Hypertension and Associated Factors Among Community-Dwelling Rural Adults in Abia State, Nigeria

Ukegbu, Patricia Ogechi[1*], Ortutu, Beulah Favour[1], Diara, Sochima[1], and Uche Chinaza Precious[1], Ukegbu Andrew Ugwunna[2]

[1]*Michael Okpara University of Agriculture, Umudike, Abia State, PMB 7267, Umuahia, Nigeria.*
[2]*Department of Community Medicine, Federal Medical Centre, Umuahia Abia State, Nigeria*

***Corresponding author:** adanna2025@yahoo.com*

ABSTRACT

Background: *Hypertension is a growing public health problem in developing countries contributing to morbidity and mortality of billions of adults worldwide.*

Objective: *The study aimed to assess the prevalence and factors associated with hypertension among adults in rural communities of Ikwuano, Abia State, Nigeria.*

Methods: *A community-based descriptive cross-sectional survey in rural communities was conducted among 429 apparently healthy adults aged 20 to 59 years using cluster sampling technique. Socio-demographic information was obtained using a validated questionnaire. Blood Pressure (BP) and anthropometric measurements were carried out following standard procedures. Hypertension was defined as systolic blood pressure (SBP) equal or greater than 140mmHg and/or diastolic BP (DBP) equal or greater than 90mmHg. Multiple logistic regression analysis was used to assess risk factors associated with hypertension.*

Results: *The prevalence of hypertension was 51.0% (58.1% in males and 43.1% in females). Hypertension was significantly associated with age, gender, marital status and BMI. In the adjusted model, older age (>40 years) (OR=1.96; 95% CL1.03 to 3.72; p<0.04) and overweight/obesity (OR=2.55; 95% CL1.50to 4.34; p<0.001) were associated with higher odds of having hypertension. Females gender was associated with lower odds of hypertension compared to males (OR=0.32; 95% CI 0.20 to 0.52; p<0.001).*

Conclusion: *The study showed a high prevalence of hypertension among rural community dwelling adults, underscoring the need for routine screening of adults for early hypertension diagnosis.*

Keywords: Hypertension, risk factors, adults, rural, prevalence.

INTRODUCTION

Hypertension is a major risk factor for many cardiovascular diseases(1),and is projected to affect about 1.6 billion adults (29.2% of the world's population) globally by 2025 (2, 3, 4). Approximately 46% of the adult population in the world have been clinically diagnosed with hypertension (5). World Health Organisation (WHO) member states have set a target for a 25% reduction in the prevalence of hypertension by the year 2025 (6). Initially, hypertension was regarded as a chronic disease associated with high-income countries; however, it is currently a rising cause of cardiovascular disease mortality in both developing and developed countries with over 80% of death occurring in low and middle-income countries (7, 8).

Hypertension or high blood pressure is excessive

pressure against the blood vessel walls (9). According to the Joint National Committee 7 (JNC7), normal blood pressure is systolic blood pressure (SBP) < 120mmHg and diastolic blood pressure (DBP) < 80mmHg, while hypertension is defined as systolic blood pressure (SBP) persistently ≥140 and/or diastolic blood pressure (DBP) ≥90 mmHg and/or taking an anti-hypertensive drug (10).An elevation of the systolic and/or diastolic blood pressure increases the risk of developing heart disease, hardening of the arteries, and stroke and a predictor of premature death and disability from cardiovascular complications (11, 12). Hypertension is regarded a *"silent killer"* and is diagnosed in many people as an incidental finding when admitted for unrelated ailments (13), thus its identification is usually through screening (14).

Hypertension is an asymptomatic condition with its own risk factors which could be classified as modifiable and non-modifiable factors (age, sex and genetics) (15). Modifiable factors such as environmental and behavioural characteristics which are consequences of nutrition transition in developing countries are mainly associated with hypertension (16). Studies have also shown that excessive weight gain, salt intake, smoking of cigarettes, drinking of alcohol and physical inactivity are the major predisposing factors for hypertension (17, 18, 19, 20).

Nigeria, currently with a population of over 200 million, is the most populous African country (21), and the prevalence of hypertension in the country hugely contributes to the overall burden in Africa (22). The prevalence of hypertension in Nigeria was 55% and 27.5%, respectively using ACC/AHA 2017 and JNC7 2003 guidelines (23). The high prevalence is believed to be due to an increasing adult population, rapid urbanization and uptake of western lifestyles, including high consumption of processed foods (with high salts and fats), tobacco and alcohol products (24, 25). Disparities are reported to exist in the prevalence of hypertension with the burden estimated to be higher in Africa than other regions (26). About half of adults in Africa are reported to be hypertensive with differences in the prevalence between rural and urban areas (27, 28).

The awareness, treatment and control of hypertension has been low especially among rural dwellers (29), therefore, many people who live with high blood pressure end up in health facilities with cardiovascular complications, including heart failures, ischemic heart disease and strokes (30). Existing data suggests that most of the interventions in place to reduce the prevalence of hypertension are focused more in urban areas as opposed to rural areas (31. 32). There is thus the need to regularly update relevant epidemiological data for continuous design and implementation of effective strategies for the prevention and control of hypertension among different segments of the population. Hence, this study was carried out to determine the burden of hypertension and its associated factors among adults in rural communities of Ikwuano, Abia State, Nigeria.

METHODS

Study Design, Population and Sample size determination

This descriptive community-based cross sectional survey was carried out among adults in rural communities of Ikwuano Local Government Area (LGA) in Abia State, South Eastern Nigeria. Ikwuano was randomly selected from the 17 LGAs in the state. A total of 429 eligible adults (20 to 59years) participated in this study. Sample size calculation was based on the formular $N/1 + N(e)^2$ (33, 34), where N represents the population size based on age distribution of the 2006 census report in Ikwuano LGA estimated to be 72,635 (35) and e representing level of precision (0.05) with a 10% drop-out rate. The sample size calculation showed that at least 398 participants were required to obtain a statistically representative data. The purpose and content of the questionnaire was explained to the participants. Informed consent was obtained from each person who agreed to take part in the study, while permission was obtained from the traditional rulers of the communities used. The ethics committee of the Federal Medical Centre, Umuahia, gave approval for the study (FMC/QEH/G.596/Vol.10/44).

Data Collection

Four research assistants were trained on questionnaire administration, blood pressure and anthropometric measurements.

Questionnaire

Structured questionnaires were used to obtain information on socio-demographics, including age, gender, marital status, educational level, occupation, household size and source of income. Lecturers with expertise in the areas of chronic disease risk factor surveillance validated the

questionnaire and gave feedback which was incorporated into the questionnaire. A group of healthy adults from Umudike community (another rural community) pretested the questionnaire to check for clarity and understanding of the questions.

Anthropometric Measurements

Anthropometric measurement of height and weight were taken by trained research assistants following standard procedures. Weight was measured to the nearest 0.1kg using a portable OMRON digital scale, with the respondent putting on light clothing, bare-footed and standing on the scale with head pointing straight (36). The height measurement was taken with the subject bare-feet. The subjects were asked to look straight ahead and the head piece was gently lowered, crushing the hair and making contact with the head, and height was recorded to the nearest 0.1 cm using a portable stadiometer (36). Body mass index (BMI) was calculated using weight and height measurements. Participants were classified as underweight (BMI = $<18.5 kg/m^2$), normal (BMI = 18.5-24.9 kg/m^2), overweight (BMI = 25.0-29.9 kg/m^2), and obese (BMI = $\geq 30 kg/m^2$) (37).

Blood Pressure

Blood pressure measurement was taken using a digital automatic blood pressure sphygmomanometer (Andron KD-595 Model). Blood pressure was measured on the left arm twice after 5 minutes of rest in a seated position and the average recorded. The consumption of alcohol, cigarette, and coffee as well as engagement in any form of physical exercise at least 30 minutes before the measurement was confirmed from the respondents. The systolic BPs (SBP) and diastolic BPs (DBP) were recorded to the nearest 2mmHg and related to the reference standard (3). Hypertension was defined as systolic blood pressure (SBP) equal or greater than 140mmHg and/or diastolic BP (DBP) equalor greater than 90mmHg, and/or taking an anti-hypertensive drug (1). Participants were classified as normal: SBP<120mmHg and DBP<80mmHG and/or DBP of 80-90, stage 1 hypertension: SBP of 140-159mmHg and/or DBP of 90-99mmHg, stage 2 hypertension SBP ≥160mmHg and/or DBP ≥100mmHg (12).

Statistical Analysis

Statistical Package for Social Sciences (SPSS version 20) was used for data analysis. Descriptive statistics were used to summarize socio-demographics and blood pressure data. Bivariate associations between hypertension and risk factors were determined. Multivariate logistic regression was further used to assess significant factors associated with hypertension. Results were expressed as odds ratios (OR) with 95% confidence intervals (CIs). A P-value of >0.05 was considered statistically significant.

RESULTS

The socio-demographic characteristics of the study participants are presented in Table 1. A total of 429 participants took part in the study. Of these, more than half (59.1%) belonged to the age group 20-30 years and were single (57.8%). Males accounted for 52.9% of study participants, while about two-thirds (65.5%) earned less than N30,000 and a third (34.7%) were artisans by profession.

Figure 1 represents blood pressure classification of the participants. More than half were hypertensive (51%), while about 49% had normal blood pressure. Of these, male participants (58.1%) were more hypertensive than females (43.1%).

The classification of anthropometrics and blood pressure according to sex is shown in Table 2. The BMI (p=0.000) and blood pressure (p=0.021) of the participants significantly differed between sex.

The association between hypertension and socio-demographic characteristics are described in Table 3. Hypertension was significantly associated with sex (p=0.002), older age (p=0.000), marital status (p=0.000), income (p=0.020) and BMI (p=0.003).

Factors associated with hypertension are summarized in Table 4 using multivariate logistic regression model. The result shows that female sex, older age and high BMI were the main risk factors associated with likelihood of having hypertension. Participants older than 40 years were twice more likely to have hypertension compared to those lower than 40 years of age (OR=1.96; 95% CL1.03 to 3.72; p<0.04). Likewise, overweight and/or obesity participants had three times higher odds of having

hypertension compared to normal weight individuals (OR=2.55; 95% CL1.50to 4.34; p<0.001). On the other hand, females had lower odds of having hypertension compared to males (OR=0.32; 95% CI 0.20 to 0.52; p<0.001).

Table 1: Socio-demographic characteristics of participants (n = 429)

Variables	Frequency (n)	Percentage (%)
Sex		
Male	227	52.9
Female	202	47.1
Age range		
20-30 years	254	59.1
31-40 years	94	21.9
41-50 years	28	6.5
51-60 years	24	5.6
61-70 years	16	3.7
71 and years	13	3.0
Mean	1.47 ± 0.50	
Marital status		
Single	248	57.8
Married	181	42.2
Household size		
1-3	137	31.9
4-6	190	44.3
7-9	82	19.1
10 and above	20	4.7
Highest educational level		
No formal education	15	3.5
Primary education	23	5.4
Secondary education	189	44.1
Tertiary education	202	47.1
Occupation		
Trader	114	26.6
Farmer	15	3.5
Civil servant	34	7.9
Artisan	149	34.7
Unemployed	117	27.3
Monthly income (Naira)		
Less than 30,000	281	65.5
30,000 – 50,999	108	25.2
51,000 – 70,999	18	4.2
71,000 – 100,999	9	2.1
Above 100,999	13	3.0

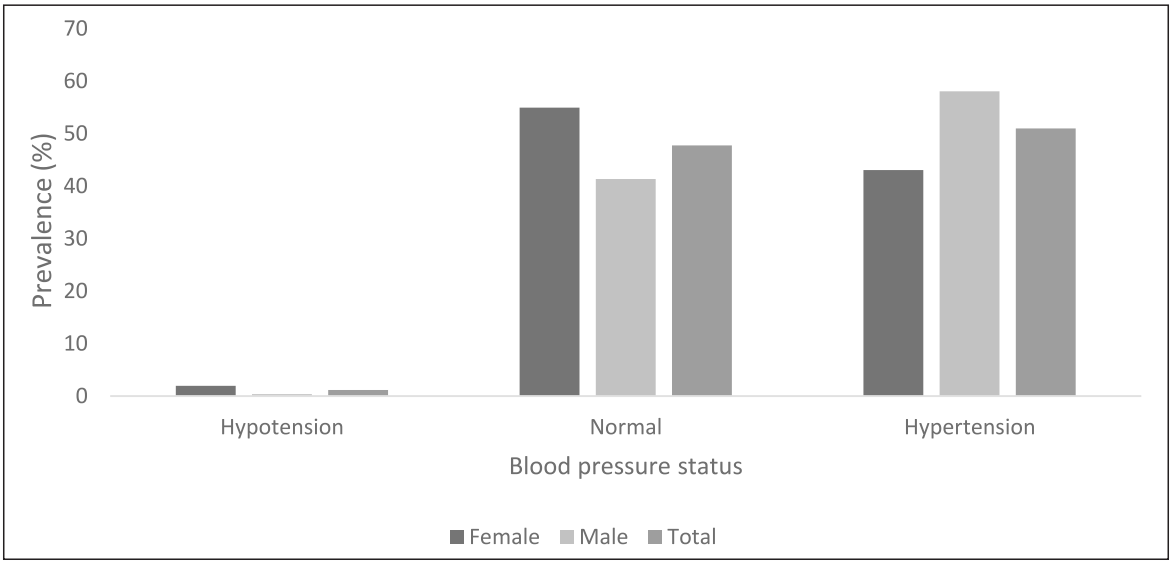

Figure 1. Blood pressure status of respondents.

Table 2: Anthropometrics and blood pressure classification according to sex

Variables	Male		Female		Total		p-value
	F	%	F	%	F	%	
BMI (kg/m²)							0.000*
Normal (18.5-24.9 kg/m²)	203	89.4	106	52.6	309	72.0	
Overweight/obese (>25 kg/m²)	24	10.6	96	47.5	120	28.0	
Hypertension (mmHg)							0.021*
Normal (120/80mmHg)	95	41.8	115	57.0	210	49.0	
Pre-hypertension (120-129/80-89mmHg)	62	27.3	42	20.8	104	24.2	
Stage 1 hypertension (130-139/90-99mmHg)	42	18.5	24	11.9	16	15.4	
Stage 2 hypertension (≥140/100mmHg)	28	12.3	21	10.4	49	11.4	

* Significant at < 0.05

DISCUSSION

This community-based cross sectional study examined the prevalence of hypertension and associated factors among adults in rural communities in Ikwuano Abia State, Nigeria. The overall prevalence of hypertension was high (51%) and the factors associated with hypertension after adjustments were older age (≥40 years), female gender and high BMI.

Result from this study agrees with reported prevalence of hypertension in high-income countries which is as high as 45% in USA (2016), 48% in Japan (2015), 50.5% in Italy and 55.5% in Finland (2017) (NCD-RISC, 2019).The 51% hypertension prevalence in this study is way higher than the national rural prevalence of 26%estimated in 2020 (27).The wide variations in the reported values across different studies may be attributed to differences in methodologies (38), social, cultural as well as behavioural habits (27). Prevalence of 44.3% (39), 32.8% (40), 44% (41) and 45.6% (38) have been reported in more recent studies among rural communities in Nigeria. In urban areas in Nigeria, lower prevalence has been reported in Ibadan (33.1%) (42), Lagos (27.5%) (23) and Anambra state

(22.8%) (43). The higher prevalence in rural areas as compared to urban areas could be a function of lower level of awareness, limited control measures (32) and unavailable health centres and basic instruments like sphygmomanometer (44). On the other hand, a study observed that the prevalence in rural areas (44.5%) is as high as observed in urban areas (45). This could be due to the recent trends in globalization, urbanization, nutrition transition and current preference for western-oriented lifestyle of rural communities which was initially common in urban areas and high-income countries (38). The observed high prevalence of hypertension shows that Nigerian adults are at high risk of increase in rates of hypertension. This portends serious public health challenges and has important implications for increasing the national burden of NCDs in the near future in adults especially those in rural areas.

In the bivariate analysis, the current study found that age, sex, marital status, income and BMI were significantly associated with hypertension. Similar findings have been reported by other authors (38, 46, 47, 48). In the bivariate analysis, a significant relationship was observed between

Table 3: Association between hypertension and socio-demographics

Variables	Hypertension, n (%)	χ^2	p-Value
Sex			
Male	132 (58.1)	9.727	0.002*
Female	87 (43.1)		
Age			
<40 years	160 (46)	18.974	0.000*
≥40 years	59 (72.8)		
Marital status			
Single	108 (43.5)	13.233	0.000*
Married	111 (61.3)		
Household size			
1-3	64 (46.7)	1.513	0.219
>3	155 (53.1)		
Educational Level			
No formal education	11 (73.3)	3.089	0.079
Formal education	208 (50.2)		
Occupation			
Unemployed	55 (47)	2.344	0.305
Employed	164 (52.6)		
Income			
<30,000	132 (47)	5.653	0.020*
≥30,000	87 (58.8)		
BMI (kg/m²)			
Normal	144 (46.6)	8.742	0.003*
Overweight/obese	75 (62.5)		

*significant at $p \leq 0.05$, X^2=Chi square

Table 4: Multivariate binary logistic regression for risk factors of hypertension

Variables	Standardized β	AOR (95% CL)	p-Value
Sex			
Male	Ref		
Female	-1.137	0.32 (0.20-0.52)	0.000*
Age			
<40 years	Ref		
≥40 years	0.672	1.96 (1.03-3.72)	0.040*
Marital status			
Single	Ref		
Married	0.431	1.54 (0.92-2.59)	0.104
Household size			
1-3	Ref		
>3	0.241	1.27 (0.82-1.97)	0.280
Educational level			
No formal education	Ref		
Formal education	-0.548	0.58 (0.17-2.01)	0.388
Occupation			
Employed	Ref		
Unemployed	0.048	1.05 (0.82-1.34)	0.704
Income			
<30,000	Ref		
≥30,000	0.369	1.45 (0.56-3.75)	0.447
BMI (kg/m²)			
Normal	Ref		
Overweight/obese	0.935	2.55 (1.50-4.34)	0.001*

*significant at p≤0.05

marital status and hypertension (p=0.000), however, when adjusted the effect of marital status on hypertension showed no statistical association. This is consistent with a prospective study in Portugal which found no predictive role of marital status in the incidence of hypertension (49). We therefore speculate that this association maybe due to married individuals having better sleep, less stress and better moods than unmarried/divorced/widowed individuals.

The multivariate regression analysis showed that an increase in the prevalence of hypertension was associated with aging, and this is tandem with other studies (27, 50, 23, 51, 52, 53, 54, and 55). This can be attributed to the stiffing and hardening of the aorta and artery walls that increase with age (56). Research has also indicated that blood vessels naturally harden with age, losing their elasticity. This may be a possible explanation for older people/ adults being more at risk of developing high blood pressure compared to young adults (57).

Our study further confirms sex as an important determinant of hypertension, with females having lower odds of having hypertension compared to males. Hypertension prevalence of 77.7% (females) and 24.4% males (40) and 52.3% and 29.2% (41) have been reported in rural areas. Studies in urban areas have shown the prevalence to be higher in males compared to females (42, 23). Gender differences in blood pressure have been mainly attributed to behavioural risk factors such as smoking, alcohol consumption physical activity level, obesity, dietary habits and genetics (58). However, recent studies included, biological sex differences, health-seeking behaviours of women, socio-economic and socio-religious status of men as the considerable factors that attributes to sex differences for hypertension (59, 52, and 60).

Obese participants in this study had three-fold risk of hypertension which was consistent with

many studies showing positive association between increasing BMI and increasing rate of hypertension (52, 61, 62, 45, 46, 63). The link between obesity and hypertension have been explained by various epidemiological, biochemical, pathophysiological and functional mechanisms, some of which includes the increase in cardiac input and peripheral resistance of arterioles due to increased weight gain as well as angiotensinogen production serving as a cause and effect of adipocyte hypertrophy, which leads to elevation of blood pressure (64, 65). Furthermore, recent trends in urbanisation and nutrition transition has caused a change in lifestyle behaviours which leads to obesity and subsequently results in hypertension (56).

The cross sectional nature of the study did not permit examination of causal relationships between hypertension and identified factors. Another limitation is that blood pressure readings was taken at a single contact, however, as recommended by American Heart Association (AHA), subsequent readings were collected at intervals for respondents that had high SBP and/or high DBP in order to verify the result (66).

CONCLUSION

Hypertension prevalence is on the rise among rural community dwelling adults. This confirms the growing concern that hypertension is a public health concern. It is therefore recommended that aggressive and routine screening of adults for early hypertension diagnosis be carried out in order to prevent the- damaging consequences if left untreated. Educational programs aimed at maintaining normal arterial blood pressure should also be implemented by healthcare providers at the grassroots.

REFERENCES

1. World Health Organisation (WHO) (2013). Global Strategy on Diet, Physical Activity and Health. WHO Fact Sheet. World Health Organization, Geneva, Switzerland. Available at: http://www.int/dietphysicalactivity

2. Lim, S. S., Vos, T., Flaxman, A. D., Danaei, G., *et al.* (2012). A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: A systematic analysis for the Global Burden of Disease Study. Lancet. 380(9859):2224–60.

3. World Health Organisation (WHO) (2019). Hypertension. [Cited 2019 Aug 30]. Available from: *https://www.who.int/health-topics/hypertension/*

4. Kearney, P. M., Whelton, M., Reynolds, K., Muntner,P., *et al.* (2005). Global burden ofhypertension: Analysis of worldwide data. Lancet.365(9455):217–23.

5. World Health Organisation (WHO) (2022). Hypertension fact sheets. Available at: *https://www.who.int/news-room/fact-sheets/detail/hypertension*

6. WHO (2016). Global NCD target to reduce high blood pressure.

7. Lloyd-Sherlock, P., Beard, J., Minicuci N, Ebrahim S, *et al.* (2014). Hypertension among older adults in low- and middle-income countries: prevalence, awareness and control. International Journal of Epidemiology, 43(1):116–28.

8. World Health Organization (WHO) (2011). Global status report on non-communicable diseases 2010. Geneva: World Health Organization.

9. Kannel, W.B. (1996). Blood pressure as a cardiovascular risk factor: prevention and treatment. Journal of the American Medical Association. 275: 1571-1576.

10. World Health Organization (WHO) (2013). A Global Brief on Hypertension Silent Killer; Global Public Health Crisis. Geneva: World Health Organization.

11. Bakris, G. L., Black, H. R., Cushman, W. C. et al. (2004). The seventh report of the joint national committee on prevention, detection, evaluation, and treatment high blood pressure. Bethesda: National Heart, Lung, and Blood Institute.

12. Chobanian, A. V., Bakris, G. L., Black, H. R, et al. (2003). The seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. J Am Med Assoc. 289(19): 2560–2572.

13. Perkovic, V., Huxley, R., Wu, Y., Prabhakaran, D., MacMahon, S. (2007). The burden of blood pressure-related disease: a neglected priority for global health. Hypertension. 50:991–997.
14. Onwubere, B. J. C., Ejim, E. C., Okafor, C. L., Emehel, A., *et al.* (2011). Pattern of Blood Pressure Indices among the Residents of a Rural Community in South East Nigeria. International Journal of Hypertension, Article ID::621074.doi:10.4061/2011/621074 .
15. Park, K. (2007). Park's Textbook of Preventive and Social Medicine 19th edition. Jabalpur: M/s Banarsidas Bhanot Publishers.
16. Van de Vijver, S., Akinyi, H., Oti, S., Olajide, A., *et al.* (2013). Status report on hypertension in Africa - Consultative review for the 6th Session of the African Union Conference of Ministers of Health on NCD's. Pan African Medical Journal, 16:38.
17. He, F. J., MacGregor, G.A. (2013). Effect of longer-term modest salt reduction on blood pressure: Cochrane systematic review and meta-analysis of randomized trials. British Medical Journal. 346:1325.
18. Law, M. R., Frost, C. D. and Wald, N.J. (1991). By how much does dietary salt reduction lowers blood pressure? British Medical Journal. 302: 811-824.
19. Ijarotimi, O. S. and Keshinro O.O. (2008). Nutritional knowledge, nutrient intake and nutritional status of hypertensive patients in Ondo state, Nigeria; Tanzanian Journal of Health Research, 10(2): 59-67.
20. Olaitan O.O, Fadupin, G. T. and Adebiyi, A. A. (2018). Dietary pattern, lifestyle and nutritional status of hypertensive outpatients attending university college hospital, Ibadan, Nigeria; African Journal of Biomedical Reseaerch, 21: 29-36.
21. World Bank, Nigeria. (2013). http://data.worldbank.org/country/nigeria. (Assessed: 06/22/2013].
22. WHO AFRO, editor. (2005). Report of regional director: cardiovascular diseases in the African region: current situation and perspectives. Regional committee for Africa. Maputo, Mozambique: The WHO Regional Office for Africa.
23. Okubadejo, N. U., Ozoh, O. B., Ojo. O. O, Akinkugbe A. O., *et al.* (2019). Prevalence of hypertension and blood pressure profile amongst urban-dwelling adults in Nigeria: a comparative analysis based on recent guideline recommendations. Clinical Hypertension 25, 7. https://doi.org/10.1186/s40885-019-0112-1
24. Bello, M. (2013). Nigerians wake up to high blood pressure. Bull. World Health Organisaion. 91:242–243.
25. Mezue, K. (2013). The increasing burden of hypertension in Nigeria: can dietary salt reduction strategy change the trend? Perspect Public Health, 134(6):346-352
26. WHO (2019). Hypertension Fact Sheet. https://www.who.int/news-room/fact-sheets/hypertension/
27. Wada, O.Z., Olawade, D. B., Afolalu, T. D., Oluwatofarati, A, O., *et al.* (2020). Prevalence of hypertension among rural adults and availability of management services in a Nigerian community. Journal of Hypertension Management. 6:046. Doi.or/10.23937/2474-3690/1510046.
28. Cappuccio, F. P., Micah, F. B., Emmett, L., Sally, M. K. *et al.* (2004). Prevalence, detection and control of hypertension in Ashanti, West Africa. Hypertension 1017-1022
29. Kayima, J., Wanyenze, R. K., Katamba, A., Leontsini, E., *et al.* (2013). Hypertension awareness, treatment and control in Africa: a systematic review. BMC Cardiovascular Disorders, 13:54.
30. Ogah, O. S., Okpechi, I., Chukwuonye, I. I., Akinyemi, J. O., *et al.* (2012). Blood

pressure, prevalence of hypertension and hypertension related complications in Nigerian Africans: A review. World Journal of Cardiology, 4:327-340.

31. Tabi, A. W., Dimala, C. A., Mbuagbaw, J. and Monekosso, G. L. (2016). Hypertension, an emerging problem in rural Cameroon: Prevalence, risk factors, and control. International Journal of Hypertension. 5639146

32. Roland, G. A., Takramah, W., Axame, W. K., Owusu, R., *et al*.. (2017). Prevalence and awareness of hypertension among urban and rural adults in the Keta Municipality. The Journal of Medical Research. 3: 155-163.

33. Yamane, T. (1967). Statistics. An introductory analysis, 2nd ed, New York: Harper and Row.

34. Cochran, W. G. (1977). Sampling techniques (3rd ed). New York. John Wiley & Sons.

35. National population commission (NPC) (2006). The Population Census of the Federal Republic of Nigeria Analytical report at the National Population Commission, Abuja.

36. World Health Organization (WHO) (2008). Waist circumference and waist-hip ratio: Report of a WHO expert consultation Geneva, 8-11 December 2008. WHO document production services, Geneva, Switzerland. Pp. 33-34.

37. World Health Organization (2000). Obesity: Preventing and Managing the Global Epidemic. Geneva, Switzerland: World Health Organization.

38. Opreh, O. P., Olajubu, T. O., Akarakiri, K. J., Ligenza, V., *et al*. (2021). Prevalence and factors associated with hypertension among rural community dwellers in a local government area, South West Nigeria. African Health Sciences, *21*(1), 75–81. https://doi.org/10.4314/ahs.v21i1.12

39. Akpan, E. E., Udeme, E. E., Aniema, I. A. U., Bassey, E. B. (2015) Prevalence of hypertension in Akwa Ibom state, South-south Nigeria: Rural versus Urban Communities Study. International Journal of Hypertensio, Article ID; 075819

40. Lawson, E. and Iwasam, E. (2016) Hypertension prevalence in a rural community in south south Nigeria. Journal of the College of Physicians and Surgeons--Pakistan: JCPSP 26: 868-869.

41. Ofili, M. I., Ncama, B. P. and Sartorius, B. (2015) Hypertension in rural communities in Delta State, Nigeria: Prevalence, risk factors and barriers to health care. African Journal of Primary Health Care and Family Medicine 7: 875
.

42. Ajayi, I. O., Sowemimo, I. O., Akpa, O. M. and Ossai, N. E. (2016). Prevalence of hypertension and associated factors among residents of Ibadan-North Local Government Area of Nigeria. Nigerian Journal of Cardiology, 13:67-75

43. Ezekwesili, C. N., Ononamadu, C. J., Onyeukwu, O. F. and Mefoh, N. C. (2016). Epidemiological survey of hypertension in Anambra state, Nigeria. Nigerian Journal of Clinical Practice, 5: 659-667.

44. Ratovoson, R., Rasetarinera, O. R., Andrianantenaina, I., Rogier, C., *et al*. (2015). Hypertension, a neglected disease in rural and urban areas in Moramanga, Madagascar. PLoS One 10: e0137408.

45. Ahaneku, G. I., Osuji, C. U., Anisiuba, B. C., Ikeh, V. O., *et al*. (2011). Evaluation of blood pressure and indices of obesity in a typical rural community in Eastern Nigeria. Annals of African Medicine, 10:120-126.

46. Daniel, O. J., Adejumo, O. A., Adejumo, E. N., Owolabi, R. S., Braimoh, R. W. (2013). Prevalence of hypertension among urban slum dwellers in Lagos, Nigeria. Journal of Urban Health. 90:1016–1025. - PMC – PubMed

47. Ugwuja, E., Ezenkwa, U., Nwibo, A., Ogbanshi, M., *et al.* (2015). Prevalence and determinants of hypertension in an agrarian rural community in southeast Nigeria. Ann Medical and Health Science Research, 5(1):45–49

48. Asekun-Olarinmoye, E., Akinwusi, P., Adebimpe, W., Isawumi, M., *et al.* (2013). Prevalence of hypertension in the rural adult population of Osun State, southwestern Nigeria. International Journal of General Medicine, 6:317–322

49. Pereira, M., Lunet, N., Paulo, C., Severo, M., *et al.* (2012). Incidence of hypertension in a prospective cohort study of adults from Porto, Portugal. BMC Cardiovascular Disorders. 12:114 doi: 10.1186/1471-2261-12-114

50. Adeloye D, Basquill C, Aderemi A. V., Thompson JY, *et al.* (2015). An estimate of the prevalence of hypertension in Nigeria: a systematic review and meta-analysis. Journal of Hypertension 33:230-242.

51. Ulasi I.I., Ijoma, C. K. and Onodugo, O. D. (2010). A community-based study of hypertension and cardio-metabolic syndrome in semi-urban and rural communities in Nigeria. BMC Health Services Research. 10:71.

52. Tabrizi, J. S., Sadeghi-Bazargani, H., Farahbakhsh, M., Nikniaz,L., *et al.* (2016). Prevalence and associated factors of prehypertensionand hypertension in Iranian population: the lifestyle promotion project (LPP). PLoS ONE, 11:10.

53. Thankappan, K., Mini, G., Daivadanam, M., Vijayakumar, G., *et al.* (2013). Smoking cessation among diabetes patients: results of a pilot randomized controlled trial in Kerala, India. BMC Public Health, 13:1

54. Gao, Y., Chen, G., Tian, H. *et al.* (2013). Prevalence of hypertension inChina: a cross-sectional study. PLoS ONE, 8:6,

55. Priya M. and Mishra, C. (2016). Prevalence of hypertension in an area of urban Varanasi, India and its association with selected demographic factors. International Journal of Community Medicine and Public Health, 1600–1605.

56. Abebe, S. M., Berhane, Y., Worku, A. and Getachew, A. (2015). Prevalence and associated factors of hypertension: a crossectional community based study in Northwest Ethiopia. PLoS ONE, 10:4

.

57. Xu, X., Wang, B., Ren, C., Hu, J., *et al.* (2017). Age-related impairment of vascular structure and functions. Aging Dis, 8(5): 590 – 610.

58. Ruixing, Y., Jinzhen, W., Shangling, P. and Weixiong, L. (2008). Sex differences in environmental and genetic factors for hypertension. American Journal of Medicine, 121(9):811-9

59. Saswata, G., Simantini, M. and Anamite, B. (2016). Sex differences in the risk profile of hypertension: a cross-sectional study. BMJ. 6(7): e010085.

60. Everett, B. and Zajacova, A. (2015). Gender differences in hypertension and hypertension awareness among young adults," *Biodemography and Social Biology*, 61(1):1–17.

61. Osunkwo, D., Mohammed, A., Kamateeka, M., Nguku, P., *et al.* (2020). Population-based prevalence and associated risk factors of hypertension among adults in Benue state, Nigeria. Nigerian Journal of Clinical Practice. 23(7): 944-949.

62. Amare, B., Tilahun, T., Yihun, M., Ermias, M., *et al.* (2018). Prevalence and associated factors of hypertension among adult patients in Felege-Hiwot comprehensive referral hospitals, Northwest, Ethiopia. BMC Research Notes, 11:876 doi: 10.1186/s13104-108-3986-1

63. Ogah, O. S., Madukwe, O. O, Chukwonye, I. I., Onyenoro, U. U. *et al.* (2013). Prevalence and determinants of hypertension in Abia State Nigeria:

Results from the Abia state non-communicable diseases and cardiovascular risk factors survey. Ethn Dis, 23:161-7.

64. Hall, J. E. (2000). Pathophysiology of obesity hypertension. Current Hypertension Reports. 2:139-147. Doi: 10.1007/s11906-000-0073-4

65. Yiannikouris, F., Karounos, M., Charnigo, R., English, V. L., *et al.* (2012). Adipocyte-specific deficiency of angiotensinogen decreases plasma angiotensinogen concentration and systolic blood pressure in mice. American Journal of Physiology, Regulatory, Integrative and Comparative Physiology, 302: R244-R251

66. American Heart Association (2017) Monitoring your blood pressure at home.