Original Article

Hypertension in the Young: A Post-Hoc Analysis of Two Studies in Enugu State

CC Okwara, BA Ezeala-Adikaibe, PO Njoku, NC Mbadiwe, TH Ikenwugwu[1], EA Ekwe, OB Anyim, F Ekochin[2], CM Abonyi[2], GE Anigbo[2]

Departments of Medicine and [1]Biochemistry, University of Nigeria, Nsukka, [2]Department of Medicine, Enugu State Teaching Hospital, Nigeria

Abstract

Background: Hypertension is a common cardiovascular disease among the young Nigerians. Little is known about urban-rural differences in the pattern hypertension in the young Nigerians. **Aim:** The aim of this study was to describe the pattern of hypertension in young Nigerians in a rural and urban settings and to establish the differences between them if any. **Methods:** Data for the index study was retrieved from two previous studies. Blood pressures were measured according to the guidelines of the European Society of Hypertension. **Results:** Data from 605 participants were included in the study: urban 360 (59.7%) and rural 245 (40.5%). Males were 158 (21.6%) and females were 447 (73.9%). The mean age of the populations was (urban 30 ± 6 years and rural 29.2 ± 0.63 years P = 0.47). The overall prevalence of hypertension in this study was 35.9% (217/605), similar in urban (36.1%) and rural (35.9%) dwellers P = 0.88. Forty-two (6.9%) were previously diagnosed (urban 39 (30%) and rural 3 (3.4%), P < 0.01. About 66.7% were controlled (urban 25 (64.1%) and rural 3 (100%). Urban dwellers have significantly higher rates of raised diastolic blood pressure compared to rural dwellers, who had higher rates of systolic blood pressure. In both locations, although there was no sex difference in the prevalence of hypertension, hypertension significantly increased with age. **Conclusion:** There is a high rate of hypertension in rural and urban middle-aged Nigerians in Enugu southeast Nigeria. Continuous educational programs will be important in reducing both the morbidity and complications of hypertension in the future.

Keywords: *Cardiovascular disease, hypertension, rural community, Southeast Nigeria, urban community, young Nigerians*

Received: 11-Oct-2024;
Revision: 23-Jan-2025;
Accepted: 04-Mar-2025;
Published: 04-Jun-2025

Introduction

Hypertension is a common cardiovascular disease and biggest contributor to the burden of disease globally.[1,2] Hypertension and its complications can occur at any age[3] thus early detection and proper management of HBP may prevent complications in adulthood.[4] Hypertension and its complications contribute significantly to poverty in the region through high health expenditure and loss of productivity.[5,6]

Studies have linked several risk factors including urbanization to the prevalence of hypertension.[7-9] Most recent reports in urban-rural differences in hypertension in has not been consistent.[10,11] In a systematic review and meta-analysis of 22 studies that examined the difference in the prevalence of hypertension between rural and urban areas of West Africa, the likelihood of hypertension was 26% lower, among people living in rural areas compared to those living in urban areas.[11] The pooled prevalence of hypertension was 27.4% and 33.9% for rural and urban areas respectively. Adeloye *et al.*[12] reported a pooled prevalence of hypertension

Access this article online

Quick Response Code:

Website: www.njcponline.com

DOI: 10.4103/njcp.njcp_693_24

***Address for correspondence*:** Dr. BA Ezeala-Adikaibe, University of Nigeria Teaching Hospital, Enugu, Nigeria. E-mail: birinusadikaibe@gmail.com

How to cite this article: Okwara CC, Ezeala-Adikaibe BA, Njoku PO, Mbadiwe NC, Ikenwugwu TH, Ekwe EA, *et al.* Hypertension in the young: A post-hoc analysis of two studies in Enugu State. Niger J Clin Pract 2025;28:574-81.

in Nigeria to be 28.9% (urban 30.6%, rural 26.4%). In Ghana Bosu *et al*.[13] in a systematic review found that urban areas consistently reported higher prevalence of hypertension. Sani *et al*.[11] reported that the odds of hypertension were lower in rural dwellers compared to urban dwellers.

Some potential reasons for higher prevalence of hypertension in urban areas include socioeconomic and lifestyle changes that may lead to the higher prevalence of hypertension.[14-16] However, better access to healthcare facilities in urban compared to rural areas may also contribute to a higher reported prevalence in these areas.[17]

Little is known about hypertension in young southeastern Nigerian, as well as urban rural differences in hypertension in the young. The aim of this study is to describe the pattern of hypertension in a rural and urban slum and to establish the differences between them if any.

Materials and Methods

Data for the index study was retrieved from a study carried out in Ugwuomu Village in Enugu South Local Government area of Enugu State and a study carried out in Agu-Abor and Ugbodogwu slums in Enugu, the capital of Enugu State, Southeast Nigeria. The urban settlement is located at the foot of Udi hills and occupy an area of about 2.5–5 and 1–2.5 km, respectively, from the city center and the nearest tertiary hospital, while the rural village available is located about 20 km from the city center and about 4 km from the nearest semi-urban settlement.

Study design and recruitment of participants

For both studies, a three-phase cross-sectional descriptive design was used, although questionnaires for data collection on sociodemographic variables were different. In both studies the first phase of the study was sensitization of the community through meetings with elected community leaders. Announcements were also made in churches as well as by the town announcer. In the second phase of the study, participants were visited in their homes. During this phase a structured questionnaires were used to collect data on selected socio-demographic characteristics. All consenting individuals were interviewed at their respective homes or offices/places of work. Participants were also invited to come to the clinic on any day of their choice within the stipulated time and when necessary for follow-up.

The third phase of the study was carried out in a field clinic in both locations. In the last phase, the remaining part of the questionnaire on physical measurements of weight, height, blood pressure and fasting blood glucose were carried out. Medical history of hypertension was also obtained from the subjects. All consecutive consenting adults 20 years and above were included in the study. For both studies, study protocols were reviewed on behalf of Enugu State Ministry of Health by the Ethics committee of the Enugu State University and University of Nigeria Teaching Hospital, Enugu. All participants gave their informed consent after reading or having the consent form read for and explained to them.

Blood pressure measurement

All eligible participants who gave their consent were interviewed. All participants were first interviewed at home, but blood pressure measurement was done in the field clinic. After resting for at least 10 min, blood pressures were recorded at least 3 times by means of mercury sphygmomanometer according to the guidelines of the European Society of Hypertension.[18] Blood pressure was measured by either a trained nurse or a doctor. All the doctors that participated in the study were either senior residents or consultants in the department of medicine. Blood pressure measurements were obtained from the non-dominant arm using a standard cuff with an inflatable bladder of 22 cm^2 × 12 cm^2 if the arm circumference was 32 cm, and cuffs with a 35 cm^2 × 15 cm^2 bladder on larger arms. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were taken at the first and fifth Korotkoff sounds, respectively. The average of the three blood pressure measurements was used for the analysis. Fasting blood glucose was measured using a glucometer (Fine test premium; Infobia Co. Ltd, Dongan-gu, South Korea). The waist and hip circumference were measured using a standard centimeter tape, by standard method.

Definition of terms

Hypertension was defined as an SBP of ≥140 mmHg and/or DBP of ≥90 mmHg, and/or reporting use of antihypertensive drug therapy. Blood pressure status was defined based on WHO recommendations as WHO follows: Normal blood pressure systolic blood pressure less than 140 and diastolic blood pressure less than 90 mmHg, stage I hypertension as systolic blood pressure from ranging 140 to 159 and diastolic blood pressure from 90 to 99 mmHg, stage II hypertension as systolic blood pressure ranging from 160 to 179 and diastolic blood pressure from 100 mmHg to 109 mmHg, and stage III hypertension systolic blood pressure equal or greater than 180 and diastolic blood pressure equal or greater than 110/mmHg.[19] Awareness was confirmed by asking for past medical history of raised blood pressure recorded by a health professional or identifying those

who were taking blood pressure lowering medications. A patient is defined as having hypertension awareness if there was a history of hypertension diagnosed by a qualified health worker (nurses or doctors). All new cases of hypertension were started on medications and were referred to the health center of any hospital nearest to them for continued care.

Occupation was defined as the respondent's primary job and or source of income in a month. An artisan was defined as a skilled manual worker in a particular trade or craft, such as masonry, mechanics, tailoring, welding, metal working and other crafts. Professional drivers were also grouped as artisans. Office workers included teachers, civil servants and individuals that spend most of their working hours in the office. Level of education was the highest educational attainment (primary education, secondary, and tertiary) at the time of the study.

Sample size. All participants with complete data within the defined age group for the review were included.

Statistical methods

For database management and statistical analyses, we used the SPSS version 26 (IBM Corporation, New York, NY, USA). Data were presented in tables and figures. For continuous variables, mean values and standard deviation were calculated. Prevalence of hypertension was expressed as percentages, and confidence interval (CI) was Students T-test for unpaired observations to compare means. P value < 0.05 was regarded as statistically significant. Conclusions were drawn at the level of significance. The confidence level was kept at 95%.

Results

A total of 605 individuals 20–40 years of age who with complete data were included in the analysis. The urban population was 360 (59.7%) and rural was 245 (40.5%). Males were 158 (21.6%) and females were 447 (73.9%).

Table 1 summarizes the characteristics of the study participants included in the current analysis from both locations. Although most participants came from urban centers, there were no statistically significant differences in sex distribution between the two groups. Their mean ages were also similar (urban 30 ± 6 years and rural 29.2 ± 0.63 years, $P = 0.47$) as well as their age distribution. Urban dwellers were taller and heavier than rural dwellers, however their body mass indices were similar.

Average systolic pressure was higher in rural dwellers while the average diastolic blood pressure which was higher in urban dwellers. Mean blood glucose measurements was also higher among rural dwellers.

Table 1: Characteristics of participants

n	Urban	Rural	Total	*P*
Sex				
Males	90 (25)	68 (43)	158 (21.6)	
Females	270 (75)	177 (72.2)	447 (73.9)	0.45
Age				
Mean age (sd), years	30 (6)	29.2 (6)	30 (6)	0.11
Males	29.5 (5.8)	28.9 (5.4)	29.3 (0.56)	0.46
Females	30.1 (6.0)	29.3 (6.4)	29.8 (6.2)	0.17
Age group, years				
<26	101 (28.1)	83 (33.9)	184 (30.4)	
26-30	109 (30.3)	79 (32.2	188 (31.1)	
31-35	77 (21.4)	40 (16.3)	117 (19.3)	
36-40	73 (20.3)	43 (17.6)	116 (19.2)	0.23
Anthropometrics				
Height, m	1.6 (0.09)	1.5 (0.13)	1.6 (0.11)	<0.01
Weight, Kg	66 (12.6)	60.4 (11.7)	63.9 (12.6)	<0.01
Mean BMI (kg/m^2)	25.3 (4.6)	25.4 (4.6)	25.3 (4.6)	0.8
Peripheral hemodynamic				
Mean SBP, mm Hg	123.4 (18.8)	128.1 (20.5)	125.3 (19.6)	<0.01
Mean DBP, mm Hg	78.8 (11.3)	70 (13.1)	75.2 (12.8)	<0.01
Measurements on blood				
Glucose, mg/dl	95.3 (53.7)	109.5 (28.9)	100.8 (45.9)	<0.01
Total	360 (59.5)	245 (40.5)	605 (100)	<0.01

P-values are for urban and rural differences. Peripheral systolic and diastolic blood pressure were the average of 3 consecutive measurements. SBP=Systolic blood pressure. DBP=diastolic blood pressure

Table 2 summarizes the participants' characteristics within each location.

Females were more than males in both locations, but their mean ages and the age distribution appeared similar. Anthropometric measurements showed differences between urban and rural populations. Urban dwellers showed sex differences in height, weight, and body mass index. Other parameters are shown in Table 2. Within the same locality average blood pressure measurements appeared similar.

The age distribution of systolic and diastolic blood pressure measurements recorded during the studies are shown in Figures 1 and 2. In all cases, both systolic and diastolic blood pressure measurements increased with age. In rural dwellers diastolic blood pressure trended towards significance with a P value of 0.06.

Table 3 summarizes the pattern of hypertension in both communities.

The overall prevalence of hypertension was 35.9% (217/605), similar in urban (36.1%) and rural (35.9%) dwellers, $P = 0.88$. Forty-two (6.9%) of those with hypertension were previously diagnosed (urban 39 (30%) and rural 3 (3.4%), $P < 0.01$ and out of

Table 2: Age and sex distribution of Characteristics of the participants in both locations

	Urban				Rural			
	Male	Female	Total	*P*	Male	Female	Total	*P*
n	90 (25)	270 (75)	360 (60.7)	<0.01	68 (27.8)	177 (72.2)	245 (39.3)	<0.01
Mean age (sd), years	29.5 (5.8)	30.1 (6)	30±6	0.43	28.9 (5.4)	29.3 (6.4)	29.2±6.1	0.63
Age group, years								
<26	24 (26.7)	77 (28.5)	101 (28.1)		25 (36.8)	58 (32.8)	83 (33.9)	
26–30	32 (35.6)	77 (28.5)	109 (30.3)		25 (36.8)	54 (30.5)	79 (32.2)	
31–35	20 (22.2)	57 (21.1)	77 (21.4)		9 (13.2)	31 (17.5)	40 (16.3)	
36–40	14 (15.6)	59 (21.9)	73 (20.3)	0.47	9 (13.2)	34 (19.2)	43 (17.6)	0.49
Anthropometrics								
Height, m	1.7 (0.08)	1.6 (0.07)	1.6 (0.09)	<0.01	1.5 (0.13)	1.6 (0.14)	1.5 (0.14)	0.18
Weight, Kg	69.1 (11.9)	65.1 (12.7)	66 (12.6)	0.01	59.5 (11.1)	60.7 (12)	60.4 (11.7)	0.48
Mean BMI (kg/m^2)	23.9 (3.2)	25.7 (4.9)	25.3 (4.6)	<0.01	25.7 (4.7)	25.3 (4.5)	25.3 (4.5)	0.49
Level of education, *n* (%)								
Primary	16 (20.3)	63 (23.3)	79 (21.9)		20 (29.4)	59 (33.3)	79 (32.2)	
Secondary	51 (56.7)	170 (63)	221 (61.4)		39 (57.4)	90 (50.8)	129 (52.7)	
Tertiary	23 (25.6)	37 (13.7)	60 (16.7)	0.03	9 (13.2)	28 (15.8)	37 (15.1)	0.66
Not indicated	-	-						
Occupation, *n* (%)								
Students	16 (17.8)	25 (9.3)	41 (11.4)		18 (26.5)	44 (24.9)	62 (25.3)	
Business	10 (11.1)	64 (23.7)	74 (20.6)		15 (22.1)	35 (19.8)	50 (20.4)	
Office workers/teachers	5 (5.6)	20 (7.4)	25 (6.9)		9 (13.2)	25 (14.1)	34 (13.9)	
Artisans	11 (12.2)	20 (7.4)	31 (8.6)		4 (5.9)	11 (6.2)	15 (6.1)	
Farmers	-	3 (1.1)	3 (0.8)		19 (27.9)	52 (29.4)	71 (29)	
Unemployed	-	10 (3.7)	10 (2.8)		3 (4.4)	10 (5.6)	13 (5.3)	
Not indicated	48 (53.3)	128 (47.4)	176 (48.9)		-	-	-	
Peripheral hemodynamics								
Mean SBP, mm Hg	125.9 (20.2)	122.6 (18.3)	123.4 (18.8)	0.15	127.7 (18.1)	69.9 (13.2)	128.1 (20.5)	0.87
Mean DBP, mm Hg	78.6 (11.2)	78.9 (11.5)	78.8 (11.4)	0.83	128.2 (21.4)	70.1 (13.2)	70 (13.2)	0.9
Measurements on blood								
Glucose, mg/dl	89 (19.3)	97.0 (59.3)	95.3 (53.3)	0.32	112.2 (39.5)	108.5 (23.4)	109.5 (28.9)	0.46

P-values are for the sex differences. Peripheral systolic and diastolic blood pressure were the average of 3 consecutive measurements. SBP=Systolic blood pressure. DBP=diastolic blood pressure

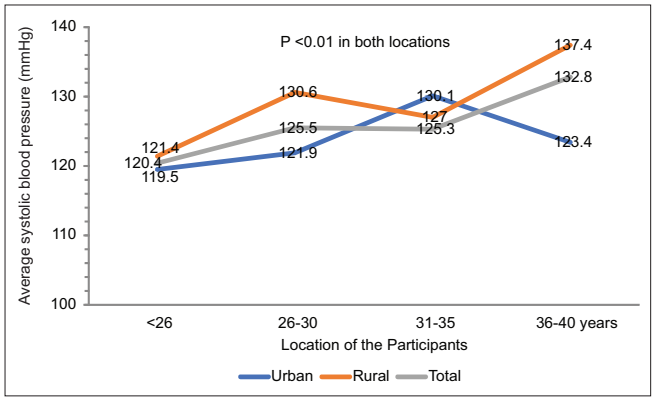

Figure 1: Age distribution of average systolic blood measurements in both locations

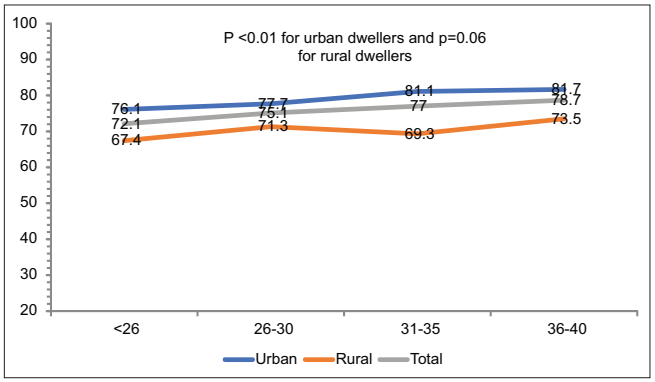

Figure 2: Age distribution of diastolic blood measurements in both locations

these (those known to have hypertension), 66.7% were controlled (urban 25 (64.1%) and rural 3 (100%).

The pattern of raised systolic and diastolic blood pressures is shown also in Table 3. Urban dwellers have significantly higher rates of raised diastolic blood pressure compared to rural dwellers who had higher rates of systolic blood pressure.

Age distribution of hypertension in the urban and rural areas is shown in Table 4. In both locations, although there was no sex difference in the prevalence of hypertension, hypertension significantly increased

Table 3: Characteristics of hypertension in the two localities

	Urban	Rural	Total	*P*
Hypertension[β]	130 (36.1)	87 (35.5)	217 (35.9)	0.88
Previously diagnosed[α]	39 (30)	3 (3.4)	42 (6.9)	<0.01
Newly Diagnosed[α]	91 (70)	84 (96.6)	175 (80.6)	0.02
Controlled[µ]	25 (64.1)	3 (100)	28 (66.7)	0.2
Raised systolic blood pressure[β]	69 (19.2)	84 (34.3)	153 (25.3)	<0.01
Raised diastolic blood pressure[β]	90 (25)	35 (14.3)	125 (20.7)	<0.01
Raised systolic and diastolic blood pressure[β]	54 (15)	35 (14.3)	89 (14.7)	0.81

[β]Percentage of the entire population surveyed. [α]Percentage of people with hypertension. [µ]Percentage of those with previously diagnosed hypertension

Table 4: Age and sex distribution of hypertension in both locations

Hypertension	Urban				Rural			
	Male	Female	Total	*P*	Male	Female	Total	*P*
n	28 (31.1)	102 (37.8)	130 (36.1)	0.25	20 (29.4)	67 (37.9)	87 (35.5)	0.22
Age group, years								
<26	7 (29.2)	19 (24.7)	26 (25.7)		5 (20)	14 (24.1)	19 (22.9)	
26–30	7 (21.9)	25 (32.5)	32 (29.4)		6 (24)	26 (48.1)	32 (40.5)	
31–35	6 (30)	25 (43.9)	31 (40.3)		3 (33.3)	12 (38.7)	15 (37.5)	
36–40	8 (57.1)	33 (55.9)	41 (56.2)	<0.01	6 (66.7)	15 (44.1)	21 (48.8)	<0.01

P-values are for the sex differences. Peripheral systolic and diastolic blood pressure were the average of 3 consecutive measurements. SBP=Systolic blood pressure. DBP=diastolic blood pressure

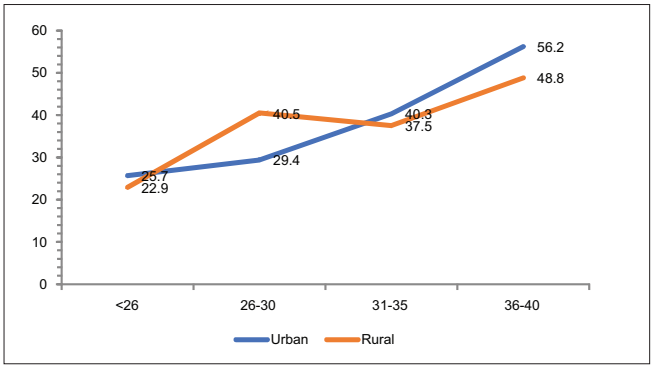

Figure 3: Age and sex distribution of the prevalence of hypertension in both locations

with age. Among rural dwellers hypertension peaked at 36–40 years ($P < 0.01$). This is similar the pattern recorded among rural dwellers. See also Figure 3.

Discussion

The index study has documented a high rate of hypertension among rural and urban dwellers in Enugu aged 20–40 years. In the index study although average systolic increased with age in both locations, only diastolic blood pressure increased with age in the urban location.

Although females were more in number in both locations, the mean age, and the age distribution of the participants in both locations appeared similar. More than 80% were newly diagnosed and most of them from the rural area. Systolic blood pressure was more prevalent in the urban locations while diastolic blood pressure in the rural location.

These finding while supporting already known facts about the prevalence of hypertension in Nigeria, it is important to note that there were no significant differences in blood measurements between urban and rural dwelling young people. It has often been documented that risk factors for hypertension are commoner among urban dwellers,[14-16] however this study did not document significant differences in blood pressure measurements. One possible reason for this may be because the rural village surveyed in this study was not very far from the city suggesting the possibility of similar lifestyles and habits in both locations.

The overall prevalence of hypertension was 35.9%, similar in urban (36.1%) and rural (35.9%) dwellers. This study suggests that middle-aged individuals may be the primary pool of people with hypertension. Over time these people may develop complications thus increasing the burden of cardiovascular complications such as stroke in society. This is worrisome considering the poor state of health infrastructure and dearth of manpower in the country. Furthermore, when the cost of treating of hypertension over a long period will be staggering.[5] On the other hand, when people with hypertension are diagnosed early, complications can be averted if proper treatment is instituted, and treatment adhered to.

Reports in urban-rural differences in hypertension in West Africa has not been consistent. While some studies have reported higher prevalence in urban areas,[20,21] others report higher rates in area,[22,23] yet some did not find any significant differences.[24,25] The likelihood of hypertension in rural areas has been reported to be 26% lower among people living in rural areas compared to those living in urban areas.[11] Adeloye and colleagues reported no significant difference in the prevalence of hypertension between males and females the years 2000 and 2010, although they observed a higher prevalence in males compared to females in the year 1990.[1]

Only about 7 out every 100 cases of those with hypertension in this study were previously diagnosed (urban 39 (30%) and rural 3 (3.4%) and out of those with previous hypertension, 66.7% were controlled (urban 25 (64.1%) and rural 3 (100%). High prevalence of undiagnosed hypertension has been reported in several studies.[26,27] The high prevalence of undiagnosed hypertension in our sub-region is a driver of higher rates of complications in the community. Among adults in Ethiopia, the pooled prevalence of undiagnosed hypertension was 18.3%. Ataklte *et al.*[28] in their meta-analysis of the burden of undiagnosed hypertension in the African region indicated that the prevalence in the region is age dependent.

Reasons for undiagnosed hypertension in this study are likely to be many. Generally, the knowledge and practice of hypertension low in Africa.[1,27] This is true across different socio-economic classes within the region.[27,29] Multiple overlapping factors affect blood pressure control in the community[30,31] and like other health challenges, compliance plays a key role in the successful control and management of hypertension.

The potential effects of poverty and cultural beliefs in the index study should not be underestimated. Poverty makes people resort to other inappropriate therapy such as local herbs with unproven efficacy.[31,32] For example in the United States, poverty and cultural factors have been shown to prevent the application of the DASH (Dietary Approach to Stop Hypertension) via high-vegetable, lesser-salt and high-fruit diets, that have been shown to be efficacious African Americans.[33] Our findings suggest the need for continuous health education and awareness to educate people on the diagnosis and need for treating hypertension.

The prevalence of hypertension significantly increased with age in both locations. This is in keeping with already known facts on the relationship between hypertension and age in Enugu State, Nigeria.[26,34]

In the index study urban dwellers had significantly higher rates of raised diastolic blood pressure compared to rural dwellers who had higher rates of systolic blood pressure. The reason for this finding is not known, nevertheless, both systolic and diastolic hypertension have similar risk factors and treatment is the same.

Sex differences in blood pressure were reported in both locations. Mean blood pressure is generally higher in men than women, but the subsequent rate of rise in blood has been found to be steeper for women than men.[35,36] Prevalence and severity of hypertension increase markedly with advancing age in women, such that a higher percentage of women than men have high BP after 65 years.[35,37]

Furthermore, hypertension is more prevalent in middle aged males compared to females, chiefly because of protective hormones in the latter.[28,39] Other factors that may contribute to higher prevalence of hypertension/ blood pressure measurements in females includes higher BMI and lower rates of physical activity.[38,39]

Limitations

Although data for the index analysis were derived from community-based studies, there were more females in both locations which might have affected the results of the index study. This study is also subjected to all the limitation of cross-sectional studies for example participants were not followed-up over time to document the outcome of hypertension.

Conclusion

There is a high rate of hypertension in rural and urban young Nigerians. The prevalence of hypertension did not vary with location but varied with gender within each location. Although most cases were mild to moderate hypertension, continuous educational programs will be important in reducing both the morbidity and complications of hypertension in the future.

Acknowledgements

The authors acknowledge the village heads and church leaders as well as the community nurses for their support and help.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Adeloye D, Basquill C. Estimating the prevalence and awareness rates of hypertension in Africa: A systematic analysis. PLoS One 2014;9:e104300.

2. Zhou B, Perel P, Mensah GA, Ezzati M. Global epidemiology, health burden and effective interventions for elevated blood pressure and hypertension. Nat Rev Cardiol 2021;18:785-802.
3. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: A pooled analysis of 1201 population-representative studies with 104 million participants. Lancet 2021;398:957-80.
4. Lackland DT. Early-life detection of hypertension risks. Hypertension 2017;70:486–7.
5. Gnugesser E, Chwila C, Brenner S, Deckert A, Dambach P, Steinert JI, *et al*. The economic burden of treating uncomplicated hypertension in Sub-Saharan Africa: A systematic literature review. BMC Public Health 2022;22:1–20.
6. Sorato MM, Davari M, Kebriaeezadeh A, Sarrafzadegan N, Shibru T. Societal economic burden of hypertension at selected hospitals in southern Ethiopia: A patient-level analysis. BMJ Open 2022;12:e056627.
7. Kayima J, Nankabirwa J, Sinabulya I, Nakibuuka J, Zhu X, Rahman M, *et al*. Determinants of hypertension in a young adult Ugandan population in epidemiological transition—the MEPI-CVD survey. BMC Public Health 2015;15:830.
8. Bernabe-Ortiz A, Sanchez JF, Carrillo-Larco RM, Gilman RH, Poterico JA, Quispe R, *et al*. Rural-to-urban migration and risk of hypertension: Longitudinal results of the PERU MIGRANT study. J Hum Hypertens 2017;31:22–8.
9. Bernabé-Ortiz A, Carrillo-Larco RM, Gilman RH, Checkley W, Smeeth L, Miranda JJ, *et al*. Impact of urbanisation and altitude on the incidence of, and risk factors for, hypertension. Heart 2017;103:827–33.
10. Amegah AK. Tackling the growing burden of cardiovascular diseases in Sub-Saharan Africa. Circulation 2018;138:2449–51.
11. Sani RN, Connelly PJ, Toft M, Rowa-Dewar N, Delles C, Gasevic D, *et al*. Rural-urban difference in the prevalence of hypertension in West Africa: A systematic review and meta-analysis. J Hum Hypertens 2022;1–13.
12. Adeloye D, Basquill C, Aderemi AV, Thompson JY, Obi FA. An estimate of the prevalence of hypertension in Nigeria: A systematic review and meta-analysis. J Hypertens 2015;33:230–42.
13. Bosu WK, Bosu DK. Prevalence, awareness, and control of hypertension in Ghana: A systematic review and meta-analysis. PLoS One 2021;16:e0248137.
14. Adams VE. Rural and urban disparities in smoking behaviors among men in Nigeria : A decomposition analysis. 2022. Available from: https://urn.kb.se/resolve?urn=urn:nbn:se:umu:diva-200083.
15. Onodugo OD, Orjioke C, Anyim OB, Ezeala-Adikaibe B, Chime P, Peter C, *et al*. Correlates of tobacco and marijuana use among Urban Dwellers in Enugu, Nigeria. Open J Prev Med 2019;9:80–94.
16. Onodugo OD, Ezeala-Adikaibe BA, Anyim OB, Ezeme M, Ijoma UN, Obumneme-Anyim IN, *et al*. Prevalence and pattern of alcohol use among adults in an urban slum in South East Nigeria. Open J Psychiatry 2019;09:179–91.
17. Samuel O, Zewotir T, North D. Decomposing the urban–rural inequalities in the utilisation of maternal health care services: Evidence from 27 selected countries in Sub-Saharan Africa. Reprod Health 2021;18:216.
18. Oloyede O. Rural-urban disparities in health and health care in Africa: Cultural competence, lay-beliefs in narratives of diabetes among the rural poor in the Eastern Cape Province of South Africa. Afr Soc Rev Rev Afr Soc 2017;21:36–57.
19. Williams B, Mancia G, Spiering W, Agabiti Rosei E, Azizi M, Burnier M, *et al*. 2018 ESC/ESH guidelines for the management of arterial hypertension. Eur Heart J 2018;39:3021–104.
20. Kodaman N, Aldrich MC, Sobota R, Asselbergs FW, Poku KA, Brown NJ, *et al*. cardiovascular disease risk factors in Ghana during the rural-to-urban transition: A cross-sectional study. PLoS One 2016;11:e0162753.
21. Houehanou YCN, Lacroix P, Mizehoun GC, Preux PM, Marin B, Houinato DS. Magnitude of cardiovascular risk factors in rural and urban areas in Benin: Findings from a nationwide steps survey. PLoS One 2015;10:e0126441.
22. Agyemang C. Rural and urban differences in blood pressure and hypertension in Ghana, West Africa. Public Health 2006;120:525–33.
23. Ntandou G, Delisle H, Agueh V, Fayomi B. Abdominal obesity explains the positive rural-urban gradient in the prevalence of the metabolic syndrome in Benin, West Africa. Nutr Res 2009;29:180–9.
24. Abegunde KA, Owoaje ET. Health problems and associated risk factors in selected urban and rural elderly population groups of South-West Nigeria. Ann Afr Med 2013;12:90–7.
25. Ejim EC, Onwubere BJ, Okafor CI, Ulasi II, Emehel A, Onyia U, *et al*. Cardiovascular risk factors in middle-aged and elderly residents in South-East Nigeria: Tthe influence of urbanization. Niger J Med2013;22:286–91.
26. Ezeala-Adikaibe BA, Orjioke C, Ekenze OS, Ijoma U, Onodugo O, Okudo G, *et al*. Population-based prevalence of high blood pressure among adults in an urban slum in Enugu, South East Nigeria. J Hum Hypertens 2016;30:285-91.
27. Guwatudde D, Nankya-Mutyoba J, Kalyesubula R, Laurence C, Adebamowo C, Ajayi I, *et al*. The burden of hypertension in sub-Saharan Africa: A four-country cross sectional study. BMC Public Health 2015;15:1211.
28. Ataklte F, Erqou S, Kaptoge S, Taye B, Echouffo-Tcheugui JB, Kengne AP. Burden of undiagnosed hypertension in sub-saharan Africa: A systematic review and meta-analysis. Hypertens Dallas Tex 1979 2015;65:291-8.
29. Addo J, Smeeth L, Leon DA. Hypertensive target organ damage in Ghanaian Civil servants with hypertension. PLoS One 2009;4:e6672.
30. Devkota S, Dhungana RR, Pandey AR, Bista B, Panthi S, Thakur KK, *et al*. Barriers to treatment and control of hypertension among hypertensive participants: A Community-based cross-sectional mixed method study in municipalities of Kathmandu, Nepal. Front Cardiovasc Med 2016;3:26.
31. Macquart de Terline D, Diop BI, Bernard M, Do B, Ikama MS, N'guetta R, *et al*. Substandard drugs among five common antihypertensive generic medications: An analysis from 10 African countries. J Hypertens 2018;36:395–401.
32. Bosu WK. The prevalence, awareness, and control of hypertension among workers in West Africa: A systematic review. Glob Health Action. 2015;8:26227.
33. Douglas JG, Bakris GL, Epstein M, Ferdinand KC, Ferrario C, Flack JM, *et al*. Management of high blood pressure in African Americans consensus statement of the hypertension in African Americans Working Group of the International Society on Hypertension in Blacks. Arch Intern Med 2003;163:525-41.
34. Ulasi II, Ijoma CK, Onwubere BJC, 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.
35. Wenger NK, Arnold A, Bairey Merz CN, Cooper-DeHoff RM, Ferdinand KC, Fleg JL, *et al*. Hypertension across a woman's

life cycle. J Am Coll Cardiol 2018;71:1797–813.

36. Tasić T, Tadić M, Lozić M. Hypertension in women. Front Cardiovasc Med 2022;9:905504.
37. Roger VL, Go AS, Lloyd-Jones DM, Adams RJ, Berry JD, Brown TM, *et al*. heart disease and stroke statistics--2011 update: A report from the American Heart Association. Circulation 2011;123:e18–209.
38. Wassertheil-Smoller S, Hendrix SL, Limacher M, Heiss G, Kooperberg C, Baird A, *et al*. Effect of estrogen plus progestin on stroke in postmenopausal women: the Women's Health Initiative: A randomized trial. JAMA 2003;289:2673–84.
39. Ong KL, Tso AWK, Lam KSL, Cheung BMY. Gender difference in blood pressure control and cardiovascular risk factors in Americans with diagnosed hypertension. Hypertension 2008;51:1142–8.