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Predictors of blood pressure control among patients with hypertension: a cross-sectional study in a Nigerian tertiary health facility

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ABSTRACT

Background Adequate blood pressure control improves clinical outcomes in patients with hypertension. Poor blood pressure control is linked with cardiovascular diseases and poor quality of life.

Aim To identify the predictors of blood pressure control among patients with hypertension treated at the University of Calabar Teaching Hospital, Calabar, Nigeria.

Methods This was a descriptive, cross-sectional study that recruited 441 hypertensive adults who were on medications for at least 6 months through systematic random sampling. Data were analysed using bivariate and multivariate methods at 95% CI and α=0.05. Blood pressure was measured twice using a mercury sphygmomanometer, with averages recorded.

Results The average age of participants was 55.46 years±12.91. About 48.1% of respondents achieved adequate blood pressure control. Major reported risk factors of inadequate blood pressure control were sedentary lifestyle (67.8%), use of caffeinated drinks (51.9%) and family history of hypertension (47.5%). The major comorbidities of hypertension were gastrointestinal symptoms (46.72%) and diabetes (31.39%). The predictors of adequate blood pressure control were higher income (adjusted OR (AOR)=2.94, p=0.026), full health insurance (AOR=2.32, p=0.030), non-usage of caffeinated drinks (AOR=4.13, p=0.001) and normal body mass index (AOR=1.63, p=0.026). Predictors of inadequate blood pressure control were older age (AOR=0.30, p<0.001), living with a spouse (AOR=0.14, p=0.014), non-compliance with antihypertensive medications (AOR=0.53, p=0.040) and moderate obesity (AOR=0.29, p=0.032).

Conclusion Addressing prevalent risk factors like sedentary lifestyle and dietary habits, as well as structural initiatives like accessibility to health insurance, presents opportunities for targeted interventions to enhance well-being and improve outcomes that will strengthen public health, clinical practice and research.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The cross-sectional nature of the study allowed for the collection of data at a single point in time, making it ideal for estimating the prevalence of the subject.
⇒ The study's cross-sectional design limits its ability to establish causality between identified predictors and hypertension management outcomes.
⇒ The auscultatory mercury method is used for office blood pressure (BP) measurement, and per guidelines, this method should not be used.
⇒ Also, BP measurements were done twice instead of thrice, thus posing a limitation to the study.

INTRODUCTION

Hypertension is an important public health epidemic and a leading contributor to disease burden and morbidity globally.[1] Hypertension is the leading cause of death and disability worldwide. It remarkably increases the risk of heart attack, stroke and kidney diseases.[2] Hypertension constitutes a significant health burden to individuals with resultant complications of cerebrovascular, cardiovascular and renal diseases, especially in low- and middle-income countries.[3] Globally, the number of adults aged 30–79 years with hypertension increased from 650 million to 1.28 billion from 1990 to 2019. 40% of these patients with hypertension are diagnosed and treated, while only 21% have good blood pressure (BP) control.[2] In Africa, the prevalence in individual studies ranges from 22.3% to 90%, while the pooled prevalence is 57.9%. It is highest in persons aged 60 and above. Only 27% of the hypertensives were aware of their status, 18% had access to treatment and 13% achieved adequate BP control.[4] In Nigeria, the age-standardised prevalence of hypertension is 38.1%; this varies across the six geopolitical zones, with the least (20.9%) in the North-Central while the South-East has 52.8%.[5] Hypertension is often called a 'silent killer' due to its asymptomatic presentation. However, it may manifest with various symptoms which include

headache, dizziness, light-headedness, palpitations, tinnitus and blurred vision. The frequency and severity of the complications may be reduced through appropriate management and adequate BP control by adhering to those factors that predict effective BP control and elimination of the conditions that promote poor BP control.[6] These factors, known as predictors of BP control, include sedentary lifestyle, use of caffeinated drinks, socioeconomic status, comorbidities like diabetes mellitus, intake of salty diet and increased body mass index (BMI). These factors could also be termed in some cases as risk factors for hypertension.[7]

In sub-Saharan Africa, 45% of patients with hypertension were aware of their status. Out of this number, 19% received treatment while only 13% had good BP control.[2] In Nigeria, data from the National Hypertension Survey 2017, which had 4192 patients with hypertension, showed that only 12.4% had good BP control.[5] The improvements in the management of hypertension to reduce adverse outcomes involve the awareness of the factors that mitigate good BP control.[5] Poor BP control has been documented in patients who are elderly, non-adherent to medication, have a longer duration of hypertension and with comorbidities, for example, diabetes mellitus and chronic kidney disease.[8] The use of combination therapy has been noted as a significant predictor of good BP control, while diabetes mellitus as a comorbidity is a predictor of poor BP control.[9]

There is a paucity of data on the predictors of good BP control. The goal of this study was to identify the predictors of good BP control in a clinical setting in Calabar, Nigeria. The study also determined the characteristics of patients with hypertension and the comorbidities of hypertension among these patients. Operationally, this study was guided by hypotheses to identify if there were statistically significant associations between BP control and sociodemographic factors, compliance with medications and risk factors.

METHODOLOGY

Scope of the study

This study aimed to identify the predictors of BP control among only patients with hypertension treated at the general outpatient department (GOPD), medical outpatient department (MOPD) and cardiology clinics of the University of Calabar Teaching Hospital (UCTH), Nigeria.

Study design

This was a descriptive cross-sectional study that employed only a quantitative method of data collection.

Study population

The subjects were adults aged 18 and above who had a clinical diagnosis of hypertension and presented to either the MOPD, cardiology clinic, general outpatient clinic or the medical wards of the UCTH, Calabar. BP control was defined as having a systolic BP (SBP) of <130 and a diastolic BP (DBP) of 80. The patients were those who were on medications for hypertension. Patients with comorbidities like chronic obstructive pulmonary disease (COPD), diabetes mellitus, asthma, sickle cell disease, connective tissue disease, HIV/AIDS and patients with stage 3 chronic kidney disease were also recruited.

Sample size determination

The sample size was determined using Fisher's formula:

$$n = \frac{Z^2(P)(1-P)}{d^2}$$

where n=minimum sample size; Z=constant at 95% CI given to be 1.96; P is the prevalence of hypertension in Nigeria which is expressed as 22%; and d is the absolute precision. In this study, 4% (0.04) was used. Therefore:

$$N = \frac{(1.96)^2(0.22)(1-0.22)}{(0.04)^2} = 412$$

The sample size was 412. Using an attrition rate of 10%, the sample size was increased to 458.

Sampling procedure

A systematic random sampling method was used to recruit subjects with hypertension into the study. The sampling frame consisted of the GOPD, MOPD and cardiology clinic attendance registers, from where subjects were recruited using a sampling interval as illustrated below. The sampling interval was calculated by dividing the expected weekly number of patients who presented with hypertension (obtained from records) by the allocated sample size per week.

With an expected study duration of 3 months (12 weeks), the allocated sample size was a total sample size of 458 divided by the study duration of 12 weeks, which yielded approximately 38 subjects. This number was recruited per week. Therefore, the sampling interval was calculated as the expected weekly number of patients with hypertension, 100, divided by the allocated weekly sample size of 38. This yielded approximately 3. The first subject was selected through balloting among the first three (early) clinic attendees, and subsequent subjects were selected using the appropriate sampling interval of 3. If a subject was ineligible or did not consent to participate, then the next patient on the register was contacted, and recruited using the sampling interval continued from that point. Sampling was continued until the allocated sample size for the study group was completed.

Instruments for data collection

Instruments used for the study included the following: pretested semistructured questionnaire, weighing scale (kg), measuring tape (cm), stadiometer (cm), sphygmomanometer (Accoson brand) and Littmann stethoscope (classic).

Method of data collection

All participants were interviewed by the researcher and the research assistants using a semistructured questionnaire

that sought information about demographic data, history of hypertension, symptoms of hypertension, comorbidities, treatment (behavioural and pharmacological), compliance with antihypertensive medications, cigarette smoking, alcohol use, history suggestive of complications and symptoms of cardiac dysfunction. Thereafter, patients had detailed general physical, cardiovascular and systemic examinations. Physical examination of the subjects included assessment of height, weight, abdominal girth measurement and determination of BMI. BP was measured using a mercury sphygmomanometer, twice in the same arm, after the participant had been seated for at least 10–15 min. The SBP and DBP were measured twice, and the average values were taken. Waist circumference was evaluated using a measuring tape to the nearest 0.1 kg. Height was measured without shoes using a stadiometer to the nearest 1 cm. BMI was calculated using the subject's weight in kilograms divided by the square of height in metres (kg/m^2).

Method of data analysis

Data were extracted from the questionnaire and entered into Microsoft Excel. All data were scanned for entry completeness. Data were exported and analysed using SPSS V.23. The sociodemographic characteristics of respondents and factors associated with hypertension were analysed using descriptive statistics (mean, frequencies and percentages). Descriptive statistics were also used to present data on cases that were on treatment, those who complied with medications, BP control status (adequate or inadequate) and common complications among patients with hypertension. The outcome variable was dichotomised into 'Adequate' and 'Inadequate' BP control based on the SBP and DBP values. Pearson's χ^2 test of independence was used to test bivariate associations in the outcome across sociodemographic characteristics and associated factors. For tables with 20% of cells of expected counts less than 5, Fisher's exact test was used to determine the associations. Multivariate logistic regression analysis was used to estimate the odds of being in either category of the dependent variable (BP control) while controlling for statistically significant sociodemographic correlates and associated factors found in the bivariate analyses. These associated factors were selected a priori based on evidence from relevant literature and our theoretical assumption that these factors will be relevant in studying BP control in the study population. Only factors that were associated with the outcome of interest in the χ^2 procedures were included in the corresponding multivariable procedure to limit the probable risk of overadjusting without compromising the identification of the predictors for the outcome. However, regardless of their significance status, the age and sex of respondents were included in our regression model due to their biological relevance. Adjusted ORs (AORs) were used to determine the strength of association in the model and were determined with a 95% CI. The significance threshold was set at α=0.05.

Ethical consideration

The nature of the study was explained to each participant with a full understanding of the processes of the study. Consenting participants were required to sign a consent form or append their thumbprint where appropriate. Participation was voluntary and participants were at liberty to withdraw from the study at any stage without consequence. All information obtained was treated as confidential. The data obtained were stored on the investigator's personal computer, and a backup was made on an external hard drive. Both data were encrypted to ensure no other person except the investigator and his supervisor had access to the data. Consent and approval for the study were also obtained from the consultant physicians in charge of GOPD, MOPD and the cardiology clinic of UCTH.

Patient and public involvement

None.

RESULTS

Out of 458 anticipated responses, we received 441 responses yielding a 96.3% response rate. The sociodemographic characteristics and biomarkers of the study respondents are presented in table 1. Most of the respondents (55.7%) were females. The average age of participants was 55.46 years±12.91 (ranging from 19 years to 87 years). Most respondents (52.8%) were aged 55 years and above, while younger adults aged 18–35 years made up the least number of respondents (5.4%). Most respondents identified themselves as being married (74.4%). Most respondents (70.4%) were Efiks and all respondents (100%) were Christians. Respondents were predominantly business managers (40.4%) while the unemployed made up the least number of respondents (7.5%). Most of the respondents (54.9%) had attained tertiary education. In terms of monthly income, most of the respondents (68.3%) earned wages within the NGN10 001–100 000 range. Most of the respondents (67.4%) lived with their spouses and children. In terms of geographical location, most respondents (91.8%) resided in urban areas. Out-of-pocket health expenditure was the most commonly used form of payment for health services (63.5%).

The study found that the majority of the respondents (30.8%) were overweight while this was followed closely by 24.1% who were mildly obese. In essence, 3 in 10 respondents were reportedly overweight. Moderate obesity was found in 12.3% of the respondents while severe obesity was identified in 5.9% of the study population. 48% of the patients with hypertension in this study had attained adequate BP control. In terms of medications, aldosterone antagonists (79.7%) and diuretics (74.3%) were the most commonly used medications for BP control.

Table 2 presents the data on reported risk factors and comorbidities for hypertension among the study respondents. Most respondents (67.8%) had a sedentary lifestyle. Also, the use of caffeinated drinks was a major risk

Table 1 Sociodemographic characteristics of the study respondents

Variables	Frequency (n=441)	%
Sex		
Male	194	44.3
Female	246	55.7
Age (in years)	M=55.46, SD=12.91	
18–35 (young adults)	24	5.4
36–54 (middle-aged adults)	184	41.7
55 and above (older adults)	233	52.8
Marital status		
Single	34	7.7
Married	328	74.4
Divorced/separated	23	5.2
Widowed	56	12.7
Tribe (n=429)		
Efik	302	70.4
Ibibio	49	11.4
Igbo	57	13.3
Yoruba	10	2.3
Hausa	11	2.6
Religion		
Christianity	441	100
Occupation		
Civil servant	152	34.5
Retired	78	17.7
Business manager	178	40.4
Unemployed	33	7.5
Level of education		
No formal education	12	2.7
Primary	111	25.2
Secondary	76	17.2
Tertiary	242	54.9
Monthly income		
NGN1000–10 000	37	8.4
NGN10 001–100 000	301	68.3
>NGN100 000	103	23.4
Living status (n=423)		
Alone	45	10.6
With spouse	22	5.2
With spouse and children	285	67.4
With relatives	10	2.4
With children only	61	14.4
Geographical location		
Urban	405	91.8
Rural	29	6.6
Semiurban	7	1.6
Mode of payment for healthcare		

Continued

Table 1 Continued

Variables	Frequency (n=441)	%
Out of pocket	280	63.5
Partial insurance	12	2.7
Full health insurance	70	15.9
Charity	79	17.9
BMI category		
Underweight	20	4.9
Normal	89	21.9
Overweight	125	30.8
Mild obesity	98	24.1
Moderate obesity	50	12.3
Severe obesity	24	5.9
Blood pressure control (n=420)	Mean SBP=132±20.8; mean DBP=88±14.3	
Yes	202	48.1
No	218	51.9
Medications used*		
Beta blockers	60	21.7
ACE inhibitors	94	34.1
Angiotensin II Receptor Blockers (ARBs)	91	33.0
Aldosterone antagonist	220	79.7
Diuretics	205	74.3
Calcium Channel Blockers (CCB)	67	24.3

NGN1=US$1500.
*Multiple responses allowed.
BMI, body mass index; DBP, diastolic blood pressure; M, mean; NGN, Nigerian naira; SBP, systolic blood pressure; SD, Standard Deviation.

factor for hypertension, as 51.9% of the respondents used these substances frequently. Furthermore, a family history of hypertension (47.5%) was found to be one of the major risk factors for hypertension among the respondents. Affinity to salty meals (34.8%) also posed a key risk factor for hypertension among the patients.

The most prominent comorbidity of hypertension among the study respondents was peptic ulcer disease (PUD, 46.72%), followed by diabetes (31.39%). Tuberculosis and COPD (both at 0.73%) were the least occurring comorbidities of hypertension among the study respondents.

Table 3 shows the results of the χ^2 test of independence for a statistically significant association between sociodemographic characteristics, associated risk factors, compliance and BP control among patients with hypertension in the study area. There was a statistically significant association between respondents' age and their BP control, χ^2=10.97, df=2, p=0.004. There was also a statistically significant association between the marital status of respondents and their BP control, χ^2=6.60, df=3, p=0.008. In terms of income, there was a statistically significant association between respondents' income level and their BP control status, χ^2=11.78, df=2, p=0.003. Additionally, there was a statistically significant association between respondents' living status and their BP control status, χ^2=7.95, df=4, p=0.037. Lastly, in terms of payment for healthcare, there was a statistically significant association between respondents' mode of payment for healthcare and their BP control status, χ^2=8.99, df=3, p=0.026. In each of the above scenarios, however, we reject the null hypothesis.

The data indicate that use of caffeinated drinks (χ^2=15.73, df=1, p<0.001) and sedentary lifestyles (χ^2=1.03, df=1, p=0.048) were statistically significantly associated with BP control among the study respondents. There was a statistically significant association between BMI and BP control status of the respondents, χ^2=13.98, df=5, p=0.016. In each of the above scenarios, however, we reject the null hypothesis. Lastly, findings of this present study indicate that there was a statistically significant association between respondents' compliance with hypertension medications and BP control (χ^2=5.976, df=1, p=0.014).

A multiple logistic regression analysis was done by factoring in all the significant sociodemographic characteristics and associated risk factors of hypertension in a single model to predict the respondents' BP control status. We also factored in respondents' compliance

Table 2 Reported risk factors and comorbidities for hypertension among the study respondents

Risk factors	Frequency	%	Comorbidities	Frequency	%
Family history of hypertension	183	47.5	Diabetes	86	31.39
Alcohol intake	113	29.4	Stroke	16	5.84
Smoking	37	9.6	Heart failure	17	5.11
Combined Oral Contraceptives (COC) pills	50	13.0	Chronic kidney disease (CKD)	8	2.92
History of pre-eclampsia	39	10.1	COPD	2	0.73
History of eclampsia	2	0.5	Epilepsy	6	2.19
Use of caffeinated drinks	200	51.9	HIV	4	1.46
Affinity to salty meals	134	34.8	TB	2	0.73
Sedentary lifestyle	261	67.8	Benign Prostatic Hyperplasia (BPH)	4	1.46
History suggestive of glomerulonephritis/chronic kidney disease	68	17.7	Breast cancer	4	1.46
History suggestive of hyperthyroidism	8	2.1	Gastrointestinal symptoms	128	46.72
History suggestive of pheochromocytoma	8	2.1	–	–	–

*All variables are multiple responses.
**Percentages do not amount to 100.
COPD, chronic obstructive pulmonary disease; TB, tuberculosis.

with medications as a potential predictor of BP control. Table 4 shows the multivariate logistic regression analysis of the anthropometric factor, sociodemographic correlates and associated factors that predict BP control after adjusting for all potential covariates that were found significant in the bivariate χ^2 analysis. However, regardless of their significant status in the bivariate analysis, age and gender were included in the multivariate model due to their biological relevance. This present study found that those aged greater than 54 years were less likely to attain adequate BP control than young adults, b=−1.19, p<0.001, AOR=0.30 (95% CI 0.18, 0.52). We also found that respondents who earned NGN100 000 and greater were 2.94 times more likely to attain adequate BP control, b=1.08, p=0.026, AOR=2.94 (95% CI 1.14, 7.59). In terms of residential companionship, respondents who resided with their spouses alone were significantly less likely to attain adequate BP control, b=−1.96, p=0.014, AOR=0.14 (95% CI 0.03, 0.67). Additionally, respondents who were under full health insurance coverage were 2.32 times significantly more likely to attain adequate BP control, b=0.84, p=0.030, AOR=2.32 (95% CI 1.09, 4.96). Respondents who did not frequently use caffeinated drinks or beverages were over four times significantly more likely to attain adequate BP control, b=1.19, p<0.001, AOR=4.13 (95% CI 1.40, 10.1). Respondents who failed to comply with BP medications were less likely to attain adequate BP control, b=−0.64, p=0.040, AOR=0.53 (95% CI 0.27, 1.05). Lastly, the study also found that those with normal BMI were 1.63 times significantly more likely than those underweight to maintain adequate BP control, b=0.49, p=0.026, AOR=1.63 (95% CI 0.41, 6.43), and respondents who were moderately obese were significantly less likely than those underweight to attain adequate BP control, b=−1.22, p=0.032, AOR=0.29 (95% CI 0.09, 0.90).

DISCUSSION

A little more than half (51.9%) of our respondents in the current research had insufficient BP control, according to the findings. This suggests that only 48.1% of the respondents had achieved acceptable BP control. According to a study[10] conducted in Ibadan, Nigeria, 48% of the 162 patients who were treated for moderate and severe hypertension had their BP adequately controlled, which is in agreement with the result of this study. Also consistent with the result of this study is a study done in the USA among adults with hypertension, where 53.0% had controlled hypertension during 2011–2014.[11] The prevalence of controlled hypertension was higher among those aged 40–59 (57.2%) and 60 and over (52.5%) than among those aged 18–39 (37.4%).[11] One possible explanation for the finding that fewer patients achieve adequate BP control is the complexity and severity of the disease itself. Hypertension varies widely in severity among patients, with some individuals having more advanced stages or additional health complications like diabetes or kidney disease. These factors can make managing BP more

Table 3 X^2 analysis of the association between sociodemographic as well as associated risk factors and blood pressure control

Variables	Adequate BP control n (%)	Inadequate BP control n (%)	P value	Variables	Adequate BP control n (%)	Inadequate BP control n (%)	P value
Sex			0.163	Family history of hypertension			0.117
Male	63 (46.7)	72 (53.3)		Yes	103 (53.1)	91 (46.9)	
Female	139 (48.8)	146 (51.2)		No	117 (54.7)	97 (45.3)	
Age (in years)			0.004*	Alcohol intake			0.490
18–35 (young adults)	18 (81.8)	4 (18.2)		Yes	52 (46.0)	61 (54.0)	
36–55 (middle-aged adults)	84 (48.0)	91 (52.0)		No	148 (49.8)	149 (50.2)	
>55 (older adults)	100 (44.8)	123 (55.2)		Smoking			0.669
Marital status			0.008*	Yes	15 (45.5)	18 (54.5)	
Single	22 (66.7)	11 (33.3)		No	190 (50.7)	185 (49.3)	
Married	147 (47.4)	163 (52.6)		Use of caffeinated drinks			<0.001**
Divorced/separated	12 (52.2)	11 (47.8)		Yes	123 (59.1)	85 (40.9)	
Widowed	21 (38.9)	33 (61.1)		No	79 (39.5)	121 (60.5)	
Level of education			0.305	Affinity to salty meals			0.864
No formal education	4 (33.3)	8 (66.7)		Yes	68 (48.9)	71 (51.1)	
Primary	56 (53.8)	48 (46.2)		No	134 (49.8)	135 (50.2)	
Secondary	30 (41.7)	42 (58.3)		Sedentary lifestyle			0.048*
Tertiary	112 (48.3)	120 (51.7)		Yes	131 (51.0)	126 (49.0)	
Occupation			0.789	No	71 (45.8)	84 (54.2)	
Civil servant	71 (49.0)	74 (51.0)		History suggestive of glomerulonephritis/chronic kidney disease			0.892
Retired	38 (52.1)	35 (47.9)		Yes	32 (49.2)	33 (50.8)	
Business owner	79 (46.7)	90 (53.3)		No	170 (50.1)	169 (49.9)	
Unemployed	14 (42.4)	19 (57.6)		History suggestive of hyperthyroidism			0.498
Monthly income			0.003*	Yes	5 (62.5)	3 (37.5)	
₦1000–10 000	9 (26.5)	25 (73.5)		No	197 (49.0)	205 (51.0)	
₦10 001–100 000	152 (53.3)	133 (46.7)					
Above ₦100 000	41 (40.6)	60 (59.4)		History suggestive of pheochromocytoma			0.444
Living status			0.037*	Yes	4 (66.7)	2 (33.3)	
Alone	25 (59.5)	17 (40.5)					
With spouse	6 (33.3)	12 (66.7)					
With spouse and children	127 (46.5)	146 (53.5)					
With relatives	8 (80.0)	2 (20.0)		No	198 (49.0)	206 (51.0)	
With children only	29 (49.2)	30 (50.8)		BMI			0.016*
Mode of payment for healthcare			0.028*	Underweight	14 (70.0)	6 (30.0)	
Out of pocket	123 (45.7)	146 (54.3)		Normal	39 (47.0)	44 (53.0)	

Continued

Table 3 Continued

Variables	Adequate BP control n (%)	Inadequate BP control n (%)	P value	Variables	Adequate BP control n (%)	Inadequate BP control n (%)	P value
Partial insurance	7 (70.0)	3 (30.0)		Overweight	57 (47.1)	64 (52.9)	
Full health insurance	41 (62.1)	25 (37.9)		Mild obesity	51 (53.1)	45 (46.9)	
Charity	31 (41.3)	44 (58.7)		Moderate obesity	20 (40.8)	29 (59.2)	
				Severe obesity	19 (79.2)	5 (20.8)	
				Compliance with antihypertension medications			0.014*
				Yes	151 (50.7)	147 (49.3)	
				No	27 (35.1)	50 (64.9)	

NGN1=US$1500.
** Statistical significance at P-Value <0.05
BMI, body mass index; BP, blood pressure; NGN, Nigerian naira.

challenging and require more aggressive treatment strategies. Patients with milder forms of hypertension or fewer comorbidities may find it easier to achieve and maintain target BP levels with less intensive management, leading to a higher proportion of patients not requiring extensive treatment measures. Another critical factor influencing BP control is treatment adherence. Even when prescribed effective medications, achieving optimal BP control relies heavily on patients' adherence to their treatment plans. This includes taking medications consistently as directed, making necessary lifestyle changes (such as dietary modifications and regular exercise) and attending follow-up appointments for monitoring and adjustment of treatment. Patients who struggle with adherence, whether due to medication side effects, forgetfulness or lack of understanding about the importance of adherence, are less likely to achieve and sustain adequate BP control over time.

On risk factors for hypertension among the study respondents, many respondents indicated exposure to sedentary lifestyles (67.8%) constituting mainly a lack of physical activity. Also, the use of caffeinated drinks (59.1%) was a major risk factor for hypertension as the respondents used these substances frequently. Some identified a family history of hypertension (47.5%) as another major factor for hypertension among the respondents. Affinity to salty meals was seen in 34.8% of the respondents as a key risk factor for hypertension among the patients. This was similar to a study[12] conducted in Oyo State, Southwestern Nigeria, among the 376 participants. In this study,[12] alcohol consumption, sedentary lifestyle, abnormal weight and inadequate sleep were found to be major risk factors for hypertension. Another study which was conducted to assess the prevalence and associated risk factors for hypertensive complications also showed that participants who had sedentary lives were four times more likely to develop complications than those who had vigorous physical activity.[13] Sedentary behaviours, characterised by prolonged sitting and low levels of physical exercise, contribute significantly to the development of hypertension. Physical inactivity reduces the body's ability to regulate BP effectively, leading to higher resting BP levels over time. This underscores the importance of regular physical activity in maintaining cardiovascular health and preventing hypertension. Caffeine, a central nervous system stimulant found in coffee, tea and energy drinks, can temporarily elevate BP by stimulating the release of epinephrine and cortisol.[14] Habitual and excessive consumption of caffeinated beverages has been associated with sustained hypertension in susceptible individuals.[15] In terms of family history, genetic predisposition plays a crucial role in hypertension, with individuals having a family history of the condition being more susceptible to developing hypertension themselves. Genetic factors influence how the body regulates BP and responds to lifestyle factors such as diet and physical activity.[16] Also, high dietary sodium intake disrupts the body's fluid balance, leading to increased fluid retention and elevated

Table 4 Multivariate logistic regression to identify predictors of blood pressure control among the study respondents

Variables	AOR	95% CI	P value
Gender			
Male	Ref	–	–
Female	0.83	0.45, 1.53	0.561
Age (in years)			
18–35 (young adults)	Ref	–	–
36–54 (middle-aged adults)	0.26	0.13, 0.49	0.99
>54 (older adults)	0.30	0.18, 0.52	<0.001**
Marital status			
Single	Ref	–	–
Married	0.59	0.17, 0.98	0.412
Divorced/separated	0.98	0.23, 4.17	0.975
Widowed	0.44	0.11, 1.77	0.246
Monthly income			
NGN1000–10 000	Ref	–	–
NGN10 001–100 000	0.92	0.31, 2.72	0.884
>NGN100 000	2.94	1.14, 7.59	0.026*
Living status (n=402)			
Alone	Ref	–	–
With spouse	0.14	0.03, 0.67	0.014*
With spouse and children	0.59	0.22, 1.65	0.321
With relatives	0.82	0.33, 0.93	0.980
With children only	0.77	0.25, 0.89	0.639
Mode of payment for healthcare			
Out of pocket	Ref	–	–
Partial insurance	1.95	0.85, 4.45	0.118
Full health insurance	2.32	1.09, 4.96	0.030*
Charity	1.02	0.49, 2.09	0.950
Use of caffeinated drinks			
Yes	Ref	–	–
No	4.13	1.40, 10.1	0.001*
Sedentary lifestyle			
Yes	Ref	–	–
No	1.44	0.11, 2.03	0.472
Compliance with BP medications			
Yes	Ref	–	–
No	0.53	0.27, 0.95	0.040*
BMI			
Underweight	Ref	–	–
Normal	1.63	1.41, 6.43	0.026*
Overweight	0.38	0.14, 1.06	0.064
Mild obesity	0.49	0.17, 1.37	0.172
Moderate obesity	0.29	0.09, 0.90	0.032*
Severe obesity	0.38	0.13, 1.08	0.071

NGN1=US$1500.
*Statistical significance based on p<0.05.
**Statistical significance based on p<0.001.
AOR, adjusted OR; BMI, body mass index; BP, blood pressure; NGN, Nigerian naira; Ref, reference category.

BP levels. The widespread availability and consumption of processed foods high in sodium contribute to excessive sodium intake in many diets worldwide.[17] These findings underscore the multifaceted nature of hypertension, where lifestyle behaviours, genetic predisposition and environmental factors intersect to influence BP regulation and cardiovascular health outcomes.

PUD (46.72%), diabetes mellitus (31.39%) and heart failure (17%) were common comorbidities of hypertension among our Nigerian study respondents. The least frequent comorbidities of hypertension among research participants were tuberculosis and COPD (both 0.73%). This is slightly at variance with a study conducted in Korea on the prevalence of comorbidity among people with hypertension.[18] Common comorbidities identified in the study were obesity (60.1%), dyslipidaemia (57.6%) and impaired fasting glucose (45.1%).[18] Patients with hypertension with two or more comorbid diseases were 42.2% and those with three or more diseases were 17.7%.[18] The age and sex-specific prevalence of three or more comorbid diseases among male patients with hypertension was significantly higher than those patients in the 30–59 ($p<0.05$) age group.[18] Another study reported that diabetes without complications was the most common comorbidity of unspecified (10.7%) and malignant (12.3%) patients with hypertension.[19] Concerning the age impact, older groups had much larger OR values for diabetes mellitus (2.98 and 4.73) and coronary heart disease (3.29 and 8.44) than hyperlipidaemia (1.25 and 1.24).[19] The middle-aged group had a higher OR (1.25) than the elderly group (1.24), which showed a different trend from those of the other two comorbidities, as reported in a study done on Prevalence and Risk Factors of Comorbidities among Hypertensive Patients in China.[20] This finding underscores the significant burden of gastrointestinal complications among individuals with hypertension in the Nigerian context. The high prevalence of PUD could be attributed to factors such as stress, dietary habits and potentially the use of non-steroidal anti-inflammatory drugs, which are commonly prescribed for pain management but can exacerbate gastric ulceration in patients with hypertension.[21 22] The coexistence of hypertension and diabetes is well documented[23 24] and poses substantial challenges in clinical management due to their synergistic impact on cardiovascular health. Hypertension accelerates the progression of diabetic complications such as nephropathy, retinopathy and cardiovascular disease,[25] highlighting the need for integrated treatment approaches to mitigate these risks effectively.

Additionally, this current study revealed that age greater than 54 years, monthly income of more than ₦100 000, full health insurance, presence of spouse, use of caffeinated substances and failure to comply with medications were the significant predictors of BP control. The finding on age is consistent with a study that found the probability of raised BP increases with ageing.[26] The factors associated with ageing in hypertension include atherosclerosis, intimal medial thickening and calcification of blood vessels.[26] A study by Borzecki *et al*[27] categorised age into three groups, namely 40–49, 50–59 and 60 years and above, to assess the BP control among respondents. Participants in the 40–49 years age group had good BP control (AOR=1.35 (95% CI 1.26 to 1.44)), and participants who were 50–59 years old also had better control (1.22 (95% CI 1.17 to 1.28)), while participants who were 60 years and over had worse control (OR 0.92 (95% CI 0.88 to 0.99)).[27] The study also found that the oldest patients with hypertension were treated less aggressively with fewer medications than their younger counterparts.[27]

Studies have shown that health outcomes correlate with the financial status of an individual.[28 29] The findings from our study showed the same trend. Participants on full National Health Insurance Scheme (NHIS) had good BP control compared with those with no or partial NHIS. This corroborates the result from Oseni *et al*,[30] which indicated that participants who benefitted from the scheme were over three times more likely to have good BP control (OR=3.516, 95% CI 1.946 to 6.352). Conversely, out-of-pocket spending is a major cause of poor BP control with a predisposition to stroke.[30] A similar result was obtained from a study in the National Health and Nutrition Examination Surveys conducted in 1999 through 2002 which showed that among all hypertensive participants, only 58% of the uninsured had a BP check within 6 months, compared with 82% of the privately insured.[18] Overall, uninsured individuals (AOR=0.63, 95% CI 0.44 to 0.92) were at lower odds of adequate BP control than the privately insured. Among treated participants, the uninsured were at lower odds of adequate control (AOR=0.42, 95% CI 0.23 to 0.73) than the privately insured.[31]

Spousal or family support was a predictor of BP control. In our study, living with a spouse negatively predicted BP control. In contrast, Ojo *et al*[32] studied 360 patients with hypertension and found that most of the respondents (79.4%) had strong perceived family support. Strong perceived family support (OR=4.778, 95% CI 2.569 to 8.887) was an independent predictor of controlled BP.[32] Chacko and Jeemon[33] studied 690 patients with hypertension; they found that good family support for self-care (AOR=1.9, 95% CI 1.1 to 3.1) was associated with better control of BP. Among self-care activities, adherence to medications (AOR=1.8, 95% CI 1.3 to 2.5) was associated with control of BP.[33] The discrepancy observed in our study, where living with a spouse negatively impacted BP control, may stem from several factors. First, the quality and nature of family dynamics can vary widely among different populations and cultural contexts. While some individuals may benefit from supportive spousal relationships that facilitate adherence to treatment and healthy habits, others may experience stressors or conflicts within the family environment that hinder effective BP management. Factors such as marital discord, caregiver burden or differing health priorities between spouses could potentially contribute to suboptimal BP control outcomes despite living with a spouse.

Implications for future research and clinical practice

Moving forward, the findings of this study suggest several important implications for future research and clinical practice in the management of hypertension. First, the identification of significant predictors of BP control, such as age, income level and health insurance coverage, highlights the need for tailored approaches in clinical practice. Healthcare providers could benefit from integrating socioeconomic assessments into patient management strategies to better address barriers to effective hypertension control. Future studies could delve deeper into understanding how these factors interact with treatment outcomes over longer periods. Additionally, the study's findings on prevalent risk factors like sedentary lifestyle and dietary habits suggest opportunities for targeted prevention and lifestyle modification programmes. Future research could focus on assessing the effectiveness of community-based interventions or digital health solutions in promoting healthier behaviours and reducing hypertension risk factors among diverse populations. Lastly, there should be further investigation as to whose spousal influence (male or female) was negatively related to adequate BP control.

Limitations

Despite its contributions, this study is not without limitations that warrant consideration in interpreting its findings. The reliance on self-reported data and clinic records introduces potential biases such as recall bias or incomplete information, which may impact the accuracy and reliability of reported adherence rates and risk factor assessments. Variations in data quality across different healthcare settings could also limit the generalisability of findings beyond the specific clinics surveyed. Furthermore, while comparisons with other studies provide context, differences in methodologies, patient demographics and healthcare systems across regions (eg, Nigeria, Cyprus, USA) make direct comparisons challenging. These differences may influence the interpretation of findings related to adherence rates, risk factors and predictors of good BP control. Moreover, the study's cross-sectional design limits its ability to establish causality between identified predictors and hypertension management outcomes. The auscultatory mercury method is used for office BP measurement, and per guidelines, this method should not be used. Also, BP measurements were done twice instead of thrice, thus posing a limitation to the study. Lastly, self-rated health data, which are independently and directly associated with the risk of incident cardiovascular events, were not collected in this study.

Future research could benefit from longitudinal studies or randomised controlled trials to explore causal relationships and validate findings over time.

CONCLUSION

This study offers valuable insights into the management of hypertension, highlighting both strengths and areas for improvement in clinical practice and research. However, the finding that only approximately half of the respondents achieved acceptable BP control underscores ongoing challenges in hypertension management. Key predictors of BP control, such as age, income level and full health insurance coverage, emphasise the importance of personalised approaches in clinical settings. Addressing prevalent predictors of high BP like sedentary lifestyles and patient's income presents opportunities for targeted interventions to enhance good BP control and improve outcomes.

Contributors IEU conceived and carried out the study under the supervision of NCO. UM-JU designed the instruments and analysed the data. UM-JU is the assigned guarantor for this paper. PBE reviewed relevant literature. EEB and SBY headed the data collection team. MIA reviewed the manuscript.

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Patient consent for publication Consent obtained directly from patient(s)

Ethics approval This study involves human participants and was approved by the Human Research and Ethics Committee of the University of Calabar Teaching Hospital (UCTH/HREC/33/575). Participants gave informed consent to participate in the study before taking part.

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