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A retrospective cross-sectional study of the prevalence of hypertension and its co-morbidities in a Nigerian medical center

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Abstract

Introduction: Hypertension is a major risk factor for other life threatening conditions like stroke, myocardial infarction, cardiac failure, vascular disease, and chronic kidney disease. Many times, hypertension presents with other comorbidities further worsening prognosis and quality of life of the patients.

Objectives: The aim of this research was to evaluate the prevalence of hypertension and other comorbidities among patients accessing specialist care.

Method: A cross sectional design which obtained data from case files of patients who visited the hospital for follow-up in August, 2022. 251 participants were selected by randomization technique. Analyses were done using RStudio version 4.2.1 at 95% confidence interval and 0.05 level of significance.

Result: The results showed that, 50.6% of the participants were males, the mean age of the participants was 53 years with a mean BP of 126.2/77.7 mmHg. The Tiv ethnicity formed the majority (57.8%) of the sample population. The prevalence of hypertension was estimated at 54.2%. A linear correlation was found between SBP and age adjusted for marital status among non-hypertensive participants (R^2 = 26.3%, $p<0.05$). Diabetes was the most prevalent comorbidity (24.3%). ACE inhibitors and ARBs were the most prescribed antihypertensive agents (72.8%) with dual therapy (41.2%) being the most utilized pharmacotherapeutic approach. Only about 61.8% hypertensive participants had their BP under control.

In conclusion: The prevalence of hypertension was high in the FMC, Makurdi. A positive linear correlation between SBP and age was seen. Although the outcome rate was above average, it was still seen as a huge public health concern.

Keywords: Prevalence; Hypertension; Comorbidities; Nigeria; Medical center

1. Introduction

Hypertension is a non-communicable cardiovascular disease that is characterized by chronically elevated systolic blood pressure (SBP) and/or diastolic blood pressure (DBP) above the normal levels in adults aged 18 years and older (Rabi, *et al.*, 2020). A clinical diagnosis of hypertension is based on the mean of two or more properly measured and well seated blood pressure (BP) measurements taken on two or more occasions [1]. According to WHO and Alexander et al.,

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hypertension can be defined as a systolic blood pressure (SBP) ≥ 140 mmHg and/or a diastolic blood pressure (DBP) ≥ 90 mmHg; or taking anti-hypertensive medication; and/or having been told by clinicians on at least two occasions as having hypertension [2,3]. It is one of the most common diseases that afflict humans worldwide and is a major risk factor for stroke, myocardial infarction, vascular disease, and chronic kidney disease [3].

A study estimated the global prevalence of hypertension in 2015 to be 1.13 billion with age-standardized prevalence of 24% in men and 20% in women [4]. In a very recent study involving 104 million participants, the global age-standardised prevalence of hypertension in adults aged 30 to 79 years, was 32% (95% CI: 30 – 34) and 34% (95% CI: 30 – 35) in women and men respectively [5]. This reflects a double from 650 million in 1990 to 1.28 billion in 2019 [6].

In Nigeria, a meta-analysis of 27 studies involving 27,122 Nigerian participants over the age of 15 years estimated the pooled prevalence of hypertension at 28.9% which comprised of 29.5% in men and 25% in women [7]. A more recent meta-analysis of 53 studies involving 78,949 subjects estimated the overall pooled crude prevalence of hypertension in Nigeria at 30.6% (95% CI: 27.3 – 34.0) while the prevalence of hypertension in the South-east (33.3%), North-central (32.2%), North-west (31.9%), South-west (30.2%), North-east (24.7%) and South-south (27.6%) were relatively similar to the overall prevalence of hypertension in Nigeria [8] and the world [5]. The prevalence of hypertension among urban and rural dwellers was 30.6% and 26.4% respectively [7]. In a community-based study conducted in Ijegun-Isheri, Osun community of Lagos state, Nigeria, the prevalence of hypertension was 35.3% (95% CI: 29.0 – 42.1) [9]. In a hospital based study, the prevalence of hypertension among patients who obtained medical care at the medical outpatient department was 70.3% while the prevalence was 6.8% in those who received medical care at the general outpatient department [10]. Although the prevalence of hypertension among urban dwellers was higher than that of rural dwellers in some studies, this can be attributed partly to the lack of medical access in rural areas, cost, lack of appropriate medical awareness, traditional beliefs, etc. In general, these studies indicate a progressive increase in the prevalence of hypertension globally.

The association of hypertension with other non-communicable diseases (NCDs) has been established by several clinical studies. Studies have demonstrated that hypertension frequently coexists with other NCDs such as diabetes, obesity, dyslipidaemia, heart failure, chronic kidney disease, etc.[11,12,13,14]. These co-morbidities are factors that increase the risk of an individual developing hypertension and its complications if not adequately and timely managed by the appropriate pharmacologic and non-pharmacologic approaches. Researchers have also been able to correlate advanced age (men >55 years and women >65 years) and social lifestyles (such as cigarette smoking, sedentary lifestyle, poor dietary habit, harmful consumption of alcohol) among others to be important predisposing risk factors for hypertension.

In patients with documented hypertension, attaining blood pressure targets is vital in preventing cardiovascular, cerebrovascular and renal complications of hypertension [1,,2]. Antihypertensive agents combined with healthy behavioural changes can be initiated in order to achieve the goal BP. The first line antihypertensive agents for the pharmacological treatment of adults with systolic and/or diastolic hypertension without other compelling indications include the selection of drugs from any of the following three drug classes: Renin-Angiotensin-Aldosterone System (RAAS) inhibitor (specifically angiotensin converting enzyme (ACE) inhibitor or angiotensin-II receptor blocker (ARB)), long acting dihydropyridine calcium channel blocker, or thiazide type diuretic [2]. Although older guidelines recommend the inclusion of β-blockers as first-line agents, recent guidelines disrecommend the use of these agents as first-line agents [2,15] due to the results of a newer meta-analysis which revealed the association of β-blockers with an age-dependent effectiveness [16], as well as an increase in the risk of primary composite outcome of cardiovascular death, myocardial infarction, or stroke compared to the use of the other antihypertensive agents [17]. The Canada Hypertension guideline still recommends the inclusion of β-blockers as first-line agents but only in younger patients with uncomplicated hypertension and disrecommend same in patients 60 years or older [1]. These first-line BP-lowering drug classes have been shown in head-to-head comparisons to be equally effective in preventing risk of fatal and nonfatal cardiovascular events both in older and younger patients whereas β-blockers revealed an age-dependent effectiveness where it becomes less effective in patients 65 years and older [16]. Importantly, the combination of an ACE inhibitor with an ARB is contraindicated in all patients as their combination is associated with increased renal adverse events [1,2,15,18,19].

Diuretics plus CCBs have been shown to be more effective in black populations as well as in the elderly subjects than ACE inhibitors or ARBs. A multicentre study conducted in the sub-Saharan Africa demonstrated that a two-drug single pill combination containing CCB (amlodipine) plus either a thiazide diuretic (hydrochlorothiazide) or an ACE inhibitor (perindopril) was more effective than a two-drug single pill combination containing ACE and thiazide diuretic [20].

In the presence of other co-morbidities, treatment approaches involve the use of two or more drugs that target several pathologic pathways that are involved in the progression of the co-existing diseases.

This research study was instigated by the increasing frequency of hypertension among subjects who visited the Federal Medical Centre, Makurdi within the first few months of the year 2022. A good number of these subjects appeared to have elevated blood pressures and/or have been diagnosed of hypertensive heart disease. Since hypertension has been incriminated to be a major leading risk factor for several chronic illnesses especially those of cardiovascular origin, it is important to evaluate the prevalence of hypertension in this facility and to identify the major comorbidities that are associated with hypertension, as well as, explore the frequently used drug therapies implored in the management of hypertension among these participants.

Objectives

The general objective of this study was to evaluate the prevalence of hypertension and its comorbidities among patients who visited the Specialist Out-Patients clinic of the Federal Medical Centre, Makurdi within the first half of the year 2022. Specifically, the study sort to determine the prevalence of hypertension and other comorbidities, evaluate the correlation between hypertension prevalence and demographic parameters, find out if calcium channel blockers and thiazide diuretics or angiotensin converting enzymes inhibitors were the most frequently prescribed antihypertensive agents at the hospital since these two drug classes are known to be more effective in black people than other drug classes. It also determined the therapeutic approach (monotherapy or combination therapy) used in the management of hypertension at the FMC, Makurdi and the treatment outcome.

1.1. Clinical relevance

This study shall give both the healthcare teams and policy makers better insights on the therapeutic approaches needed to mitigate or halt the progression of this disease, reduce or prevent the complications of the disease, as well as, reduce its prevalence to the barest possible minimum. In this way, the quality of life of people would be improved and cost on both the individuals and the health sector would be drastically reduced.

2. Methods

2.1. Study area

The study was carried out at the Specialist Out-Patient Department (SOPD) of the Federal Medical Centre (FMC), Makurdi, Benue State, North Central, Nigeria. Federal Medical Center, Makurdi is a more than 400 bedded tertiary health institutions that serves as a referral facility but, also, provides secondary and primary care. The SOPD is a section of the hospital that offers services to patients needing specialized services like cardiology, endocrinology, neurology, gastroenterology etc.

2.2. Study Design

The study adopted a retrospective cross sectional designed. This study enrolled adult patients, 18 years and above, who came for follow up visits at the facility in the month of August, 2022 and had their disease(s) status diagnosed and confirmed in the same facility within the months of January, 2022 and June, 2022. This range was to ensure that all participants had at least two or more encounters with the Physician as at the time of data collection. Pregnant women, patients whose diagnosis were not clearly stated, regimen were not documented at last follow-up visits as well as those with more than three missing data were excluded in the study. A total of two hundred and fifty-one (251) participants met the inclusion criteria.

2.3. Data collection/analysis

The necessary data of the selected participants were collected from their medical case files obtained using the data collection sheet presented below. Data on their demographic characteristics, anthropometric parameters, social lifestyles, blood pressures at last follow-up visit, as well as data on the presence of chronic diseases were recorded adequately. For patients diagnosed with hypertensive heart disease, the antihypertensive medications they were on were also recorded.

The data collected for this study were computed using Microsoft Office Excel, version 2016. We performed statistical analyses using the RStudio.Ink software (version 4.2.1), a subsidiary of the "R" programming language (version 4.2.1). The socio-demographic characteristics of this sample were described by gender. We compared the prevalence of hypertension by gender, age category, ethnicity, occupation, and marital status. Due to too many missing anthropometric and social lifestyles data, we could not include these variables in our analyses. We also compared the prevalence of comorbidities between hypertensive and non-hypertensive participants to determine the frequently

occurring comorbidities of hypertensive heart disease among this population. The mean and the proportion estimates were reported alongside their 95% confidence intervals based on either a normal distribution or a binomial distribution, given the nature of the characteristic being analysed. We tested for significant differences using chisquared test or Fisher's exact tests for categorical data and 2-sample t-tests or ANOVA for continuous outcome variables at a 0.05 alpha level of significance and 2-tailed tests. Lastly, we constructed a multivariable linear regression model where the average systolic blood pressure of this sample at their last follow-up visit was regressed on age, occupation, ethnicity, gender and marital status. We constructed both a full model and a parsimonious model whereby we iteratively deleted variables from the model based on improvement in the Akaike information criterion (AIC), using both forward stepwise and backward elimination approaches.

2.3.1. Data collection tool

S/	**No**								
Sex									
Ethnicity									
Marital	**status**								
Age	**(years)**								
Occupation									
Wt	**(kg)**								
Ht	**(cm)**								
BP	**(mmHg)**								
Previous	**BP**	(mmHg)							
Alcohol	**Status**								
Diseases									
Anti	**Hyper**	tensives if any							

2.4. Ethical Issues

The ethical clearance was obtained from the HREC of the hospital. Confidentiality of patients' information was upheld.

3. Results

3.1. Sociodemographic data of the study population

Table 1 below presents the socio-demographic data of the population sample studied. The mean age of the total population was 53 years. Of the 251 participants, 50.6% were males. Ages 45-59 years were more represented (27.9%). Based on ethnicity, a large proportion of participants were Tiv's (57.8%).

3.2. Blood pressure measurements of the studied population

Table 2 below presents the mean ± standard deviation (SD) of both the systolic and diastolic blood pressure readings of the study participants. The mean SBP and DBP of the participants were 126.2 mmHg ± 21.7 mmHg and 77.7 mmHg ± 11.8 mmHg respectively. On average, males had an insignificantly higher blood pressure of about 126.7/76.7 mmHg compared to females (125.6/78.6 mmHg). The BP of participants increased sequentially on average, from 110.7/71.8 mmHg among those 18-29 years old to about 133.0/79.0 mmHg among those 60-69 years old but decreased to about 128.6/74.8 mmHg among those ≥70 years old.

3.3. Prevalence of Hypertension

As shown in Table 3 below, the prevalence of hypertension within the studied population was 54.2% (95% CI: 48.0% to 60.2%). No demographic impact on hypertension prevalence was documented except age where prevalence increased with age. Those between 18-29 years had a prevalence of 0.0% (95% CI: 0.0% to 14.9%); the highest prevalence was seen in those between 60-69 years [69.1% (95% CI: 56.0% to 79.7%)].

3.4. Prevalence of other morbidities in hypertensive and non-hypertensive participants

A head-to-head comparison between hypertensive and non-hypertensive participants is seen in table.4. In hypertensive participants, the most prevalent comorbidity was diabetes [24.3% (95% CI: 17.8% to 32.1%)], with a prevalence ratio of 3.47 in relation to its prevalence in non-hypertensive participants (7.0% (3.6%, 13.1%). Also, in hypertensive participants, the prevalence of dyslipidemia was 5.9% (95% CI: 3.0% to 11.2%), the prevalence of CVA (such as stroke and TIA) was 10.3% (95% CI: 6.2% to 16.5) while that of CKD was 4.4% (95% CI: 2.0% to 9.3%).

3.5. Impact of sociodemographic characteristics on systolic blood pressure

Table 5 below presents a multivariable model of SBP of non-hypertensive participants. The initial model which included the main effects of all variables listed above shows that age (p = 8E-4) and marital status (p = 8E-3) were the only significant predictors of SBP (R^2 = 19.2%). After meeting the linearity assumptions, we then used the Akaike information criterion in a forward stepwise and backward elimination fashion to parsimoniously include only age and marital status in our final model which showed an improvement in our model (R^2 = 26.3%).

3.6. Pharmacotherapeutic agents used in the management of hypertension

As shown in figure 1, 72.8% of antihypertensive drug users were placed on either ACE inhibitors or ARBs. About 50.0% of hypertensive participants were placed on CCBs while 30.1% of hypertensive participants were placed on beta blockers. The percentages of hypertensive participants placed on one or more diuretics, statins, anti-platelets and/or digoxin were 54.4%, 30.1%, 57.4% and 19.1%. There was no effect modification between age and marital status (p > 0.05).

The result shows, 11.8% of participants who were known hypertensive patients were not on any antihypertensive agents. 11.8% of participants were on monotherapy, 41.2% were on di-therapy, 27.9% were on tri-therapy and 7.4% were on quadruple therapy (figure 2).

The percentages of the numbers of antihypertensive agents and adjuvants used for the management of hypertension in hypertensive participants is shown in figure 3. Patients placed on four different drugs had the highest percentage (22.1%). As much as 5.1% and 0.7% were placed on seven and eight drugs respectively.

3.7. Treatment outcomes obtained for the management of hypertension

As shown by figure 4, 61.8% of these subgroups had their BP under control while the remaining 38.2% had uncontrolled BP (≥140/80 mmHg) as at the last follow-up visit.

Table 1 Sociodemographic characteristics of the study participants

Characteristics	% Total Participants(n=251)	Percentage of Males	Percentage of Females
Gender	100	50.6	49.4
Age			
(Mean age)	(53 years)	(56.4 years)	(49.6 years)
18-29 years	8.8	36.4	63.6
30-44 years	22.7	42.1	57.9
45-59 years	27.9	44.3	55.7
60-69 years	21.9	50.9	49.1
≥70 years	16.7	78.6	21.4

Unknown	2.0	60	40
Total	100.0		
Ethnicity			
Tiv	57.8	48.3	51.7
Idoma	24.3	54.1	45.9
Igede	5.6	64.3	35.7
Other	12.4	48.4	51.6
Total	100.0*		
Marital Status			
Single	12.0	43.3	56.7
Married	76.1	54.5	45.5
Widow/Divorced	8.0	25.0	75.0
Unknown	4.0	50.0	50.0
Total	100.0*		
Occupation			
Students, applicants	7.6	47.4	52.6
Civil servants, Clergies	12.4	54.8	45.2
Farmers	20.3	70.6	29.4
Health workers	4.4	9.1	90.9
House wives	15.5	-	100.0
Retired/pensioners	12.0	90.0	10.0
Teachers, Traders, Skilled labourers	18.7	46.8	53.2
Unknown	9.2	65.2	34.8
Total	100.0*		
BP category (at follow-up)			
Optimal BP	29.5	47.3	52.7
Normal BP	24.7	58.1	41.9
High-Normal BP	13.5	47.1	52.9
Grade 1 Hypertension	10.0	40.0	60.0
Grade 2 Hypertension	6.4	25.0	75.0
Grade 3 Hypertension	2.8	57.1	42.9
Isolated systolic hypertension	13.1	66.7	33.3
(Subtotal of Hypertensive category)	(32.3)	(49.4)	(50.6)
Total cases	100.0		
Alcohol Status			
Non-alcoholics	40.6	36.3	63.7

Former alcoholics	5.2	84.6	15.4
Active alcoholics	5.6	64.3	35.7
Unknown	48.6	57.4	42.6
Total	100.0		
Smoking Status			
Non-smokers	49.4	42.7	57.3
Former smokers	0.8	100.0	-
Active smokers	1.2	66.7	33.3
Unknown	48.6	57.4	42.6
Total	100.0		

*= Values approximated to 100% due to rounding error

Table 2 Mean systolic and diastolic blood pressures of the population sample

SBP (mean ± SD)* **Selected Characteristics**	**DBP (mean ± SD)***					
	Total Males Females			**Total Males Females**		
Gender	P = 0.71			P = 0.21		
	126.2 ± 21.7	126.7 ± 21.1	125.6 ± 22.3	77.7 ± 11.8	76.7 ± 11.2	78.6 ± 12.4
Age	p < 0.005			p >0.05		
18-29 years	110.7 ± 9.4	112.0 ± 12.0	109.9 ± 7.9	71.8 ± 9.2	71.8 ± 10.5	71.8 ± 8.8
30-44 years	121.2 ± 22.2	121.9 ± 24.6	120.7 ± 20.6	79.1 ± 11.9	77.3 ± 13.2	80.4 ± 10.9
45-59 years	128.0 ± 18.7	126.4 ± 15.9	129.3 ± 20.8	79.3 ± 11.2	77.8 ± 8.6	80.5 ± 13.0
60-69 years	133.0 ± 23.9	132.2 ± 22.7	133.7 ± 25.5	79.0 ± 11.4	78.2 ± 10.8	79.9 ± 12.2
≥70 years	128.6 ± 23.5	127.8 ± 22.4	131.1 ± 28.6	74.8 ± 13.4	75.4 ± 12.5	72.8 ± 16.7
Ethnicity	p = 0.79			p = 0.93		
Tiv	125.8 ± 21.2	125.4 ± 19.3	126.1 ± 22.9	77.9 ± 11.7	76.2 ± 10.3	79.5 ± 12.7
Idoma	127.2 ± 23.8	127.5 ± 23.9	126.9 ± 24.2	77.8 ± 13.1	77.1 ± 12.5	78.6 ± 13.9
Igede	121.6 ± 18.5	121.9 ± 17.5	121 ± 22.3	75.8 ± 8.6	76 ± 8.6	75.4 ± 9.5
Other	128.0 ± 21.8	134.1 ± 25.4	122.7 ± 17.1	77.4 ± 11.5	79.3 ± 14.1	75.7 ± 8.8
Marital Status	p = 0.10			p = 0.85		

Single	118.3 ± 22.1	111.6 ± 20.3	123.5 ± 22.6	76.8 ± 15.9	71.9 ± 15.5	80.5 ± 15.6
Married	127.1 ± 20.9	127.7 ± 20.4	126.3 ± 21.5	78.1 ± 10.6	77.2 ± 10.3	79.0 ± 10.9
Widow/Divorced	131.8 ± 26.7	148.4 ± 21.7	126.3 ± 26.4	76.2 ± 17.4	79.4 ± 18.8	75.1 ± 17.5
Unknown	121.0 ± 22.6	122.2 ± 17.2	119.8 ± 29.2	76.3 ± 6.8	76.6 ± 8.5	76 ± 5.5
Occupation	p = 0.04			p = 0.18		
Students, applicants	111.7 ± 10.3	109.9 ± 8.5	113.4 ± 11.9	72.5 ± 10.1	70.3 ± 9.7	74.4 ± 10.7
Civil servants, religious clergies	128.1 ±15.6	126.9 ± 16.1	129.6 ± 15.4	77.8 ± 10.4	75.8 ± 8.2	80.2 ± 12.5
Farmers	124.2 ± 21	125.1 ± 20.3	122 ± 23	75.9 ± 11.8	76.6 ± 10.7	74.4 ± 14.5
Health workers	119.1 ±16.5	100.0 ± 0	121 ± 16.1	77.8 ± 11.7	60.0 ± 0	79.6 ± 10.6
Housewives	128.2 ±26.6	-	128.2 ± 26.6	79.2 ± 11.7	-	79.2 ± 11.7
Retired/Pensioners	132.0 ± 17	131.6 ± 17.9	135 ± 5	78.7 ± 10.1	77.9 ± 10.1	86.3 ± 6.4
Teachers, Traders, Skilled labourers	130.4 ± 24.3	135 ± 27.4	126.6 ± 21.1	80.9 ± 13.5	83.5 ± 13	78.7 ± 13.8
Unknown	123.5 ± 25.7	121.3 ± 23	127.5 ± 31.5	75.3 ± 12.7	71.7 ± 11.2	82 ± 13.2

* => The SBP and DBP of one participant was excluded due to missing values

Table 3 Prevalence of Hypertension

Characteristics	**95% Confidence Interval**	**Prevalence**	
Estimate		**Lower**	**Upper**
Total Prevalence	54.2%	48.0%	60.2%
Gender Males	52.2%	43.8%	60.4%
Females	47.8%	39.6%	56.1%
Age*			
18-29 years	0.0%	0.0%	2.7%
30-44 years	17.6%	12.2%	24.9%
45-59 years	32.4%	25.1%	40.6%
60-69 years	27.9%	21.1%	36.0%
≥70 years Missing cases	19.9% 2.2%	14.0% 0.8%	27.3% 6.3%

Ethnicity			
Tiv	56.6%	48.2%	64.7%
Idoma	23.5%	17.2%	31.3%
Igede	6.6%	3.5%	12.1%
Other Total* Marital Status	13.2% 100	8.5%	20.0%
Single	3.7%	1.6%	8.3%
Married	83.1%	75.9%	88.5%
Widow/Divorced	10.3%	6.2%	16.5%
Missing cases Total Occupation	2.9% 100	1.1%	7.3%
Students/applicants	0.7%	0.1%	0.4%
Civil servants, religious clergies	11.0%	6.8%	17.4%
Farmers	19.1%	13.4%	26.5%
Health workers	5.1%	2.5%	10.2%
House wives	18.4%	12.8%	25.7%
Retirees/Pensioners	13.2%	8.5%	20.0%
Teachers, Traders, Skilled labourers	21.3%	15.3%	28.9%
Missing cases Total	11.0% 100%	6.8 %	17.4%

* => Five participants were excluded due to unidentified ages

Table 4 Prevalence of other morbidities

Characteristics	**Prevalence**			**Prevalence ratio**
	Hypertension (95% Cl)	**Non-Hypertension (95% Cl)**	**Total(95% Cl)**	
Diabetes	24.3% (17.8%, 32.1%)	7.0% (3.6%, 13.1%)	16.3% (12.3%, 21.4%)	3.47
Dyslipidaemia	5.9% (3.0%, 11.2%)	0.9% (0.2%, 4.8%)	3.6% (1.9%, 6.7%)	6.56
Cerebrovascular accident (stroke, TIA)	10.3% (6.2%, 16.5%)	6.1% (3.0%, 12.0%)	8.4% (5.5%, 12.5%)	1.69
CKD	4.4% (2.0%, 9.3%)	0.9% (0.2%, 4.8%)	2.8% (1.4%, 5.6%)	4.89
GI ulceration or dyspepsia	18.4% (12.8%, 25.7%)	17.4% (11.5%, 25.3%)	17.9% (13.7%, 23.1%)	1.06

BPH and prostate cancer (males only)	9.9% (4.9%, 19.0%)	7.1% (2.8%, 17.0%)	8.7% (4.9%, 14.8%)	1.39
Non-prostate cancers	7.4% (4.0%, 13.0%)	10.4% (4.1%, 17.4%)	8.8% (5.9%, 12.9%)	0.71
Chronic respiratory diseases (asthma, COPD)	2.2% (0.8%, 6.3%)	2.6% (0.9%, 7.4%)	2.4% (1.1%, 5.1%)	0.85
Chronic inflammatory bone diseases (RA, OA,...)	13.2% (8.5%, 20.0%)	14.8% (9.4%, 22.4%)	13.9% (10.2%, 18.8%)	0.89
Liver disease	0.7% (0.1%, 4.0%)	6.1% (3.0%, 12.0%)	3.2% (1.6%, 6.2%)	0.11
Chronic viral hepatitis infection	2.9% (1.1%, 7.3%)	8.7% (4.8%, 15.3%)	5.6% (3.4%, 9.1%)	0.33
Other CNS disorders (PKD, epilepsy)	6.6% (3.5%, 12.1%)	7.0% (3.6%, 13.1%)	6.8% (4.3%, 10.6%)	0.94
Thyroid disorder	0.0% (0.0%, 2.7%)	2.6% (0.9%, 7.4%)	1.2% (0.4%, 3.5%)	0
Retroviral disease	4.4% (2.0%, 9.3%)	4.3% (1.9%, 9.8%)	4.4% (2.5%, 7.7%)	1.02

AKI: Acute Kidney injury, CI: Confidence Interval, CKD: Chronic Kidney Disease, COPD: Chronic Obstructive Pulmonary Disease, OA: Osteoarthritis, PKD: Parkinson Disease, RA: Rheumatoid arthritis

Table 5 Impact of sociodemographic characteristics on systolic blood pressure

Characteristics	**Initial Model**		**Final Model**	
	SBP(95% CI)	p value	SBP (95% CI)	p value
(Adjusted R-squared)	(0.192 [19.2%])		(0.263 [26.3%])	
Intercept	95.66	<2E-16	96.29	<2E-16
Age (years) Marital Status	0.65 (0.27, 1.02)	<0.0008	0.58 (0.29, 0.87)	<0.0002
Single Married	Reference 0.93 (-15.01, 16.86)	< 0.008	Reference -0.49 (-11.87, 10.90)	<0.004
Widow/Divorced Gender	-30.61 (-55.59, -5.63)		-29.95 (-50.79, -9.11)	
Male	Reference			
Female Ethnicity	3.73 (-6.25, 13.70)	0.46		
Tiv	Reference			
Idoma Igede	-7.74 (-18.96, 3.47) -7.92 (-30.36, 14.52)	0.51		
Other Occupational Status	-4.68 (-18.50, 9.14)			
Students/applicants	Reference			

Civil/religious servants Farmers Health workers House wives	-1.13 (-21.68, 19.42) -5.78 (-24.76, 13.20) -3.14 (-31.01, 24.72) -4.18 (-25.18, 16.82)	0.99		
Retired	-1.22 (-26.37, 23.93)			
Teachers/Traders/skilled	-6.99 (-26.92, 12.95)			
Unknown	0.79 (-17.51, 19.10)			

All p-values obtained from F-statistics

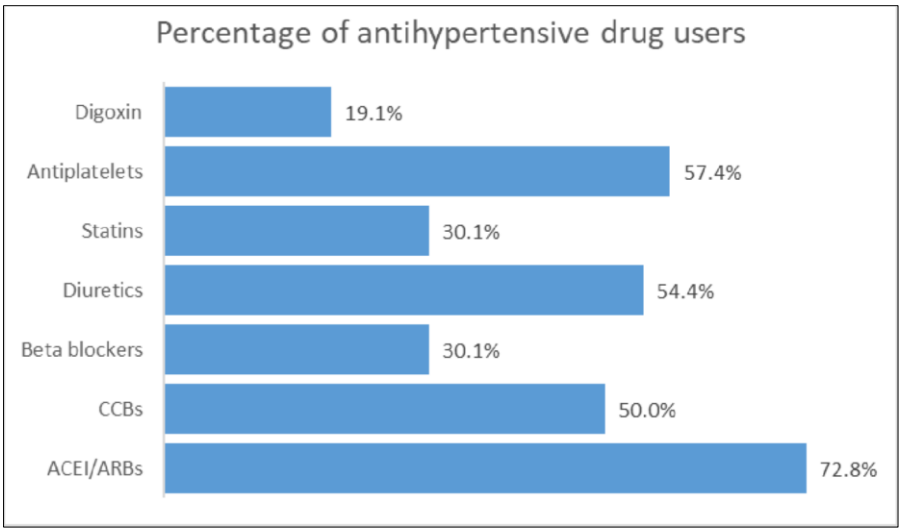

Figure 1 Percentage of hypertensive participants on different antihypertensive agents

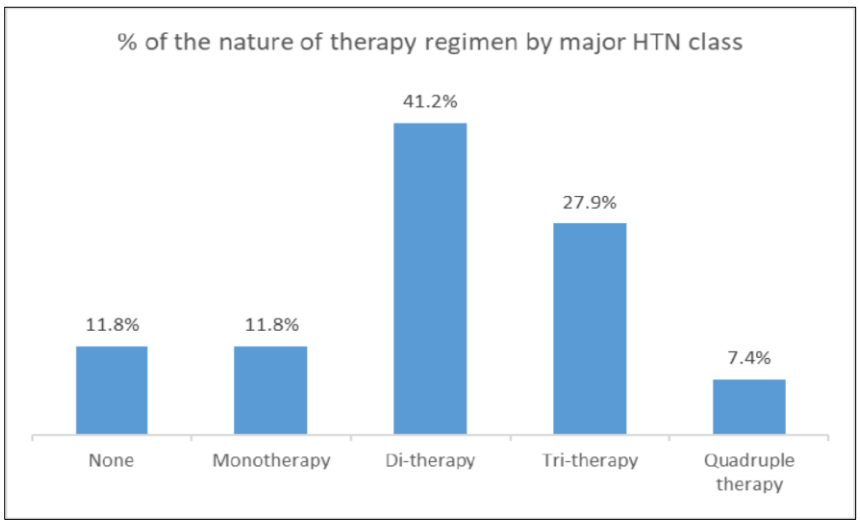

Figure 2 Nature of pharmacotherapeutic regimen used for the management of hypertension

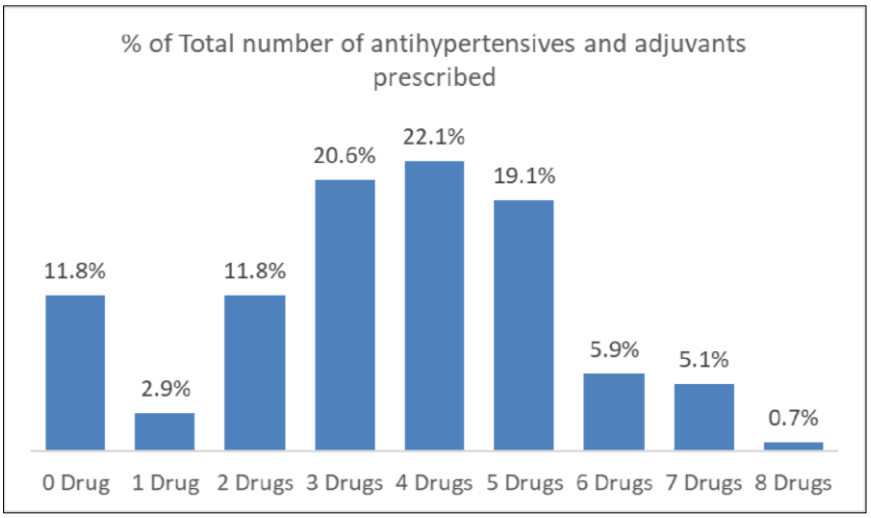

Figure 3 Percentages of the numbers of antihypertensive agents and adjuvants used for the management of hypertension in hypertensive participants

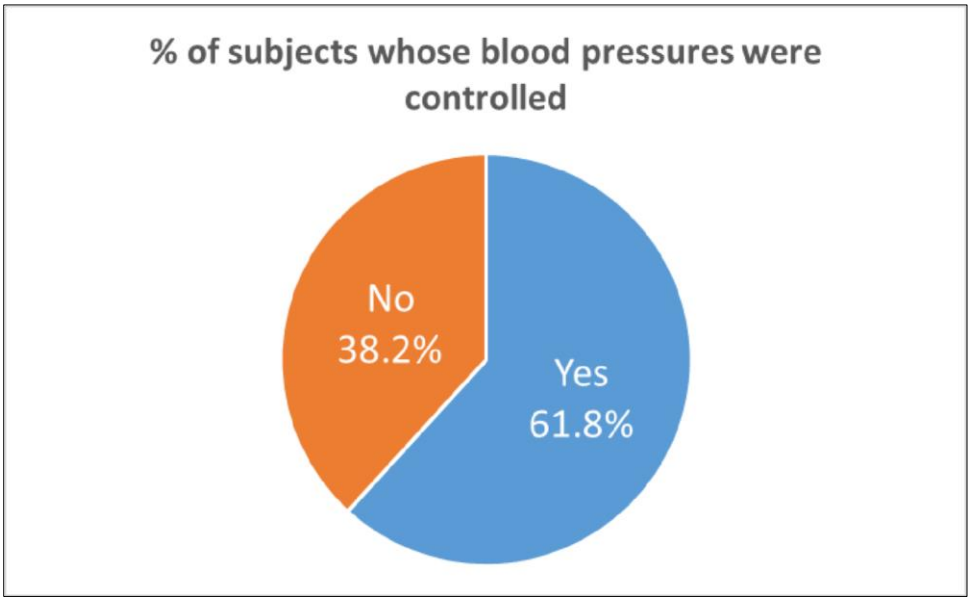

Figure 4 Percentage of participants whose BP were controlled

4. Discussion

Hypertension is a global public health challenge. Studies have shown that SBP is a significant predictor of hypertension as well as other CVDs [21]. It has been found to increase progressively with age [22]. The current study has been able to demonstrate a weak linear correlation between SBP and age adjusted for marital status among this subgroup. With no effect modification, age was found to be a better predictor of SBP ($p<0.0002$) than marital status ($p<0.004$). With a regression equation of $y = 96.29 + 0.58*(Age) - 0.49*(Married) - 29.95*(Widow/Divorced)$, non-hypertensive individuals who were 18 years old and single had an SBP of 15.2 mmHg lower compared to those who were married and were 45 years old. This difference in SBP is quite a huge health risk as older individuals tend to be more likely to become hypertensive in the near future than younger adults if appropriate measures are not put in place.

Using their most recent blood pressure readings as at their last follow-up visit, the BP of these participants were categorized based on the guidelines by the Nigerian Hypertension Guidelines Committee (NHGC, 2020) which is also supported by both the European Society of Cardiology/European Society of Hypertension (ESC/ESH, 2018) [19]. The

prevalence of hypertension in this facility was found to be higher when compared to those of population-based prevalence studies [28.9% and 30.6%]) [7,8] but was found to be lower when compared to a hospital based study (70.3%) [10]. Nevertheless, this prevalence is quite a huge public health concern. For instance, in an assumed population of 1,000 patients who receive medical care from the SOPD clinic of this facility, it is expected that about 542 patients would be hypertensive, in the extreme circumstances, we expect to have about 480 to 620 patients being hypertensive.

Consistent with the findings by Fryar et al. [23], this study shows that there is a linear correlation between age and the prevalence of hypertension. With an assumed population of 1,000 patients who received medical care from this facility, if their ages were between 18 and 29 years, we expect that at worst scenarios, about 149 of them would be hypertensive. But if their ages were between 30 to 44 years, or 45 to 59 years, or 60 to 69 years, we would expect to find about 302 to 550 patients, or 511 to 732 patients, or 560 to 797 patients respectively who would be hypertensive. These large numbers of patients that increase with age poses a huge burden on the individuals, their families, the healthcare facility and the government at large. A fall in the prevalence of hypertension among those who were 70 years or older could mean that not all of these patients make it to their seventies due to death from probably the disease and/or its complications. Aside age, there appears to be no correlation between the prevalence of hypertension and other sociodemographic characteristics (such as gender, ethnicity, marital status, and occupational status) among this population.

We also looked at the rates of occurrence of hypertension comorbidities. The prevalence rates of diabetes, dyslipidaemia and CKD were respectively 3.47, 6.56 and 4.89 times higher in hypertensive than in non-hypertensive participants. CVA and benign prostatic events were respectively 1.69 times and 1.39 times higher in hypertensive participants as well. As observed, diabetes was the most prevalence morbidity of hypertension in our study and was fairly similar to the prevalence (25.7%) observed by Ogunmola et al., [14]. However, Noh et al. observed obesity to be the most prevalent comorbidity of hypertension followed by dyslipidaemia [13]. Diaconu et al., also failed to identify diabetes as the most prevalent comorbidity of hypertension. Instead, they found diabetes to be the third most prevalent comorbidity after dyslipidaemia and heart failure [11]. The high prevalence of diabetes instead of obesity or dyslipidaemia among our participants could be partly due to their poor socioeconomic status and occupation (eg. farming, trading) as physical activity and socioeconomic status have been found to be related to obesity and dyslipidaemia. The prevalence of CKD in hypertensive participants in our study was the least when compared to those (27.5% and 17.6%) observed by Crews et al.[24] and Hunegnaw et al.[12] respectively . However, the prevalence of same was higher than that (0.4%) observed by Noh et al.[13]. Although the prevalence of CKD in this facility appears to be low and one might misinterpret it to be negligible, it is quite a misconception as this prevalence is 4.89 times higher in hypertensive patients than in non-hypertensive patients. As such, it is reasonable to conclude that hypertension has a clinically significant public health impact in CKD patients.

Majority of hypertensive participants were prescribed either ACE inhibitors or ARBs (72.8%) followed by antiplatelet/anticoagulant agents. Diuretics were the third most prescribed medications of which thiazide diuretics were the most predominant. CCBs were the fourth most prescribed. These findings are inconsistent with those recommended by official guidelines for the management of hypertension in black population, where CCBs and thiazide type diuretics were recommended as the most preferred first-line drugs of choice [1,19]. This inconsistency, although not fully certain, can be partly ascribed to the use of evidence-based therapy employed by most physicians for management of hypertension.

Among those placed on antihypertensive agents, majority of them were placed on either dual or triple therapy with only a small proportion placed on quadruple therapy consisting of all the three first-line antihypertensive drug classes and a beta blocker. When considering the total number of antihypertensive medications (both directly acting and indirectly acting agents) prescribed to each hypertensive participant, majority of them were placed on about three to five different medications with a few of them being placed on about six to eight medications. These indicate that combination therapy is the most utilized pharmaco-therapeutic approach employed for the management of hypertension in the FMC, Makurdi. Although these medications were prescribed on need bases, it is quite important that patients are monitored regularly and educated appropriately for possible side effects as a result of concurrent use of these drugs. Also, the prescriber should constantly evaluate the patient and use patient-centered individualized approaches to deliver the most effective, safe and still better tolerated treatments to suit each patient. And most of all, patients should be encouraged to adhere to their therapeutic regimens as prescribed to avoid being wrongly changed to a different therapy regimen caused by their poor adherence.

Although the BP control rate among hypertensive patients, were lower compared to that of the hospital based study (72.9%) by Chijioke *et al.* (2016), this is a fairly good outcome and more can be done to improve it further with the aim of reaching the ideal BP control rate of 100%. Measures such as patient education and counselling, avoidance of

polypharmacy, where possible, prescription of longer acting drugs instead of shorter acting agents, prescription of safer and cost-effective drugs among others would go a long way in improving the treatment outcomes among hypertensive in this facility.

5. Conclusion

Hypertension is a public health concern globally. This study has been able to demonstrate a positive linear correlation between systolic blood pressure and age adjusted for marital status. The prevalence of hypertension in the FMC, Makurdi was higher with diabetes as the most prevalent comorbidity. Although the outcome rate for the management of hypertension was above average, this is still a huge public health concern that needs to be addressed through appropriate interventions such as development and implementation of effective policies, patient education and counselling, avoidance of polypharmacy, prescription of long acting if available, prescription of safer and cost-effective drugs etc.

Recommendation

We recommend that further studies be done to evaluate the risk factors of hypertension as well as the impact of hypertension and its complications among this population as these would further help in providing better insights needed to create policy plans and therapeutic approaches needed to mitigate hypertension and its complications to the barest possible minimum.

Compliance with ethical standards

Acknowledgements

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Disclosure of conflict of interest

The Authors declared no conflict of interest

Statement of ethical approval

Ethical approval for the study was given by the hospitals ethical research committee (HERC). Patients' information were kept confidential

Authors Contributions

All authors made contributions enough to earn authorship and have approved the version to be published. The Authors have all agreed to take responsibility for all aspects of the work.

Accidental findings

In this study, we are not certain if the participants who were not placed on any antihypertensive medications were place on DASH (Dietary Approaches for Stopping Hypertension) therapy. However, it is paramount that their health outcomes be monitored closely and appropriate measures be taken if the need arises.

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