

## A review of hypertension in Nigeria and the 'Rule of halves'

Ahmed Dahiru Balami<sup>1,\*</sup>, Musa Mohammed Baba<sup>2</sup>

<sup>1</sup> Department of Community Health, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor Darul Ehsan, Malaysia

<sup>2</sup> Department of Internal Medicine, Federal Medical Centre, Nguru, Yobe State, Nigeria

### ARTICLE INFO

### ABSTRACT

#### Article history:

Received 9 April 2017

Received in revised form 29 July 2017

Accepted 2 August 2017

Available online 5 August 2017

Hypertension is a condition associated with adverse vascular complications. Its prevalence is on the increase globally and same is true for Nigeria. Very few studies have assessed the prevalence, awareness, treatment and blood pressure control among hypertensive patients in Nigeria. The few available studies generally show figures less than 50% for all the three indicators of success with regards to hypertension. These studies are however deficient in their coverage, country representativeness and methodology, and as such, they fail to provide the evidence for which conclusions can be drawn. There is need to intensify blood pressure screening at both hospital and community levels. More comprehensive research with wider coverage and sound methodologies are also needed to determine those associated factors and to discover better treatment options for hypertension in Nigeria. These findings would guide health promotion activities and policy making.

#### Keywords:

Hypertension, awareness, treatment, control, rule of halves, Nigeria

Copyright © 2017 PENERBIT AKADEMIA BARU - All rights reserved

## 1. Introduction

Hypertension is increasingly becoming a public health concern in many countries. In the year 2000, the overall global prevalence among adults was 26.4%, and this value was predicted to increase by 60% by the year 2025 [1]. According to the Joint National Committee (JNC) on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure, hypertension is defined as a systolic blood pressure of 140 mmHg and above and/or diastolic blood pressure of 90 mmHg and above based on two or more properly measured seated blood pressure readings on each of two or more office visits [2]. It is also associated with vascular complications like stroke; ischaemic heart disease [3]; and chronic kidney disease [4]. Very high prevalences are continuously being reported all over the globe. The pooled prevalences of hypertension in Africa were 19.7%; 27.4%; and 30.8% respectively for the years 1990; 2000 and 2010 [5]. In West Africa, the prevalence has almost tripled in three decades, from the 1980s (12.9%) to 2010-2014 (34.4%) [6]. This increasing prevalence should prompt an expanded screening programme with a simultaneous expansion of treatment coverage alongside research into better treatment measures. However, a survey among general practitioners

\* Corresponding author.

E-mail address: Ahmed Dahiru Balami ([ahdahiru@yahoo.com](mailto:ahdahiru@yahoo.com))

in Lagos, Nigeria, revealed that despite having a high daily hypertension patient load, they had an unsatisfactory approach to the detection and evaluation of hypertension [7].

The basic aim of treating hypertension is to achieve and/or maintain controlled blood pressure and to prevent the onset of complications. It has been proposed that in a given population, only a half of those with hypertension will be aware of their hypertension status (Rule 1); out of which only a half would be receiving treatment (Rule 2); and out of which only a half will have a controlled blood pressure. This is known as the 'rule of halves'. 'Rule 1' is an indicator of how effective, awareness and screening programmes are, in a country; while 'Rule 2' portrays the level of treatment coverage for those already diagnosed, while 'Rule 3' is an indicator of success level of treatment [8]. Due to the generally asymptomatic nature of hypertension, a lot of cases have remained undiagnosed and a vast majority is unaware of their hypertensive status. The level of applicability of the 'rule of halves' is very heterogeneous with regards to location and its different items. In most advanced countries, the levels of awareness and treatment coverage have exceeded those of the 'rule of halves', but the levels of control still remain below 50%. A successive improvement in awareness and control has been reported among the Scots over the years [9]. Among the Swiss, a prevalence of 36% was recorded out of which 63% were aware; of which 78% were treated and 48% controlled [10]. Similar prevalence with high awareness (60.2%) and treatment (87.6%) has been reported among the Greeks but with low control (32.8%) [11]. In Italy, even among patients followed up by specialist physicians control was only 37.5% [12]. In a rural community in western Sweden, the prevalence of hypertension was 20%, out of whom 67% were aware of their status, and out of whom 31% had controlled blood pressure [13].

In less advanced countries, levels of awareness, treatment and control have almost always been below half. In an urban community in Peru, the prevalence was 24.1%; and 48.3% were aware of their condition; out of whom 48.3% were aware; out of whom 40% were receiving treatment and of whom 30.4% had controlled blood pressures [14]. High treatment coverage for hypertension has been reported in India. In Basavanapura village, 16.1% were hypertensive of whom 61.1% were aware and of whom 90.9% were receiving treatment; and 70% were controlled [15]. In the Chennai Urban Rural Epidemiology Study (CURES), 20% had hypertension, out of which only 32.8% were aware of their status; out of which 70.8% were on treatment and 45.9% were controlled [16]. Rampal *et al.* [17] reported that in Malaysia among those aged > 15 years, a prevalence of 27.8%, among which 34.6% were aware of their status, out of which 32.4% were receiving treatment, with only 26.8% having controlled blood pressure. In Thai Nguyen, Vietnam, the prevalence was 23% out of whom 34% were aware of their status; of whom 43% were receiving treatment and 39% had the blood pressures under control [18].

Statistics for African communities and other less advanced countries generally show values lower than that, for the 'rule of halves' for awareness, treatment and control. For them, it seemed 'the rule of thirds' as described by Lindblad *et al.* [13] was more likely to apply. A systematic review of studies from 2010-2014 revealed that among hypertensive persons in west Africa, the proportion of those who were aware of their status ranged from 19.6% to 84%; and 0 to 79.2% of them were already receiving treatment, but only 0 to 12.7% of those receiving treatment had good blood pressure control [6]. The aim of this paper is to examine the level of success with regards to hypertension in Nigeria in the light of 'the rule of halves'.

## 2. Materials and Methods

A detailed literature search was conducted in Google scholar, PubMed and Cochrane library. Search terms included: hypertension; 'rule of halves'; blood pressure; awareness; treatment; Nigeria;

prevalence and control. The titles and then abstracts of the articles were screened to exclude out-of-scope papers. Articles were considered eligible for inclusion if the study had assessed at least the level of hypertension awareness; if they were published from the year 2000 onwards, and only if the JNC VII criteria for hypertension of systolic greater than or equal to 140mmHg and diastolic blood pressure greater than or equal to 90mmHg were used in the study. A total of thirteen published articles were finally included for the review. These articles were first assessed for quality using the Checklist for Prevalence Studies of the Joanna Briggs Institute [19], followed by a qualitative synthesis to derive an idea of how applicable the ‘rule of halves’ is, in the Nigerian setting.

### 3. Results

#### 3.1 Assessment of Included Studies

Quality assessment of the selected articles is presented in Table1. Despite the Fulani and Hausa ethnicities cutting across several Nigerian states and other West African countries, and with a broad range of intra-ethnic diversity, the study by Isezuo *et al.* [20] had sought to generalise its findings to the whole of this Hausa and Fulani population from data collected from only two urban and two rural areas from just a single state in Nigeria. The sample size in this study is also grossly inadequate. The study by Ulasi *et al.* [21] had utilised a convenience sampling, and the response rate had not been clearly stated. For the study by Omuemu *et al.*, [22] the sample size was grossly inadequate, considering the type of sampling method employed (cluster sampling). The sampling methods and sample size for the study by Adeoye *et al.* [23] among health workers were adequate. The study by Akpan *et al.* [24] was a community-based study which utilized a convenience sampling method. There was no sample size calculation and as such the adequacy of the sample size of the study remains unclear. Chinyere *et al.* [25] had neither stated the sampling technique clearly, nor was sample size calculation stated, as such, adequacy of the sample size remained unclear. The study by Okwonu *et al.*, [26] though had calculated the required sample size, had used a purposive sampling to recruit the participants.

**Table 1**  
 Quality assessment of selected studies

Study	Appropriate sample frame to address the target population	Appropriate sampling method	Adequate sample size	Adequate response rate	Validity and reliability of measurements
1.Isezuo <i>et al.</i> [20]	No	Yes	No	Yes	Yes
2.Ulasi <i>et al.</i> [21]	Yes	No	Yes	Not clear	Yes
3.Omuemu <i>et al.</i> [22]	Yes	Yes	No	Yes	Yes
4.Oladapo <i>et al.</i> [27]	Yes	Yes	Yes	Yes	Yes
5.Ekwunife <i>et al.</i> [28]	Yes	Yes	Yes	Yes	Yes
6.Hendriks <i>et al.</i> [29]	Yes	Yes	Yes	Yes	Yes
7.Adeoye <i>et al.</i> [23]	Yes	Yes	Yes	Yes	Yes
8. Ahaneku <i>et al.</i> [30]	Yes	Not clear	Yes	Not clear	Yes
9. Akpan <i>et al.</i> , [24]	Yes	No	Not clear	Not clear	Yes
10. Iloh & Amadi [31]	Yes	Yes	Yes	Yes	Yes
11. Owolabi <i>et al.</i> [32]	Yes	Not clear	Not clear	Not clear	Yes
12. Chinyere <i>et al.</i> [25]	Yes	Not clear	Not clear	Not clear	Yes
13. Okwonu <i>et al.</i> [26]	Yes	No	Yes	Not clear	Yes

### 3.2 Prevalence and Awareness of Hypertension Status in Nigeria

From a meta-analysis of studies from 1980-2013, the estimated pooled prevalence of hypertension among Nigerian adults was 28.9% of whom only 17.4% were aware of their hypertensive status [33]. Several prevalence studies have been conducted among different populations in the country with prevalences ranging from 1.5% to 46.4% [34-48]. However, as shown in Figure 1, only a few studies had gone further to determine the proportion of those hypertensive patients who were already aware of their status. This ranged from a minimum of 6.4% in a rural community in the South-east to 64.7% among health workers in the south-west apart from which all other findings were below 50% [24, 32]. Okwonu et al. [26] had reported no significant difference in level of awareness of hypertensive status by gender, age group, occupation or educational status, but the other studies did not explore the associated factors. Results from a systematic review revealed that in Africa, the lowest prevalence for awareness (8%) and treatment (5%) were reported in rural communities in Nigeria [49].

### 3.3 Treatment Coverage and Blood Pressure Control among Hypertensive Patients in Nigeria

As shown in Table 1, six studies had assessed the level of treatment coverage among those already aware of their hypertensive status which ranged from 5% to 85.7% [20, 22, 27, 28, 29, 30]. Adoye et al. [23] however, studied the treatment coverage among the overall hypertensive patients and reported a coverage of 54%. Most epidemiological studies on hypertension in Nigeria have focused only on persons already receiving treatment. In a semi-urban community in the south-east, 32% of hypertensive patients had controlled blood pressure [26]. In a tertiary health centre in the same region, 35% were reported to have their blood pressures under control [50]. In a Teaching Hospital in the same region too, 28.1% of hypertensive patients had controlled blood pressure [51]. In a community study in the Niger-Delta area (south-south) 7.3% of persons with hypertension treatment had their blood pressures controlled [52]. In the cardiology clinic of a tertiary hospital in same region, 24.2% of hypertensive patients had a controlled blood pressure [53]. The blood pressure control in a tertiary centre in the south-west was 29% [54]. A higher level of control (45.3%) was however reported in a similar clinic located in a rural area in the same region [55]. In the north-central, a control level of 33% was reported in a tertiary hospital [56]. A similar study in a tertiary hospital in the middle belt of Nigeria revealed a blood pressure control of 35.8% among hypertensive patients [57]. In a Teaching Hospital in the north-west the level of blood pressure control was 34.5% [58]. In another Teaching Hospital in the north-west, the percentage of blood pressure control was 30.5% [59].

Iloh *et al.* [50] reported the following as being significantly associated with good blood pressure control: being on one or more anti-hypertensive medication; adherence to anti-hypertensive medications; and duration of taking anti-hypertensive medications of greater than or equal to 3 years. In the study by Ezeala-Adikaibe *et al.* [51], higher rates of blood pressure control was reported among those on monotherapy, while lower rates among widows and dwellers of rural areas. The lowest rates were reported among those with a co-morbid condition like a stroke or diabetes mellitus. No significant correlation was reported between systolic or diastolic blood pressure with age, gender or body mass index (BMI) among hypertensive patients attending a tertiary health centre in the south-south [53]. Males were also reported to have a significantly higher proportion of good blood pressure control [58]. Ojo *et al.* [60] however found female gender; regular use of medication and regular clinic attendance were good predictors of blood pressure control. Dietary lifestyle modification has also been reported as an important positive factor [61].

**Table 2**  
 Summary of findings from selected studies

Study	Location	Sample size	Prevalence of hypertension (HTN)	Aware (% with HTN)	Treated (% of aware)	Controlled (% of treated)
1. Isezuo <i>et al.</i> [20]	Urban and rural north west	782	1.5	13.9	85.7	12.5
2. Ulasi <i>et al.</i> [21]	Market place south east	731	42	29.4	-	-
3. Omuemu <i>et al.</i> [22]	Rural south-south	590	20.2	18.5	77.3	29.4
4. Oladapo <i>et al.</i> [27]	Rural south-west	2,000	20.8	14.2	18.6	-
5. Ekwunife <i>et al.</i> [28]	Urban South-east	800	21.1	30	21	9
6. Hendriks <i>et al.</i> [29]	State north-central	2,678	19.3	8.0	5.0	3.0
7. Adeoye <i>et al.</i> [23]	Tertiary hospital (health workers) south west	352	35	-	54 (% of those with HTN)	70
8. Ahaneku <i>et al.</i> [30]	Rural South-east	218	44.5	12.4	40	-
9. Akpan <i>et al.</i> [24]	Urban South-east	590	27.5	10.6	-	-
	Rural South-east	978	44.3	6.4	-	-
10. Iloh & Amadi [31]	Clinic in South-east	1,600	12.3	38.3	-	-
11. Owolabi <i>et al.</i> [32]	Health workers south west	324	20.1	64.7	-	-
12. Chinyere <i>et al.</i> [25]	Tertiary institution staff and students	471	15.7	21.6	-	-
13. Okwonu <i>et al.</i> [26]	Semi-urban South-east	389	37.8	28.6	-	-

#### 4. Discussion

The results presented above reveal that the levels of self-knowledge of hypertensive status, level of treatment coverage, and success of treatment are generally low in Nigeria. This low level of awareness could be as a result of a poor attitude of health workers towards hypertension [7], as blood pressures are not routinely measured for patients during hospital visits. Also a lack of screening mechanism at the community level could account for this low level of awareness. However, of the three performance indicators, treatment coverage seemed to be the best. This should be expected, as most diagnoses are likely to be made by a health practitioner in a health centre, who is likely to initiate some form of treatment (lifestyle modification with/without pharmacological treatment). The findings also suggest a lower level of awareness, but better treatment coverage in rural settings which could be explained by many factors. Firstly, those in urban areas are more likely to access

screening tools like digital Sphygmomanometers, from family members or friends. Many formal employments in the cities also require medical check-ups to be conducted before resuming work, of which blood pressure measurement forms an integral part. Health facilities are also likely to be more accessible to urban dwellers. These factors combined, could account for a higher level of awareness of hypertension status among urban dwellers. The higher level of persons screened and diagnosed of hypertension is likely to be associated with a similarly higher level of control. A lack of accessibility to blood pressure screening in rural areas could also explain the better treatment coverage among diagnosed persons as only very highly motivated persons are likely to have availed themselves to screening in the first place. Apart from findings by Adeoye *et al.* [23] among health workers in a tertiary health centre, there has been so far no report of blood pressure control of up to 50% among those receiving anti-hypertensive treatment in Nigeria. In fact, as of 2013, there was no reported control rate above 45% in the whole of Africa [49].

The findings in Nigeria appear similar to those of other African countries. A nationwide study in Tunisia showed a prevalence of 30.6%; out of which 38.8% were aware of their status; out of which 84.4% were receiving treatment and of which 24.1% were under control [62]. In Mozambique, the nationwide prevalence was 33.1%; among which 14.8% were aware of their status. Of those aware of their status, 51.9% were receiving treatment out of which 39.9% had their blood pressures controlled [63]. Among rural and urban Tanzanian populace, the prevalence was 30% out of which less than 20% were aware of their status; out of which less than 10% were receiving treatment and less than 1% had their blood pressures controlled [64]. In a nationwide study in Cameroon, revealed a prevalence of 24.6% among from which 23% were aware of their status; from which 46% were receiving treatment; and of whom 19% were controlled [65]. In Ghana, a prevalence of 29.4% was reported out of whom 34% were aware of their status; 28% were receiving treatment out of whom only 6.2% were controlled [66].

Though factors associated with blood pressure control among hypertensive patients in Nigeria have not been extensively studied, findings by Tamuno and Babashani [58] of a better blood pressure control among men contrasts findings from the National survey in the United States which revealed a better blood pressure control among women [67]. Reports of higher blood pressure control among those on monotherapy by Ezeala-Adikaibe *et al.* [51] was in concordance with findings from Kenya and Malaysia, where the use of three or more anti-hypertensive medications was associated with decreased odds of good blood pressure control [68, 69]. Advanced age above 60 years was reported to be associated with lower odds of good blood pressure control in contrast to findings by Akpa *et al.* [53] that there was no significant association between age and blood pressure.

Considering the relatively high prevalence of hypertension in Nigeria, there is an obvious need to intensify screening measures. Also, more studies on hypertension with large sample sizes and employing sound methodologies are needed especially at the community level. This is because the number of available studies, their geographical coverage, and methodologies as seen from the assessments above, are grossly deficient to allow for valid conclusions to be drawn. Other factors which could affect blood pressure control as reported in studies outside Nigeria like: ethnicity [70]; occupation [71]; number of clinical visits [72, 73]; and co-morbid conditions like chronic kidney disease [74] also need to be studied extensively. There is also need for further research on more efficient treatment options for achieving good blood pressure as intensive blood pressure lowering in hypertensive patients is beneficial in reducing the rates of major cardiovascular events as demonstrated by Hansson *et al.* [75].

## 5. Conclusion

Hypertension in Nigeria is prevalent and associated with several adverse health consequences. However, comprehensive studies taking into account all the three indicators for assessing success with regards to hypertension, are limited. There is therefore a need to intensify screening measures and also boost research in this area.

## References

- [1] Schaeffner, Elke S., Tobias Kurth, Thomas S. Bowman, Rebecca P. Gelber, and J. Michael Gaziano. "Blood pressure measures and risk of chronic kidney disease in men." *Nephrology Dialysis Transplantation* 23, no. 4 (2007): 1246-1251.
- [2] The Seventh Report of the National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. U.S. Department of Health and Human Services, 2004
- [3] Lawes, Carlene MM, Stephen Vander Hoorn, and Anthony Rodgers. "Global burden of blood-pressure-related disease, 2001." *The Lancet* 371, no. 9623 (2008): 1513-1518.
- [4] Islam, Tareq M., Caroline S. Fox, Devin Mann, and Paul Muntner. "Age-related associations of hypertension and diabetes mellitus with chronic kidney disease." *BMC nephrology* 10, no. 1 (2009): 17.
- [5] Adeloje, Davies, and Catriona Basquill. "Estimating the prevalence and awareness rates of hypertension in Africa: a systematic analysis." *PloS one* 9, no. 8 (2014): e104300.
- [6] Bosu, William K. "The prevalence, awareness, and control of hypertension among workers in West Africa: a systematic review." *Global health action* 8, no. 1 (2015): 26227.
- [7] Ale, Olagoke Korede, Rotimi William Braimoh, and Sunday O. Olayemi. "The approach of general practitioners in Lagos to the detection and evaluation of hypertension." *Clinical hypertension* 21, no. 1 (2015): 10.
- [8] Varadaraja Rao, B. A. "Application of the "rule of halves" for hypertension as an assessment tool in an urban slum at davangere." *National Journal of Community Medicine* 5, no. 3 (2014): 333-336.
- [9] Chen, R., H. Tunstall-Pedoe, C. Morrison, J. Connaghan, and R. A'brook. "Trends and social factors in blood pressure control in Scottish MONICA surveys 1986-1995: the rule of halves revisited." *Journal of human hypertension* 17, no. 11 (2003): 751.
- [10] Danon-Hersch, Nadia, Pedro Marques-Vidal, Pascal Bovet, Arnaud Chiolero, Fred Paccaud, Alain Pécoud, Daniel Hayoz, Vincent Mooser, Gérard Waeber, and Peter Vollenweider. "Prevalence, awareness, treatment and control of high blood pressure in a Swiss city general population: the CoLaus study." *European Journal of Cardiovascular Prevention & Rehabilitation* 16, no. 1 (2009): 66-72.
- [11] Efstratopoulos, Aris D., Sofia M. Voyaki, Athanasios A. Baltas, Filippos A. Vratsistas, Dimitrios-Eteoklis P. Kirlas, John T. Kontoyannis, John G. Sakellariou et al. "Prevalence, Awareness, Treatment and Control of Hypertension in Hellas, Greece\* The Hypertension Study in General Practice in Hellas (HYPERTENSHELL) National Study." *American journal of Hypertension* 19, no. 1 (2006): 53-60.
- [12] Mancia, Giuseppe, Achille C. Pessina, Bruno Trimarco, Guido Grassi, and SILVIA (Studio Italiano Longitudinale sulla Valutazione della Ipertensione Arteriosa nel 2000) Study Group. "Blood pressure control according to new guidelines targets in low-to high-risk hypertensives managed in specialist practice." *Journal of hypertension* 22, no. 12 (2004): 2387-2396.
- [13] Lindblad, Ulf, Johanna Ek, Jenny Eckner, Charlotte A. Larsson, Guangliang Shan, and Lennart Råstam. "Prevalence, awareness, treatment, and control of hypertension: rule of thirds in the Skaraborg project." *Scandinavian journal of primary health care* 30, no. 2 (2012): 88-94.
- [14] Lerner, Alana G., Antonio Bernabe-Ortiz, Robert H. Gilman, Liam Smeeth, and J. Jaime Miranda. "The 'rule of halves' does not apply in Peru: Awareness, treatment, and control of hypertension and diabetes in rural, urban and rural-to-urban migrants." *Critical pathways in cardiology* 12, no. 2 (2013): 53.
- [15] Kutnikar, Jatin Venugopal, Madhu Basavegowda, Vidyaxmi Kokkada, and Nagaralu Channabasappa Ashok. "Prevalence of Hypertension and Assessment of" Rule of Halves" in Rural Population of Basavanapura Village, Nanjangud Taluk, South India." *Heart India* 2, no. 4 (2014): 99.
- [16] Mohan, V., M. Deepa, Syed Farooq, M. Datta, and R. Deepa. "Prevalence, awareness and control of hypertension in Chennai-the Chennai urban rural epidemiology study (CURES-52)." *Journal of Association of Physicians of India* 55 (2007): 326-32.
- [17] Rampal, L., S. Rampal, M. Z. Azhar, and A. R. Rahman. "Prevalence, awareness, treatment and control of hypertension in Malaysia: a national study of 16,440 subjects." *Public health* 122, no. 1 (2008): 11-18.

- [18] Ha, Duc Anh, Robert J. Goldberg, Jeroan J. Allison, Thang Hong Chu, and Hoa L. Nguyen. "Prevalence, awareness, treatment, and control of high blood pressure: a population-based survey in Thai Nguyen, Vietnam." *PLoS One* 8, no. 6 (2013): e66792.
- [19] Joanna Briggs Institute (2006). Checklist for Prevalence Studies. The Joanna Briggs Institute Critical Appraisal tools for use in JBI Systematic Reviews. Retrieved from: <http://joannabriggs.org/research/critical---appraisal---tools.html>
- [20] Isezuo, S. A., A. A. Sabir, A. E. Ohwovorilole, and O. A. Fasanmade. "Prevalence, associated factors and relationship between prehypertension and hypertension: a study of two ethnic African populations in Northern Nigeria." *Journal of human hypertension* 25, no. 4 (2011): 224.
- [21] Ulasi, Ifeoma I., Chinwuba K. Ijoma, Basden JC Onwubere, Ejikeme Arodiwe, Obinna Onodugo, and Christian Okafor. "High prevalence and low awareness of hypertension in a market population in Enugu, Nigeria." *International journal of hypertension* 2011 (2011).
- [22] Omuemu, V. O., O. H. Okojie, and C. E. Omuemu. "Awareness of high blood pressure status, treatment and control in a rural community in Edo state." *Nigerian journal of clinical practice* 10, no. 3 (2007): 208-212.
- [23] Adeoye, Abiodun M., Adewole Adebisi, Mayowa O. Owolabi, Daniel T. Lackland, Gbenga Ogedegbe, and Bamidele O. Tayo. "Sex disparity in blood pressure levels among Nigerian health workers." *The Journal of Clinical Hypertension* 18, no. 7 (2016): 685-689.
- [24] Akpan, Effiong Ekong, Udeme E. Ekrikpo, Aniema IA Udo, and Bassey Edet Bassey. "Prevalence of hypertension in Akwa Ibom State, South-South Nigeria: rural versus urban communities study." *International journal of hypertension* 2015 (2015).
- [25] Chinyere, Okpara Ihunanya, Utoo Priscilla Mwuese, and Bako Ishaku Ara. "Prevalence and awareness of hypertension amongst staff and students of a tertiary institution in Nigeria." *Glo Adv Res J Med Med Sci* 4 (2015): 061-6.
- [26] Okwuonu, Chimezie Godswill, Nnamdi Ezekiel Ojmadu, Oluchi Justina Chimezie, Uche Madudonu, Nkechi Ogbulafor, and Okechukwu Samuel Ogah. "Awareness of blood pressure status, undiagnosed hypertension and proteinuria among adults in Umuahia, South-East Nigeria." *Sahel Medical Journal* 19, no. 2 (2016): 82.
- [27] Oladapo, O. O., L. Salako, O. Sodiq, K. Shoyinka, K. Adedapo, and A. O. Falase. "A prevalence of cardiometabolic risk factors among a rural Yoruba south-western Nigerian population: a population-based survey: cardiovascular topics." *Cardiovascular journal of Africa* 21, no. 1 (2010): 26-31.
- [28] Ekwunife, Obinna Ikechukwu, Patrick Obinna Udeogaranya, and Izuchukwu Loveth Nwatu. "Prevalence, awareness, treatment and control of hypertension in a Nigerian population." *Health* 2, no. 07 (2010): 731.
- [29] Hendriks, Marleen E., Ferdinand WNM Wit, Marijke TL Roos, Lizzy M. Brewster, Tanimola M. Akande, Ingrid H. de Beer, Sayoki G. Mfinanga et al. "Hypertension in sub-Saharan Africa: cross-sectional surveys in four rural and urban communities." *PLoS one* 7, no. 3 (2012): e32638.
- [30] Ahaneku, Gladys I., C. U. Osuji, B. C. Anisiuba, V. O. Ikeh, O. C. Oguejiofor, and J. E. Ahaneku. "Evaluation of blood pressure and indices of obesity in a typical rural community in eastern Nigeria." *Annals of African Medicine* 10, no. 2 (2011).
- [31] Iloh, Gabriel Uche Pascal, and Agwu Nkwa Amadi. "Essential hypertension in adult Nigerians in a primary care clinic: A cross sectional study of the prevalence and associated family socio-biological factors in Eastern Nigeria." *Eur J Prev Med* 2, no. 6 (2014): 81-9.
- [32] Owolabi, Akinwumi Olayinka, Mojisola Oluyemisi Owolabi, Akintayo David OlaOlorun, and Isaac Olusayo Amole. "Hypertension prevalence and awareness among a health workforce in Nigeria." *Internet Journal of Medical Update-EJOURNAL* 10, no. 2 (2015): 10-19.
- [33] Adeloye, Davies, Catriona Basquill, Adewale V. Aderemi, Jacqueline Y. Thompson, and Felix A. Obi. "An estimate of the prevalence of hypertension in Nigeria: a systematic review and meta-analysis." *Journal of hypertension* 33, no. 2 (2015): 230-242.
- [34] Ekore, R. I., I. O. Ajayi, and A. Arije. "Case finding for hypertension in young adult patients attending a missionary hospital in Nigeria." *African health sciences* 9, no. 3 (2009).
- [35] Olatunbosun, S. T., J. S. Kaufman, R. S. Cooper, and A. F. Bella. "Hypertension in a black population: prevalence and biosocial determinants of high blood pressure in a group of urban Nigerians." *Journal of human hypertension* 14, no. 4 (2000): 249.
- [36] Akinkugbe, O. O. "Health behavior monitor among Nigerian adult population: a collaborative work of Nigerian Heart Foundation and Federal Ministry of Health and Social Services, Abuja supported by World Health Organization, Geneva. 2003."
- [37] Erhun, W. O., G. Olayiwola, E. O. Agbani, and N. S. Omotoso. "Prevalence of hypertension in a university community in South West Nigeria." *African Journal of Biomedical Research* 8, no. 1 (2005): 15-19.



- [38] Oghagbon, E. K., A. B. Okesina, and S. A. Biliaminu. "Prevalence Of Hypertension And Associated Variables In Paid Workers In Ilorin, Nigeria." *Nigerian Journal of Clinical Practice* 11, no. 4 (2008).
- [39] Nwankwo, E. A., A. C. Ene, and B. Biyaya. "Some cardiovascular risk factors in volunteers for health checks: a study of rural and urban residents in the Northeast Nigeria." *The Internet Journal of Cardiovascular Research* 5, no. 2 (2008): 2008.
- [40] Adedoyin, Rufus A., Chidozie E. Mbada, Michael O. Balogun, Tanimola Martins, Rasaaq A. Adebayo, Anthony Akintomide, and Patience O. Akinwusi. "Prevalence and pattern of hypertension in a semiurban community in Nigeria." *European Journal of Cardiovascular Prevention & Rehabilitation* 15, no. 6 (2008): 683-687.
- [41] Lawoyin, T. O., M. C. Asuzu, J. Kaufman, C. Rotimi, E. Owoaje, L. Johnson, and R. Cooper. "Prevalence of cardiovascular risk factors in an African, urban inner city community." *West African journal of medicine* 21, no. 3 (2002): 208-211.
- [42] Gezawa, Ibrahim D., Baba M. Musa, Muhammad S. Mijinyawa, Muhammad A. Talle, Yusuf M. Shehu, Andrew E. Uloko, M. M. Watila, and B. M. Musa. "Prevalence of hypertension and its relationship with indices of obesity in Maiduguri, Northeastern Nigeria." *Nigerian Journal of Basic and Clinical Sciences* 11, no. 2 (2014): 67.
- [43] Onwubere, B. J. C., E. C. Ejim, C. I. Okafor, A. Emehel, A. U. Mbah, U. Onyia, and S. Mendis. "Pattern of blood pressure indices among the residents of a rural community in South East Nigeria." *International journal of hypertension* 2011 (2011).
- [44] Ulasi, Ifeoma I., Chinwuba K. Ijoma, and Obinna D. Onodugo. "A community-based study of hypertension and cardio-metabolic syndrome in semi-urban and rural communities in Nigeria." *BMC health services research* 10, no. 1 (2010): 71.
- [45] Andy, Joseph J., Etete J. Peters, Udeme E. Ekrikpo, Ndanyongmong A. Akpan, Bernard C. Unadike, and John U. Ekott. "Prevalence and correlates of hypertension among the Ibibio/Annangs, Efiks and Obolos: a cross sectional community survey in rural South-South Nigeria." *Ethnicity & disease* 22, no. 3 (2012): 335-339.
- [46] Onwuchekwa, Arthur Chukwubike, Mary Margaret Mezie-Okoye, and Seye Babatunde. "Prevalence of hypertension in Kegbara-Dere, a rural community in the Niger Delta region, Nigeria." *Ethnicity & disease* 22, no. 3 (2012): 340-346.
- [47] Odugbemi, T. O., A. T. Onajole, and A. O. Osibogun. "Prevalence of cardiovascular risk factors amongst traders in an urban market in Lagos, Nigeria." *Niger Postgrad Med J* 19 (2012): 1-6.
- [48] Sola, A. O., O. I. Chinyere, A. O. Stephen, and J. A. Kayode. "Hypertension prevalence in an urban and rural area of Nigeria." *J Med Sci* 4 (2013): 149-54.
- [49] Kayima, James, Rhoda K. Wanyenze, Achilles Katamba, Elli Leontsini, and Fred Nuwaha. "Hypertension awareness, treatment and control in Africa: a systematic review." *BMC cardiovascular disorders* 13, no. 1 (2013): 54.
- [50] Iloh, Gabriel UP, John N. Ofoedu, Patrick U. Njoku, Ezinne U. Godswill-Uko, and Agwu N. Amadi. "Medication adherence and blood pressure control amongst adults with primary hypertension attending a tertiary hospital primary care clinic in Eastern Nigeria." *African Journal of Primary Health Care and Family Medicine* 5, no. 1 (2013): 1-6.
- [51] Ezeala-Adikaibe, B. A., Okafor, H., Orjioko, C., Okpara, T., Aneke, E., Chime, P., Mbadiwe, N., Nwosu, N., Nwobodo, N., Onyebeke, G., Nwobodo, M. & Okudo, G. "Blood pressure Control among Outpatients in Enugu. A report of the ESUT Medical Research Group". *World Journal of Pharmaceutical Sciences* 2, no. 12 (2014): 1636-1641.
- [52] Suleiman, Ismail A., Ebubechukwu O. Amogu, and Kehinde A. Ganiyu. "Prevalence and control of hypertension in a Niger Delta semi urban community, Nigeria." *Pharmacy practice* 11, no. 1 (2013): 24.
- [53] Akpa, Maclean R., Datonye Dennis Alasia, and Pedro C. Emem-Chioma. "An Appraisal of Hospital Based Blood Pressure Control in Port Harcourt, Nigeria." *Nigerian Health Journal* 8, no. 1-2 (2008): 27-30.
- [54] Yusuff, Kazeem B., and Olumide Balogun. "Physicians' prescribing of anti-hypertensive combinations in a tertiary care setting in southwestern Nigeria." *J Pharm Pharm Sci* 8, no. 2 (2005): 235-242.
- [55] Busari, Olusegun Adesola, Rotimi Oluyonbo, A. J. Fasae, and O. E. Gabriel. "Prescribing pattern and utilization of antihypertensive drugs and blood pressure control in adult patients with systemic hypertension in a rural tertiary hospital in Nigeria." *Am J Int Med* 2, no. 6 (2014): 144-49.
- [56] Sani, M. U., M. S. Mijinyawa, B. Adamu, A. Abdu, and M. M. Borodo. "Blood pressure control among treated hypertensives in a tertiary health institution." *Nigerian Journal of Medicine* 17, no. 3 (2008): 270-274.
- [57] Katibi, I. A., J. K. Olarinoeye, and S. A. Kuranga. "Knowledge and practice of hypertensive patients as seen in a tertiary hospital in the middle belt of Nigeria." *Nigerian journal of clinical practice* 13, no. 2 (2010).
- [58] Tamuno, Igbiks, and Musa Babashani. "Blood pressure control amongst hypertensive patients in a tertiary health care facility in Northern Nigeria." *Res J Med Sci* 6, no. 1 (2012): 26-32.
- [59] Etuk, E., S. A. Isezuo, A. Chika, J. Akuche, and M. Ali. "Prescription pattern of anti-hypertensive drugs in a tertiary health institution in Nigeria." *Annals of African medicine* 7, no. 3 (2008): 128-132.

- [60] Ojo, Oluwaseun S., Sunday O. Malomo, Peter T. Sogunle, and Adegbola M. Ige. "An appraisal of blood pressure control and its determinants among patients with primary hypertension seen in a primary care setting in Western Nigeria." *South African Family Practice* 58, no. 6 (2016): 192-201.
- [61] Adedapo, Aduragbenro DA, Waheed Adeola Adedeji, Abiola Muhammad Adeosun, Japhet Olaremi, and Cecelia Kehinde Okunlola. "Antihypertensive drug use and blood pressure control among in-patients with hypertension in a Nigerian tertiary healthcare centre." *International Journal of Basic & Clinical Pharmacology* 5, no. 3 (2016): 696-701.
- [62] Romdhane, Habiba Ben, Samir Ben Ali, Hajer Skhiri, Pierre Traissac, Souha Bougatef, Bernard Maire, Francis Delpeuch, and Noureddine Achour. "Hypertension among Tunisian adults: results of the TAHINA project." *Hypertension Research* 35, no. 3 (2012): 341-347.
- [63] Damasceno, Albertino, Ana Azevedo, Carla Silva-Matos, António Prista, Domingos Diogo, and Nuno Lunet. "Hypertension prevalence, awareness, treatment, and control in mozambique." *Hypertension* 54, no. 1 (2009): 77-83.
- [64] Edwards, Richard, Nigel Unwin, Ferdinand Mugusi, David Whiting, Seif Rashid, John Kissima, Terence J. Aspray, and K. George MM Alberti. "Hypertension prevalence and care in an urban and rural area of Tanzania." *Journal of hypertension* 18, no. 2 (2000): 145-152.
- [65] Kamadjeu, R. M., R. Edwards, J. S. Atanga, N. Unwin, E. C. Kiawi, and J. C. Mbanya. "Prevalence, awareness and management of hypertension in Cameroon: findings of the 2003 Cameroon Burden of Diabetes Baseline Survey." *Journal of human hypertension* 20, no. 1 (2006): 91-91.
- [66] Agyemang, Charles, Marc A. Bruijnzeels, and Ellis Owusu-Dabo. "Factors associated with hypertension awareness, treatment, and control in Ghana, West Africa." *Journal of human hypertension* 20, no. 1 (2006): 67.
- [67] Cutler, Jeffrey A., Paul D. Sorlie, Michael Wolz, Thomas Thom, Larry E. Fields, and Edward J. Roccella. "Trends in hypertension prevalence, awareness, treatment, and control rates in United States adults between 1988–1994 and 1999–2004." *Hypertension* 52, no. 5 (2008): 818-827.
- [68] Mutua, Ernest Muthami, Moses Mwangi Gitonga, Beth Mbutia, Nelly Muiruri, Joyce Jebet Cheptum, and Thomas Maingi. "Level of blood pressure control among hypertensive patients on follow-up in a regional referral hospital in Central Kenya." *The Pan African medical journal* 18 (2014).
- [69] Cheong, A. T., Shariff-Ghazali Sazlina, S. F. Tong, Abdul Samad Azah, and Sharif Salmiah. "Poor blood pressure control and its associated factors among older people with hypertension: A cross-sectional study in six public primary care clinics in Malaysia." *Malaysian family physician: the official journal of the Academy of Family Physicians of Malaysia* 10, no. 1 (2015): 19
- [70] Redmond, Nicole, Heather J. Baer, and LeRoi S. Hicks. "Health behaviors and racial disparity in blood pressure control in the national health and nutrition examination survey." *Hypertension* 57, no. 3 (2011): 383-389.
- [71] de Gaudemaris, Régis, Thierry Lang, Gilles Chatellier, Lynda Larabi, Valérie Lauwers-Cancès, Anne Maître, and Eloi Diène. "Socioeconomic inequalities in hypertension prevalence and care." *Hypertension* 39, no. 6 (2002): 1119-1125.
- [72] Rehman, Shakaib U., Florence N. Hutchison, Katharine Hendrix, Eni C. Okonofua, and Brent M. Egan. "Ethnic differences in blood pressure control among men at Veterans Affairs clinics and other health care sites." *Archives of internal medicine* 165, no. 9 (2005): 1041-1047.
- [73] Lapuerta, Pablo, Teresa Simon, Allison Smitten, Jaime Caro, and CHOICE Study Group. "Assessment of the association between blood pressure control and health care resource use." *Clinical therapeutics* 23, no. 10 (2001): 1773-1782.
- [74] Plantinga, Laura C., Edgar R. Miller, Lesley A. Stevens, Rajiv Saran, Cassandra Messer, Nicole Flowers, Linda Geiss, and Neil R. Powe. "Blood Pressure Control Among Persons Without and With Chronic Kidney Disease." *Hypertension* 54, no. 1 (2009): 47-56.
- [75] Hansson, Lennart, Alberto Zanchetti, S. George Carruthers, Björn Dahlöf, Dag Elmfeldt, Stevo Julius, Joël Ménard et al. "Effects of intensive blood-pressure lowering and low-dose aspirin in patients with hypertension: principal results of the Hypertension Optimal Treatment (HOT) randomised trial." *The Lancet* 351, no. 9118 (1998): 1755-1762.