Prevalence of Hypertension in Kegbara-Dere, a Rural Community in the Niger Delta Region, Nigeria

Arthur Chukwubike Onwuchekwa, MBBS, FMCP;
Mary Margaret Mezie-Okoye, BMBCh, MPH, FMCPH;
Seye Babatunde, MBBS, MPH, FWACP

Objectives: Hypertension has become a major health burden in sub-Saharan Africa, mainly due to urbanization and Western acculturation. We investigated the prevalence of hypertension and risk factors in a rural community in South-South Nigeria.

Design, setting, participants: Blood pressure and anthropometric indices were measured during a cross-sectional study of community health status among 1078 adults, aged ≥18 years, in 2008. Information on lifestyle was also collected through structured interviews.

Statistics: Unadjusted hypertension prevalence was calculated against selected risk factors, and association was demonstrated using risk ratios with 95% confidence intervals. Chi-square was used to test for statistical significance at $P<.05$. Adjusted analysis was done for age by direct standardization using a reference population.

Main outcome measure: Prevalence of hypertension, defined as systolic and diastolic blood pressure ≥140 mm Hg and ≥90 mm Hg respectively and/or current use of antihypertensive medication.

Results: Crude prevalence of hypertension was 18.3% (95% CI=16.0–20.7), while the age-adjusted prevalence was 2.63% (95% CI=2.59–2.66). Hypertension rate increased with age (RRs>2.0, $P=.00$) and was higher in those married (RR=.35, $P=.00$), but showed no sex difference (RR=1.13, $P=.34$). Hypertension was associated with tobacco chewing/snuffing (RR=2.32, $P=.05$) and history of diabetes (RR=3.36, $P=.00$); but central obesity, alcohol intake, cigarette smoking, and family history of hypertension or diabetes showed no valid association.

Conclusions: The study found a high prevalence of hypertension in a rural community. Although, the influence of selected risk factors could not be established, screening and health promotion in rural areas should be intensified. (*Ethn Dis*. 2012;22[3]:340–346)

Key Words: Prevalence, Hypertension, Rural Community, Niger Delta, Nigeria

From Department of Internal Medicine (ACO) and Department of Preventive and Social Medicine, University of Port Harcourt, Port Harcourt, Nigeria (MMM, SB).

Address correspondence to Arthur Chukwubike Onwuchekwa, MBBS; Department of Internal Medicine; University of Port Harcourt Teaching Hospital; Port Harcourt, Nigeria; +234.803.342.1872; ac_onwuchekwa@yahoo.com

Our study was carried out to determine the prevalence of hypertension among adults aged ≥18 years in a rural community and to identify the presence of known risk factors.

Introduction

Nigeria has a population of about 150 million people and is the most populous Black country in the world. The population distribution indicates a relatively larger rural populace compared to urban. A national survey of non-communicable disease (NCD) in Nigeria about two decades ago showed that the prevalence of hypertension in the rural community was 9.8% using the former World Health Organization criteria of blood pressure (BP) of 160/95 mm Hg.[1] The projected prevalence of hypertension using the current definition of hypertension from the Seventh Joint National Committee on Prevention, Detection, Evaluation and Treatment of high blood pressure (JNC7) guideline of a cut-off point of 140/90 mm Hg is 20–25%.[2]

Several studies attest to rural vs urban differences on blood pressure levels throughout sub-Saharan Africa.[1,3] The reported prevalence of hypertension in rural studies in the 1970s and 1980s was generally low. By 2001 and 2002, the prevalence of hypertension rose considerably with age in a Ghanaian rural community with approximately one-third having hypertension at the age ≥65.[4] Similarly, in a recent study of Port Harcourt, the urban capital city of Rivers State, Nigeria, prevalence of hypertension was 40.8%.[5] Such changes are probably the result of acculturations which can be expected to proceed at different rates in different communities. It is thought that urban societies have higher rates of hypertension when compared with the rural areas.[6] Rural to urban migration markedly increases the risk of hypertension.[7] Reasons offered for rural/urban differences in hypertension include change in diet with higher salt and calorie intake and reduced potassium intake.[8,9] Other factors include sedentary life style and more psychosocial stress,[6] which are worse in urban dwellers. Our study was carried out to determine the prevalence of hypertension among adults aged ≥18 years in a rural community and to identify the presence of known risk factors.

Methods

Study Setting

As part of an annual household–based, population study of community health status indicators undertaken by the Department of Preventive and Social Medicine of the University of Port Harcourt, a cross-sectional prevalence

study of hypertension was conducted in the rural community of Kegbara-Dere (K-Dere) in July 2008.

Despite its location within 40 km from the capital city of Port Harcourt in Rivers State, Nigeria, and in the heart of the Ogoni oil fields of the Niger Delta, K-Dere is a pristine rural farming settlement with sparse social infrastructure and an estimated population of 19,968 (based on projected 1996 census results from the National Population Commission of Nigeria).

Sample Size and Sampling

A simple random sampling of 500 households was done from a numbered list of all households in order to obtain a minimum sample size of 1,527 adults aged ≥18 years (based on an assumption of an average of three adults per household). The sample size of eligible adults was calculated based on an estimated prevalence of hypertension of 21%[2] at a set margin of sampling error of 2%, and confidence limit of 95%. A household was defined as a group of people who share a common residence and partake in common meals.

Study Procedure

Using the household numbers on the list of selected households, a team of trained field assistants enumerated all eligible adults in the households that met the age criteria. Medical personnel, who had been trained according to the survey methodology, measured BP in a quiet area of the survey site at 7 am–11 am daily. The respondents rested quietly for about 10 minutes and were not permitted to smoke or take tobacco snuff. An Accoson® Mercury Sphygmomanometer was used, held at the level of the heart, on the left arm of the participants in the sitting position. The systolic BP was taken as the first Korotkoff sound (phase 1), and diastolic BP was recorded at the disappearance of the sounds (phase 5). Measurements were recorded to the nearest 2 mm Hg on two occasions at an interval of two minutes. The mean of the two measurements was used in the analysis. Hypertension was defined as systolic or diastolic BP of ≥140 or ≥90 mm Hg, respectively, and a history of current medication on anti-hypertensive drugs.[10] Waist circumference was measured in cm in the narrowest sections of the trunk between the costal margin and the iliac crest; and the hip circumference as the widest section of the buttocks over the greater trochanters. Waist–to–hip Ratio (WHR) was determined by dividing waist circumference in cm by hip circumference in cm. A WHR of more than .8 for females and .95 for males was considered as central or abdominal obesity.[11]

Data Collection and Analysis

Structured questionnaire interviews were conducted in the households using a pre-tested tool, to obtain information on sociodemographic characteristics of the respondents, and on their medical, family and social history related to cardiovascular disease. These included age, sex, occupation, marital status, alcohol intake, cigarette smoking, tobacco chewing, diabetes mellitus, and family history of hypertension or diabetes mellitus.

Statistical Analysis

All data were entered and analyzed in the Epi-Info® v6.04d statistical package. Summary statistics were computed including proportions, means and risk ratios with 95% confidence intervals (Cls). The primary outcome variable was hypertension prevalence. Unadjusted (ie, crude) prevalence rates of hypertension were computed by age, sex and marital status, occupation and by selected risk factors. Relative risks (RR) were calculated as prevalence ratios to demonstrate relationship between variables. For the analysis of the unadjusted rates and testing for statistical significance of unadjusted RR, a chi-square statistic was calculated, except for comparison of unadjusted rate across age groups for which the Mantel-Haenszel chi-square test for trend was used. The adjusted analysis was done for age by direct standardization method using the US population 2000 as the reference population.[12] A conventional value of $P<.05$ (type I error alpha=.05) was used for all data analyses.

Ethical Considerations

Approval for the study was obtained from the Ethical Committee of the University of Port Harcourt Teaching Hospital. Verbal informed consent was obtained from all participants prior to recruitment. Confidentiality of obtained information was assured by the secure handling and storage of the questionnaires. Participants who were found to be hypertensive were consulted and given pre-printed referral letters to attend the K-Dere health center, run by the Community Medicine Department of the University of Port Harcourt Teaching Hospital, for confirmation and treatment. Management was offered free of charge to such participants.

RESULTS

A total of 491 households were located and surveyed, which yielded a total of 1,735 eligible adults. But data were not complete for all variables, thus analysis was based on a sample of 1,078 participants for whom systolic/diastolic BP measurements and age were recorded. The mean age was 35.8 ± 14.8 years with slightly more than half (55.7%) aged <35 years (Table 1). There were 604 females (56.0%; 95% Cl=53.0–59.0) and 474 males (44.0%; 95% Cl=41.0–47.0) giving a female to male ratio of 1.3:1.

More than half (56.4%) were married; single were about one-third (30.9%), and notably, about one-tenth, 9.8% were widowed (Table 1). The majority of the participants, 39.5%, reported having senior secondary education followed by 21.2% with primary

Table 1. Demographic characteristics of study population

Variable	*n*	%
Age group, years		
15–24	281	26.1%
25–34	319	29.6%
35–44	187	17.3%
45–54	151	14.0%
55–64	77	7.1%
65–74	52	4.8%
75–84	7	.6%
≥85	4	.4%
Total	1078	100.0%
Sex		
Females	604	56.0%
Males	474	44.0%
Total	1078	100.0%
Marital status		
Married	560	56.4%
Single	307	30.9%
Living with partner	21	2.1%
Divorced	1	.1%
Separated	7	.7%
Widowed	97	9.8%
Total	993	100%
Education		
Primary	210	21.2%
Junior secondary	108	10.9%
Senior secondary	391	39.5%
Tertiary	112	11.3%
None	169	17.1%
Total	990	100.0%
Occupation		
Farming	342	33.5%
Trading	120	11.8%
Fishing	39	3.8%
Civil servant	59	5.8%
Company worker	25	2.4%
Business/contractor	55	5.4%
Student	160	15.7%
Apprentice	23	2.3%
Housewife only	26	2.5%
Pensioner only	7	.7%
Artisan	53	5.2%
Professional	10	1.0%
Others	102	10.0%
Total	1021	100.0%

education, while 17.1% had no formal education (Table 1). The preponderant occupation was farming, reported by one-third (33.5%); students were the next common group at 15.7% (Table 1).

The prevalence of selected health risk factors was determined: alcohol consumption was 41.4%, (95% CI=38.5–44.4); cigarette smoking was 8.6% (95% CI=7.1–10.5) in the study population; while tobacco chewing/snuffing was far less common at 1.1% (95% CI=.6–20); and central obesity, measured as WHR, was 62.2% (95% CI=58.3–66.0) among the participants that consented (n=633) to have the measurements taken. However, there was a sex difference in the prevalence of central obesity, being higher among females at 90.1% (95% CI=86.5–92.9) compared to males at 25.1% (95% CI=20.0–30.7).

The crude prevalence of hypertension was 18.3% (95% CI=16.0–20.7) among all participants (n=1078), while isolated systolic hypertension was 12.0% (95% Cl=10.3–14.3) and isolated diastolic hypertension was 16.4% (95% Cl=14.6–19.2). The means of the systolic and diastolic blood pressure were 119.8 ± 18.1 mm Hg and 76.8 ± 12.3 mm Hg, respectively.

The unadjusted hypertension rate was higher among older participants as shown in Table 2; from 6.0% among the group aged 15–24 years to 46.2% among the 65–74 group, followed by a sharp increase to 85.7% in the 75–84 group, and then a drop to 50% in those >85. Using the 15–24 years age group as a baseline, increases at every decade of life were noted to be remarkable (RRs >2). A Mantel extension to test trend also showed a statistically significant P=.00. Males recorded a higher unadjusted hypertension prevalence of 19.6% compared to 17.2% females, but this difference was not statistically significant (P=.34). Study participants that were married and widowed recorded the highest prevalence of hypertension of 22.5% and 30.9% respectively; the only reported divorcee was not hypertensive. From the analysis, being single was associated with a reduced rate of hypertension (RR=.35, P=.00) when compared with being married. Civil servants and professionals (such as engineers, lawyers and accountants) also recorded the highest rates at 32.2% and 30.0% respectively, while students had the lowest rate of 5.6%. The prevalence of hypertension was 20.5% among farmers.

With respect to selected risk factors for hypertension (see Table 2), alcohol consumption (RR=1.20, P=.16), history of cigarette smoking (RR=1.06, P=.81), family history of hypertension in a first-degree relative (RR=1.34, P=.09), and family history of diabetes (RR=1.47, P=.06) did not show statistically valid higher rates of hypertension. Conversely, participants with history of tobacco snuffing/chewing had 2.32 times higher rate of hypertension (RR=2.32, P=.05); and those with previously diagnosed diabetes had 3.36 times higher rate of hypertension (RR=3.36, P=.00). The effect of central obesity on hypertension was also investigated using WHRs with standard cut-offs for women and men. Although a higher hypertension rate was observed in participants (combined for women and men) with central obesity, this was not statistically significant; central obesity was not found to be associated with hypertension (Unadjusted RR=1.21, P=.25).

Table 3 provides age-adjusted prevalence rates for this study. The adjustment was made by direct standardization using the US population 2000 as the reference population.[12] Thus, the age-adjusted hypertension prevalence rate for the study population was 18.3% (95% CI=2.59–2.66) or 26.26 per 1000 (95% CI=25.91–26.62).

DISCUSSION

Our study findings show a prevalence of hypertension of 18.3% in a rural community in South-South Nigeria. Even with the influence of age removed, the age-adjusted prevalence of 26 per 1000 population supports the fact that hypertension is not rare in rural populations in sub-Saharan Africa, though rural-urban differences still exist.[9,12–16] The African Union had called

Table 2. Unadjusted hypertension rates and unadjusted relative risk ratios of hypertension for selected risk factors

Variables	Hypertension rate % (95% CI)	Unadjusted RR (95% CI)	*P*
Age Group			
15–24, reference	6.0 (3.6–9.5)	1	
25–34	11.9 (8.6–16.0)	1.97 (1.14–3.41)	
35–44	19.8 (14.3–26.2)	3.27 (1.90–5.63)	
45–54	27.2 (20.2–35.0)	4.49 (2.64–7.62)	
55–64	41.6 (30.4–53.4)	6.87 (4.04–11.69)	
65–74	46.2 (32.2–60.5)	7.63 (4.42–13.17)	
75–84	85.7 (42.1–99.6)	14.17 (8.16–24.59)	
≥85	50.0 (6.8–93.2)	8.26 (2.80–24.41)	.000[a]
Sex			
Female, reference	17.2 (14.3–20.5)	1	
Male	19.6 (16.1–23.5)	1.13 (.88–1.45)	.340
Marital Status			
Married, reference	22.5 (19.1–26.2)	1	
Single	7.8 (5.1–11.4)	.35 (.23–.53)	.000
Living with partner	4.8 (.1–23.8)	.21 (.03–1.44)	.054
Separated	14.3 (.4–57.9)	.63 (.10–3.92)	.605
Divorced	.0 (.0–97.5)	-	.540[b]
Widowed	30.9 (21.9–41.1)	1.37 (.98–1.92)	.072
Alcohol consumption			
No, reference	16.9 (14.0–20.0)	1	
Yes	20.2 (16.6–24.2)	1.20 (.93–1.54)	.160
Ever Smoked			
No, reference	18.1 (15.8–20.7)	1	
Yes	19.1 (11.8–28.6)	1.06 (.68–1.63)	.806
Tobacco snuffing/chewing			
No, reference	17.9 (15.7–20.4)	1	
Yes	41.7 (15.2–72.3)	2.32 (1.18–4.60)	.050[b]
Family History of HBP			
No, reference	17.8 (17.1–31.6)	1	
Yes	23.8 (15.0–20.8)	1.34 (.96–1.87)	.094
Not sure	15.3 (11.0–20.5)	.86 (.61–1.21)	.379
Family history of diabetes			
No, reference	18.3 (17.8–37.4)	1	
Yes	26.7 (15.6–21.1)	1.47 (1.00–2.14)	.057
Not sure	14.0 (9.6–19.5)	.77 (.53–1.11)	.152
Known diabetic			
No, reference	17.8 (15.6–20.3)	1	
Yes	60.0 (26.2–87.9)	3.36 (1.99–5.67)	.004[b]
Central obesity, WHR[c]			
No, reference	17.2 (12.6–22.5)	1	
Yes	20.8 (16.9–25.2)	1.21 (.86–1.70)	.250

[a] Extended Mantel-Haenszel $\chi 2$ for trend.
[b] Fisher Exact *P*.
[c] WHR available for $n=633$.

hypertension 'one of the continent's greatest health challenges after AIDS'.[17] Curiously, a comparison of the crude prevalence of hypertension in our study community appears similar to what was reported from the National Health Survey conducted in Nigeria about two decades ago.[1] Using a projected cut-off point of 140/90 mm Hg, the National Health Survey estimated prevalence of hypertension was 20%–25%.[1] Whether this represents a 'no change' scenario is difficult to establish without disaggregated historical information specific to our study area. Changes in the pattern of hypertension and other cardiovascular diseases usually go with urbanization and lifestyle changes.[9,18] However, less Western acculturation appears to have occurred in this rural part of South-South Nigeria, where non-mechanized farming, which involves long trekking and rigorous physical activity, has remained the main occupation.

Advancing age has been established as an independent risk factor for cardiovascular diseases.[19] Our findings corroborated this known fact about the association between increasing age and hypertension.[20] However, a sharp drop in hypertension rate was observed in the age-group >85 years, which may be due to the fact that cardiovascular mortality is higher in advanced age;[21] the sample of participants in this age group were relatively few, usually typical of populations in developing countries, and the two of those four participants that were hypertensive were females.

Sex had no impact on the pattern of hypertension in the study population. This is similar to a study of rural Ga communities in Ghana where no sex difference was found in the prevalence of hypertension.[13] Sex difference in blood pressure is generally inconsistent among African origin populations.[14] Studies in various Nigerian populations also support this; in the 60s and 70s, Johnson[22] found a higher prevalence among females in an urban Lagos population, whereas Smith[23] reported higher rates in males in the same population, and so did Oviasu[24] among the Edos in South-South Nigeria. More recently, other Nigerian studies also reported higher rates in males[25] while others noted the reverse.[26] This varied pattern in sex distribution was also observed in India among a large heterogeneous population.[27–29] This

Table 3. Age-adjusted hypertension prevalence rates with adjustment to US population 2000

Age group, years	Sample population	Number with HBP	Age-specific rates	US 2000 standard population	Expected numbers
(a)	(b)	(c)	(d)	(e)	(f)
15–24	281	17	6.0	138,647	839
25–34	319	38	11.9	135,573	1,615
35–44	187	37	19.8	162,613	3,217
45–54	151	41	27.2	134,834	3,661
55–64	77	32	41.6	87,247	3,626
65–74	52	24	46.2	66,037	3,048
75–84	7	6	85.7	44,841	3,844
≥85	4	2	50.0	15,508	775
Totals	1,078	197	18.3	785,300	20,625
			Age-adjusted prevalence rate of HBP[a]		26.26

[a] Columns f/e × 1000.

Our study findings show a prevalence of hypertension of 18.3% in a rural community in South-South Nigeria.

inconsistency may be due to differences in the age of the population in the various studies or in the methodology or blood pressure cut-offs used.

Marital status has been reported to be associated with hypertension,[30,31] and apparently being married confers protection from developing hypertension.[31,32] However, a relatively higher proportion of those married in our study population had hypertension, while being single was associated with a reduced risk of hypertension. The apparent explanation could be that being married did not offer the safety net that one would expect from having a companion, but rather there may have been an increased psychosocial stress associated with family life. Though, in a recent study of African Americans, Schwandt et al[33] reported that marital status was not associated with hypertension.

Differences between occupation groups were also observed; professionals and civil servants had higher unadjusted hypertension rates compared to farmers, the dominant occupation in the community. Though level of individual physical activity was not investigated, farmers in the study community engage in a lot of trekking and manual labor, unlike the professionals and civil servants who are more sedentary, and probably live a more affordable, Westernized lifestyle that would be regarded as luxury. Available evidence indicates that the risk of developing hypertension is less among persons who engage in physical exercise.[31]

Contrary to what has been established, we found no association between hypertension and either alcohol consumption or cigarette smoking in this study.[34] These two lifestyle risk factors, however, were not commonly practiced in the study community and the common local drink, fresh palm-wine, has been reported to be low in alcoholic content.[35] However, respondents who chew tobacco and/or snuff tobacco had a higher prevalence of hypertension, and a valid association was established as documented in other studies.[10,34]

Family history of hypertension was not found to be associated with hypertension in our study population. However, hypertension is known to be usually asymptomatic, and not all the study participants were certain of the status of high BP of family members. Visible complications of hypertension such as stroke, when they occur are usually attributed to witch craft[36] and may go unrecognized. Familial aggregation of hypertension is notably evident in populations, nonetheless, it has been suggested that, relative to genetic factors, the influence of environmental factors in the causation of hypertension may have been under-appreciated.[34] Similarly, family history of diabetes was not found to be associated with hypertension, but conversely, participants who were previously diagnosed with diabetes had a three-fold increase in crude prevalence of hypertension. The concordance between hypertension and diabetes has been well documented.[10,37,38]

Central or abdominal obesity was found to be more common among women as other studies have reported,[9] but was not found to be associated with hypertension in this study. In contrast, many studies have shown a strong and independent association between obesity and blood pressure increase.[39,40] Despite this clear association, it has been suggested that the noxious effect of obesity in Black people is less than in people from other population groups.[41,42] Our finding suggest the need for further elucidation to investigate the influence of other co-founding factors, though not all the study participants consented to having their waist and hip measured.

A few of the limitations of this study have been mentioned including the incompleteness of data on some variables including waist and hip measurements. But, given our sampling techniques and the relatively large sample size, we believe that we have a representative sample of those eligible to participate in the study. In addition, we note that the blood pressure measurement was not repeated on the right arm and could have led to some underestimation of hypertension prevalence. Urinary sodium and potassium levels

were not estimated in the respondents due to financial and manpower constraints. Similarly, no detailed dietary history was taken on the respondents. Despite these limitations, our finding may be representative of most of the rural populations in South-South Nigeria, and could be used to formulate local health policy.

Hypertension in K-Dere, a rural community in Niger Delta, South-South Nigeria was found to be high, and comparable to estimates from the National Health Survey conducted about two decades ago. Although, the influence of selected lifestyle risk factors could not be established, health promotion in such areas should be intensified with emphasis on life styles that are beneficial such as diet and physical activity. Screening and management of individuals who have hypertension should be a continuous exercise, and hypertension control programs to create hypertension awareness among rural communities should be embarked upon.

ACKNOWLEDGMENTS

Dr. Owens Wiwa's unpublished work on mental stress in the Ogoni area of Rivers State accounted for the authors' comments on the effect of violence and conflict. The authors acknowledge the groundwork for the field study undertaken by the Department of Preventive and Social Medicine, University of Port Harcourt, and the support offered by Drs. Charles Tobin-West and Bliss Moore, and all the final year medical students who collected the data. The authors also thank the staff of the health centre, and members and leaders of the study community.

REFERENCES

1. Akinkugbe OO. *Non-Communicable Diseases in Nigeria. Final Report of a National Survey.* Federal Ministry of Health and Social Services, Lagos. 1997;64–90.
2. Ogah OS. Hypertension in sub-Saharan African populations: the burden of hypertension in Nigeria (Letter to Editor). *Ethn Dis*. 2006;16:765.
3. Seedat YK. Hypertension in developing nations in sub-Saharan Africa. *J Hum Hypertens*. 2000;14:739–747.
4. Cappuccio FP, Micah FB, Emmett L, et al. Prevalence, detection, management and control of hypertension in Ashanti, West Africa. *Hypertension*. 2004;43:1017–1022.
5. Akpa MR, Emem-Chioma PC, Odia OJ. Current epidemiology of hypertension in Port Harcourt metropolis, Rivers State, Nigeria. *Port Harcourt Med J*. 2008;2:218–223.
6. Cooper R, Rotimi C, Ataman S, et al. The prevalence of hypertension in seven populations of West African origin. *Am J Public Health*. 1997;87:160–168.
7. Poulter NR, Khaw K, Hopwood BE, et al. Determinants of blood pressure changes due to urbanization: a longitudinal study. *J Hypertens*. 1985;3(suppl):s375–s377.
8. Kerry SM, Emmett L, Micah FB, et al. Rural and semi-urban differences in salt intake and its dietary sources in Ashanti, West Africa. *Ethn Dis*. 2005;15:33–39.
9. Opie LH, Seedat YK. Hypertension in sub-Saharan African population. *Circulation*. 2005;112:3562–3568.
10. 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. *Hypertension*. 2003;42(6):1206–1252.
11. Carrol L. Bye-Bye BMI? Better way to measure obesity. www.msnbc.msn.com/id/14483512. June 26, 2009.
12. Klein RJ, Schoenborn CA. *Age Adjustment Using the 2000 Projected US Population.* Healthy People Statistical Notes No 20. Hyattsville, Md: National Center for Health Statistics; 2001.
13. Addo J, Amoah AG, Koram KA. The changing patterns of hypertension in Ghana: a study of four rural communities in Ga district. *Ethn Dis*. 2006;16:894–899.
14. Agyemang C, Redekop WK, Owusu-Dabo E, Bruijnzeels MA. Blood pressure patterns in rural semi-urban and urban children in the Ashanti region of Ghana, West Africa. *BMC Public Health*. 2005;5:114.
15. Addo J, Smeeth L, Leon DA. Hypertension In Sub-Saharan Africa: a systematic review. *Hypertension*. 2007;50:1012–1018.
16. Kunutsor S, Powles J. Descriptive epidemiology of blood pressure in a rural adult population in Northern Ghana. *Rural Remote Health*. 2009;9(2):1095.
17. Kluger J. Blowing a gasket. *Time*. December 6, 2004;34–40.
18. Schutte AE, van Rooyen JM, Huisman HW, Kruger HS, de Ridder JH. Factor analysis of possible risks for hypertension in a black South African population. *J Hum Hypertens*. 2003; 17:339–348.
19. Smith SM, Mensah GA. Population aging and implications for epidemic cardiovascular disease in sub-Saharan Africa. *Ethn Dis*. 2003; 13(2 Suppl 2):S77–80.
20. Kadiri S, Walker O, Salako BL, Akinkugbe O. Blood pressure, hypertension and correlates in urbanized workers in Ibadan, Nigeria: a revisit. *J Hum Hypertens*. 1999;13:23–27.
21. Das SK, Banerjee TK. Stroke: Indian scenario. *Circulation*. 2008;118:2719–2724.
22. Johnson TO. Arterial blood pressure and hypertension in an urban African population sample. *Br J Prev Soc Med*. 1971; 25:26–33.
23. Smith JA. Arterial hypertension patients at the University of Lagos Teaching Hospital, Nigeria. *West Afr J Med*. 1966;15:97–104.
24. Oviasu VO. Arterial blood pressure and hypertension in a rural Nigerian community. *Afr J Med Med Sci*. 1978;7:137–143.
25. How to Make Palm Wine. en.howtopedia.org/wiki/How_to_Make_Palm_Wine. October 28, 2009.
26. Okesina AB, Oparinde DP, Akindoyin KA, et al. Prevalence of some risk factors of coronary heart disease in a rural Nigerian population. *East Afr Med J*. 1999;76:212–216.
27. Kadiri S, Salako BL. Cardiovascular risk factors in middle-aged Nigerians. *East Afr Med J*. 1997;74:303–306.
28. Nirmala A. Age variation in blood pressure effects of sex and urbanization in a genetically homogenous caste population of Andra Pradesh. *Am J Hum Biol*. 2001;13(6):744–752.
29. Gupta R, Gupta S, Gupta VP, Prakash H. Prevalence and determinants of hypertension in the urban population of Jaipur in Western India. *J Hypertens*. 1995;13(10):1193–1200.
30. Singh RB, Sharma JP, Rastogi V, et al. Prevalence and determinants of hypertension in the Indian social class and heart survey. *J Hum Hypertens*. 1997;11:51–56.
31. Wang H. Effects of marital status and transition on hypertension in Chinese women: a longitudinal study. Paper presented at the annual meeting of the Population Association of America, March 31-April 2, 2005, Philadelphia.
32. Mandal PK, Roy AKS, Chatterjee C, et al. Burden of Hypertension and its risk factors in an urban community of India: Are we aware and concerned? *Sudanese J Public Health*. 2010;15(3):130–135.
33. Lipowicz A, Lopuszanska M. Marital differences in blood pressure and the risk of hypertension among Polish men. *Eur J Epidemiol*. 2005;20(5):421–427.
34. Schwandt HM, Coresh J, Hindi MJ. Marital status, hypertension, coronary heart disease, diabetes, and death among African American women and men: incidence and prevalence in the Atherosclerosis Risk in Communities (ARIC) Study participants. *J Fam Issues*. 2010;31:1211–1229.

35. Agyemang C, Addo J, Bhopal R, Aikins A, Stronks K. Cardiovascular disease, diabetes and established risk factors among populations of sub-Saharan African descent in Europe: a literature review. *Global Health*. 2009;5:7.
36. Ansa VO, Ekoh JU, Bassey EO. Profile and outcome of cardiovascular admissions at the University of Uyo Teaching Hospital, Uyo: a five-year review. *Niger J Clin Pract*. 2008; 11(1):22–24.
37. Epstein M, Sowers JR. Diabetes mellitus and hypertension. *Hypertension*. 1992;19:403–418.
38. Lago RM, Singh PP, Nesto RW. Diabetes and hypertension. *Nat Clin Pract Endocrinol Metab*. 2007;3(10):667.
39. Mollentze WF, Moore AJ, Steyn AF, et al. Coronary heart disease risk factors in a rural and urban Orange Free State black population. *S Afr Med J*. 1995;85(2):90–6.
40. van Rooyen JM, Kruger HS, Huisman HW, et al. An epidemiological study of hypertension and its determinants in a population in transition: the THUSA study. *J Hum Hypertens*. 2000;14(12):779–87.
41. Cooper RS, Wolf-Maier K, Luke A, et al. An international comparative study of blood pressure in populations of European vs. African descent. *BMC Med*. 2005;3:2.
42. Walker AR, Walker BF, Manetsi B, Tsotetsi NG, Walker AJ. Obesity in black women in Soweto, South Africa: minimal effects on hypertension, hyperlipidaemia and hyperglycaemia. *J R Soc Health*. 1990;110(3): 101–3.

AUTHOR CONTRIBUTIONS

Design and concept of study: Onwuchekwa
Acquisition of data: Onwuchekwa, Mezie-Okoye, Babatund
Data analysis and interpretation: Onwuchekwa, Mezie-Okoye, Babatund
Manuscript draft: Onwuchekwa, Babatund
Statistical expertise: Babatund
Administrative: Onwuchekwa, Mezie-Okoye, Babatund
Supervision: Onwuchekwa, Mezie-Okoye