related features. *Niger Med J* 1978; **8**: 465-476
  - 78 **Soyannwo MA**, Ayeni O, Lucas AO. Studies on the prevalence of renal disease and hypertension in relation to schistosomiasis: I Some aspects of epidemiological methods in the rural illiterate setting. *Niger Med J* 1978; **8**: 290-295
  - 79 **Soyannwo MA**, Lagundoye SB, Lucas AO. Studies on the prevalence of renal disease and hypertension in relation to schistosomiasis. V. Radiological findings: plain X-ray abdomen and intravenous pyelogram. *Niger Med J* 1978; **8**: 477-486
  - 80 **Soyannwo MA**, Lucas AO. Studies on the prevalence of renal disease and hypertension in relation to schistosomiasis II: Nocturia and day-time frequency of micturition in the rural community of Nigeria. *Niger Med J* 1978; **8**: 296-302
  - 81 **Soyannwo MA**, Ogbechi ME, Adeyeni GA, Soyeni AI, Lipede MR, Lucas AO. Studies on the prevalence of renal disease and hypertension in relation to schistosomiasis. III. Proteinuria, haematuria, pyuria and bacteriuria in the rural community of Nigeria. *Niger Med J* 1978; **8**: 451-464
  - 82 **Monekoso GL**. Clinical survey of a yoruba village. *West Afr Med J* 1964; **13**: 47-59
  - 83 **Ojo OA**, Akinkugbe OO. Nontoxic hypertension in pregnancy in the African indigene. An analysis of 30 cases. *Am J Obstet Gynecol* 1969; **105**: 938-941
  - 84 **Brockington IF**. Postpartum hypertensive heart failure. *Am J Cardiol* 1971; **27**: 650-658
  - 85 **Carlisle R**. Remission of hypertension in Nigerians. Clinical observations in twelve patients. *Afr J Med Sci* 1971; **2**: 57-63
  - 86 **Aderele WI**, Seriki O. Hypertension in Nigerian children. *Arch Dis Child* 1974; **49**: 313-317
  - 87 **Akinkugbe A**. Arterial pressures in non-pregnant women of child-bearing age in Ile-Ife, Nigeria. *Br J Obstet Gynaecol*

- 1976; **83**: 545-549
- 88 **Etta KM**, Watson RS. Casual blood pressures and their possible relation to age, body weight, Quetelet's index, serum cholesterol, percentage of body fat and mid-arm muscle circumference in three groups of northern Nigerian residents. *Afr J Med Med Sci* 1976; **5**: 255-262
- 89 **Olatunbosun DA**, Bolodeoku JO, Cole TO, Adadevoh BK. Relationship of serum copper and zinc to human hypertension in Nigerians. *Bull World Health Organ* 1976; **53**: 134-135
- 90 **Jain PS**, Gera SC, Abengowe CU. Incidence of hypertension in Ahmadu Bello University Hospital Kaduna--Nigeria. *J Trop Med Hyg* 1977; **80**: 90-94
- 91 **Olatunde A**, Akinkugbe OO, Carlisle R. Beta-adrenergic blockers in the treatment of hypertension--experience with propranolol at Ibadan, Nigeria. *East Afr Med J* 1977; **54**: 194-201
- 92 **Abdurrahman MB**, Ochoga SA. Casual blood pressure in school children in Kaduna, Nigeria. *Trop Geogr Med* 1978; **30**: 325-329
- 93 **Mabadeje AF**. The use of low dose of chlorthalidone in hypertensive Nigerians. *Niger Med J* 1979; **9**: 755-758
- 94 **Alakija W**. A pilot study of blood pressure levels in Benin City, Nigeria. *East Afr Med J* 1979; **56**: 182-187
- 95 **Abengowe CU**, Jain JS, Siddique AK. Pattern of hypertension in the northern savanna of Nigeria. *Trop Doct* 1980; **10**: 3-8
- 96 **Ladipo GO**. Hypertensive retinopathy in Nigerians. A prospective clinical study of 350 cases. *Trop Geogr Med* 1981; **33**: 311-316
- 97 **Twagirumukiza M**, De Bacquer D, Kips JG, de Backer 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**: 1243-1252
- 98 **Omuemu VO**, Okojie OH, Omuemu CE. Awareness of high blood pressure status, treatment and control in a rural community in Edo State. *Niger J Clin Pract* 2007; **10**: 208-212
- 99 **Ekwunife OL**, Udeogaranya PO, Nwatu IL. Prevalence, awareness, treatment and control of hypertension in a Nigerian population. *Health* 2010; **7**: 731-735
- 100 **Osoimehin B**, Lawal SO, Iyun AO, Falase AO, Pernollet MG, Devynck MA, Meyer P. Plasma levels of digitalis-like substance in Nigerians with essential hypertension. *Afr J Med Med Sci* 1988; **17**: 231-235
- 101 **Osoimehin B**, Erasmus RT, Iyun AO, Falase AO, Ahmad Z. Plasma renin activity and plasma aldosterone concentrations in untreated Nigerians with essential hypertension. *Afr J Med Med Sci* 1984; **13**: 139-143
- 102 **Ogunlesi AO**, Osoimehin B, Akinkugbe OO. Intracellular sodium and blood pressure in Nigerians. *Ethn Dis* 1991; **1**: 280-287
- 103 **Aderounmu AF**, Salako LA. Abnormal cation composition and transport in erythrocytes from hypertensive patients. *Eur J Clin Invest* 1979; **9**: 369-375
- 104 **Obasohan AO**, Osuji CO, Oforofuo IA. Sodium-lithium countertransport activity in normotensive offspring of hypertensive black Africans. *J Hum Hypertens* 1998; **12**: 373-377
- 105 **Adebiyi AA**, Akinosun OM, Nwafor CE, Falase AO. Plasma catecholamines in Nigerians with primary hypertension. *Ethn Dis* 2011; **21**: 158-162
- 106 **Azinge EC**, Sofola OA, Silva BO. Relationship between salt intake, salt-taste threshold and blood pressure in Nigerians. *West Afr J Med* 2011; **30**: 373-376
- 107 **Ukoh VA**, Ukoh GC, Okosun RE, Azubike E. Salt intake in first degree relations of hypertensive and normotensive Nigerians. *East Afr Med J* 2004; **81**: 524-528
- 108 **Elias SO**, Azinge EC, Umoren GA, Jaja SI, Sofola OA. Salt-sensitivity in normotensive and hypertensive Nigerians. *Nig Q J Hosp Med* 2011; **21**: 85-91
- 109 **Okoro EO**, Uroghide GE, Jolayemi ET. Salt taste sensitivity and blood pressure in adolescent school children in southern Nigeria. *East Afr Med J* 1998; **75**: 199-203
- 110 **Idahosa PE**. Blood pressure pattern in urban Edos. *J Hypertens Suppl* 1985; **3**: S379-S381
- 111 **Bunker CH**, Ukoli FA, Nwankwo MU, Omene JA, Currier GW, Holifield-Kennedy L, Freeman DT, Vergis EN, Yeh LL, Kuller LH. Factors associated with hypertension in Nigerian civil servants. *Prev Med* 1992; **21**: 710-722
- 112 **Cooper R**, Rotimi C, Ataman S, McGee D, Osotimehin B, Kadir S, Muna W, Kingue S, Fraser H, Forrester T, Bennett F, Wilks R. The prevalence of hypertension in seven populations of west African origin. *Am J Public Health* 1997; **87**: 160-168
- 113 **Akinkugbe OO**. The National Expert Committee. Non-Communicable Disease in Nigeria. Report of a National Survey. Series 4. Lagos: Intec Printers Limited, 1997
- 114 **Kadir S**, Walker O, Salako BL, Akinkugbe O. Blood pressure, hypertension and correlates in urbanised workers in Ibadan, Nigeria: a revisit. *J Hum Hypertens* 1999; **13**: 23-27
- 115 **Onyemelukwe GC**. National survey of non-communicable disease (NCD)- 2003 (South West Zone). On behalf of the Federal Ministry of Health NCD control programme, and the national expert committee on NCD in collaboration with the Nigeria Heart Foundation. 2003. Available from: URL: <http://www.docstoc.com/docs/106751314/RESULTS>
- 116 **Akinkugbe OO**. Health behavior monitor among Nigerian adult population: a collaborative work of Nigerian Heart Foundation and Federal Ministry of Health and Social Services, Abuja supported by World Health Organization, Geneva. 2003. Available from: URL: [http://www.who.int/chp/steps/2003\\_STEPS\\_Report\\_Nigeria.pdf](http://www.who.int/chp/steps/2003_STEPS_Report_Nigeria.pdf)
- 117 **Erhun WO**, Olayiwola G, Agbani EO, Omotosho NS. Prevalence of Hypertension in a University Community in South West Nigeria. *African Journal of Biomedical Research* 2005; **8**: 15-19
- 118 **Oghagbon EK**, Okesina AB, Biliaminu SA. Prevalence of hypertension and associated variables in paid workers in Ilorin, Nigeria. *Niger J Clin Pract* 2008; **11**: 342-346
- 119 **Ukoh VA**. Admission of hypertensive patients at the University of Benin Teaching Hospital, Nigeria. *East Afr Med J* 2007; **84**: 329-335
- 120 **Hendriks ME**, Wit FW, Roos MT, Brewster LM, Akande TM, de Beer IH, Mfinanga SG, Kahwa AM, Gatongi P, Van Rooy G, Janssens W, Lammers J, Kramer B, Bonfrer I, Gaeb E, van der Gaag J, Rinke de Wit TF, Lange JM, Schultsz C. Hypertension in sub-Saharan Africa: cross-sectional surveys in four rural and urban communities. *PLoS One* 2012; **7**: e32638
- 121 **Odugbemi TO**, Onajole AT, Osibogun AO. Prevalence of cardiovascular risk factors amongst traders in an urban market in Lagos, Nigeria. *Niger Postgrad Med J* 2012; **19**: 1-6
- 122 **Ike SO**. Prevalence of hypertension and its complications among medical admissions at the University of Nigeria Teaching Hospital, Enugu (Study 2). *Niger J Med* 2009; **18**: 68-72
- 123 **Arodiwe EB**, Ike SO, Nwokediuko SC. Case fatality among hypertension-related admissions in Enugu, Nigeria. *Niger J Clin Pract* 2009; **12**: 153-156
- 124 **Onwuchekwa AC**, Asekomeh EG, Iyagba AM, Onung SI. Medical mortality in the Accident and Emergency Unit of the University of Port Harcourt Teaching Hospital. *Niger J Med* 2008; **17**: 182-185
- 125 **Onwuchekwa AC**, Chinenye S. Clinical profile of hypertension at a University Teaching Hospital in Nigeria. *Vasc Health Risk Manag* 2010; **6**: 511-516
- 126 **Ansa VO**, Ekott JU, Essien IO, Bassey EO. Seasonal variation in admission for heart failure, hypertension and stroke in Uyo, South-Eastern Nigeria. *Ann Afr Med* 2008; **7**: 62-66
- 127 **Isezuo SA**. Seasonal variation in hospitalisation for hypertension-related morbidities in Sokoto, north-western Nigeria. *Int J Circumpolar Health* 2003; **62**: 397-409

- 128 **Kolo PM**, Jibrin YB, Sanya EO, Alkali M, Peter Kio IB, Moronkola RK. Hypertension-related admissions and outcome in a tertiary hospital in northeast Nigeria. *Int J Hypertens* 2012; **2012**: 960546
- 129 **Oladapo OO**, Salako L, Sadiq L, Shoyinka K, Adedapo K, Falase AO. Target-organ damage and cardiovascular complications in hypertensive Nigerian Yoruba adults: a cross-sectional study. *Cardiovasc J Afr* 2012; **23**: 379-384
- 130 **Ayodele OE**, Alebiosu CO, Salako BL, Awoden OG, Abigun AD. Target organ damage and associated clinical conditions among Nigerians with treated hypertension. *Cardiovasc J S Afr* 2005; **16**: 89-93
- 131 **Dada A**, Adebisi AA, Aje A, Oladapo OO, Falase AO. Standard electrocardiographic criteria for left ventricular hypertrophy in Nigerian hypertensives. *Ethn Dis* 2005; **15**: 578-584
- 132 **Nkado RN**, Onwubere BJ, Ikeh VO, Anisiuba BC. Correlation of electrocardiogram with echocardiographic left ventricular mass in adult Nigerians with systemic hypertension. *West Afr J Med* 2003; **22**: 246-249
- 133 **Ogah OS**, Adebisi AA, Oladapo OO, Aje A, Ojji DB, Adebayo AK, Salako BL, Falase AO. Association between electrocardiographic left ventricular hypertrophy with strain pattern and left ventricular structure and function. *Cardiology* 2006; **106**: 14-21
- 134 **Oyati IA**, Danbauchi SS, Alhassan MA, Isa MS. Diastolic dysfunction in persons with hypertensive heart failure. *J Natl Med Assoc* 2004; **96**: 968-973
- 135 **Ike S**, Ikeh V. The prevalence of diastolic dysfunction in adult hypertensive Nigerians. *Ghana Med J* 2006; **40**: 55-60
- 136 **Adebisi AA**, Aje A, Ogah OS, Ojji DB, Oladapo OO, Falase AO. Left ventricular diastolic function parameters in hypertensives. *J Natl Med Assoc* 2005; **97**: 41-45
- 137 **Adamu GU**, Katibi AI, Opadijo GO, Omotoso AB, Araoye AM. Prevalence of left ventricular diastolic dysfunction in newly diagnosed Nigerians with systemic hypertension: a pulsed wave Doppler echocardiographic study. *Afr Health Sci* 2010; **10**: 177-182
- 138 **Akintunde AA**, Familoni OB, Akinwusi PO, Opadijo OG. Relationship between left ventricular geometric pattern and systolic and diastolic function in treated Nigerian hypertensives. *Cardiovasc J Afr* 2010; **21**: 21-25
- 139 **Adebayo AK**, Oladapo OO, Adebisi AA, Ogunleye OO, Ogah OS, Ojji DB, Adeoye MA, Ochulor KC, Enakpene EO, Falase AO. Characterisation of left ventricular function by tissue Doppler imaging technique in newly diagnosed, untreated hypertensive subjects. *Cardiovasc J Afr* 2008; **19**: 259-263
- 140 **Adebayo AK**, Oladapo OO, Adebisi AA, Ogunleye OO, Ogah OS, Ojji DB, Aje A, Adeoye MA, Ochulor KC, Enakpene EO, Falase AO. Changes in left atrial dimension and function and left ventricular geometry in newly diagnosed untreated hypertensive subjects. *J Cardiovasc Med (Hagerstown)* 2008; **9**: 561-569
- 141 **Ogah OS**, Akinyemi RO, Adegbite GD, Udofia OI, Udoh SB, Adesina JO, Ojo OS, Alabi AA, Majekodunmi T, Osinfade JK, Ogundipe RF, Falase AO. Prevalence of asymptomatic left ventricular systolic dysfunction in hypertensive Nigerians: echocardiographic study of 832 subjects. *Cardiovasc J Afr* 2011; **22**: 297-302
- 142 **Akintunde AA**, Akinwusi PO, Opadijo GO. Relationship between Tei index of myocardial performance and left ventricular geometry in Nigerians with systemic hypertension. *Cardiovasc J Afr* 2011; **22**: 124-127
- 143 **Adebisi AA**, Ogah OS, Aje A, Ojji DB, Adebayo AK, Oladapo OO, Falase AO. Echocardiographic partition values and prevalence of left ventricular hypertrophy in hypertensive Nigerians. *BMC Med Imaging* 2006; **6**: 10
- 144 **Ogah OS**, Bamgboye AE. Correlates of left ventricular mass in hypertensive Nigerians: an echocardiographic study. *Cardiovasc J Afr* 2010; **21**: 79-85
- 145 **Karaye KM**, Habib AG, Mohammed S, Rabiu M, Shehu MN. Assessment of right ventricular systolic function using tricuspid annular-plane systolic excursion in Nigerians with systemic hypertension. *Cardiovasc J Afr* 2010; **21**: 186-190
- 146 **Akintunde AA**, Akinwusi PO, Familoni OB, Opadijo OG. Effect of systemic hypertension on right ventricular morphology and function: an echocardiographic study. *Cardiovasc J Afr* 2010; **21**: 252-256
- 147 **Okeahialam BN**. The burden of arrhythmia in hypertension: an electrocardiographic study. *Nig J Cardiol* 2004; **1**: 53-56
- 148 **Ojji DB**, Alfa J, Ajayi SO, Mamven MH, Falase AO. Pattern of heart failure in Abuja, Nigeria: an echocardiographic study. *Cardiovasc J Afr* 2009; **20**: 349-352
- 149 **Onwuchekwa AC**, Asekomeh GE. Pattern of heart failure in a Nigerian teaching hospital. *Vasc Health Risk Manag* 2009; **5**: 745-750
- 150 **Laabes EP**, Thacher TD, Okeahialam BN. Risk factors for heart failure in adult Nigerians. *Acta Cardiol* 2008; **63**: 437-443
- 151 **Ogah OS**, Falase AO, Carrington M, Stewart S, Sliwa K. Hypertensive heart failure in Nigerian Africans: insights from the Abeokuta heart failure registry. *Circulation* 2012; **125**: e703
- 152 **Falase AO**, Ogah OS. Cardiomyopathies and myocardial disorders in Africa: present status and the way forward. *Cardiovasc J Afr* 2012; In press
- 153 **Lawal SO**, Osotimehin BO, Falase AO. Mild hypertension in patients with suspected dilated cardiomyopathy: cause or consequence? *Afr J Med Med Sci* 1988; **17**: 101-112
- 154 **Ogun SA**, Ojini FI, Ogungbo B, Kolapo KO, Danesi MA. Stroke in south west Nigeria: a 10-year review. *Stroke* 2005; **36**: 1120-1122
- 155 **Danesi M**, Okubadejo N, Ojini F. Prevalence of stroke in an urban, mixed-income community in Lagos, Nigeria. *Neuroepidemiology* 2007; **28**: 216-223
- 156 **Strong K**, Mathers C, Bonita R. Preventing stroke: saving lives around the world. *Lancet Neurol* 2007; **6**: 182-187
- 157 **Wahab KW**. The burden of stroke in Nigeria. *Int J Stroke* 2008; **3**: 290-292
- 158 **Ojogwu LI**. The pathological basis of endstage renal disease in Nigerians: experience from Benin City. *West Afr J Med* 1990; **9**: 193-196
- 159 **Ulasu II**, Ijoma CK. The enormity of chronic kidney disease in Nigeria: the situation in a teaching hospital in South-East Nigeria. *J Trop Med* 2010; **2010**: 501957
- 160 **Ojo OS**, Akinsola AA, Nwosu SO, Odesanmi WO. The pathological basis of chronic renal failure in Nigerians. An autopsy study. *Trop Geogr Med* 1992; **44**: 42-46
- 161 **Akinsola W**, Odesanmi WO, Ogunniyi JO, Ladipo GO. Diseases causing chronic renal failure in Nigerians--a prospective study of 100 cases. *Afr J Med Med Sci* 1989; **18**: 131-137
- 162 **Arogundade FA**, Sanusi AA, Hassan MO, Akinsola A. The pattern, clinical characteristics and outcome of ESRD in Ile-Ife, Nigeria: is there a change in trend? *Afr Health Sci* 2011; **11**: 594-601
- 163 **Alebiosu CO**, Ayodele OO, Abbas A, Olutoyin AI. Chronic renal failure at the Olabisi Onabanjo University Teaching Hospital, Sagamu, Nigeria. *Afr Health Sci* 2006; **6**: 132-138
- 164 **Adelekan TA**, Akinsola A. Hypertension induced chronic renal failure: clinical features, management and prognosis. *West Afr J Med* 1998; **17**: 104-108
- 165 **Ojogwu LI**, Anah CO. Renal failure and hypertension in tropical Africa--a pre-dialysis experience from Nigeria. *East Afr Med J* 1983; **60**: 478-484
- 166 **Anjorin CO**, Buba F, Eneh AC. Myocardial infarction at the University of Maiduguri Teaching Hospital, North Eastern Nigeria: A long term review. *J Med Sci* 2005; **5**: 358-362
- 167 **Onakpoya OH**, Olateju SO, Ajayi IA. Retinal diseases in a tertiary hospital: the need for establishment of a vitreo-

- retinal care unit. *J Natl Med Assoc* 2008; **100**: 1286-1289
- 168 **Oluleye TS**, Ajaiyeoba AI. Retinal diseases in Ibadan. *Eye (Lond)* 2006; **20**: 1461-1463
- 169 **Eze BI**, Uche JN, Shiweobi JO. The burden and spectrum of vitreo-retinal diseases among ophthalmic outpatients in a resource-deficient tertiary eye care setting in South-eastern Nigeria. *Middle East Afr J Ophthalmol* 2010; **17**: 246-249
- 170 National survey of Non-communicable diseases (South-West Zone). Abuja: Federal Ministry of Health, 2003
- 171 **Banegas JR**, Rodríguez-Artalejo F, de la Cruz Troca JJ, Guallar-Castillón P, del Rey Calero J. Blood pressure in Spain: distribution, awareness, control, and benefits of a reduction in average pressure. *Hypertension* 1998; **32**: 998-1002
- 172 **Mainous AG**, King DE, Garr DR, Pearson WS. Race, rural residence, and control of diabetes and hypertension. *Ann Fam Med* 2004; **2**: 563-568
- 173 **Psaltopoulou T**, Orfanos P, Naska A, Lenas D, Trichopoulos D, Trichopoulou A. Prevalence, awareness, treatment and control of hypertension in a general population sample of 26,913 adults in the Greek EPIC study. *Int J Epidemiol* 2004; **33**: 1345-1352
- 174 **Edwards R**, Unwin N, Mugusi F, Whiting D, Rashid S, Kissima J, Aspray TJ, Alberti KG. Hypertension prevalence and care in an urban and rural area of Tanzania. *J Hypertens* 2000; **18**: 145-152
- 175 **Ogah OS**. Hypertension in Sub-Saharan African populations: the burden of hypertension in Nigeria. *Ethn Dis* 2006; **16**: 765

S- Editor Cheng JX L- Editor O'Neill M E- Editor Li JY