Treatment knowledge and medication adherence and their association with blood pressure control among hypertensive patients at a teaching hospital in Ghana

Mark Amankwa Harrison[1,2]; Daniel Kwame Afriyie[3]; Afia Frimpomaa Asare Marfo[2]; Charles Nii Kwade Ofei-Palm[1]; Dorcas Poku Boateng[1]; Kwame Ohene Buabeng[4]; Raymond Tetteh[5]; Daniel Ankrah[1]

[1] Pharmacy Department, Korle Bu Teaching Hospital, Accra, Ghana

[2] Department of Pharmacy Practice, Faculty of Pharmacy and Pharmaceutical Sciences, College of Health Sciences, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

[3] Pharmacy Department, Police Hospital, Accra, Ghana

[4] School of Pharmacy, University of Health and Allied Sciences, Ho, Ghana

[5] School of Pharmacy, Central University College, Accra, Ghana

Abstract

Background: Blood pressure (BP) control can be influenced by patients' knowledge of hypertension treatment and medication adherence. Adherence can be influenced by patients' knowledge. In Ghana (a resource-limited setting), the relationship between these factors and BP control is not well known. The aim of this study was to investigate hypertension treatment knowledge and medication adherence and their relationship with BP control among hypertensive patients at the Korle Bu Teaching Hospital (KBTH).

Methods: This was a cross-sectional study of 371 adult hypertensive outpatients at the KBTH Polyclinic/Family Medicine Department using a structured questionnaire. Medication adherence was evaluated based on the Hill-Bone Compliance to High Blood Pressure Therapy Scale. Systematic sampling was used. SPSS was used for data analysis.

Results: Majority (72.8%; n=270) of respondents were females. Nearly half (48.5%; n=180) were aged 65 years and above. The proportion of patients with adequate knowledge was 3.7% (n=14). About 40% of patients had high adherence. Moderate knowledge of hypertension treatment was insignificantly associated with 1.57 times higher odds of BP control (COR: 1.57; CI 0.98-2.53). Moderate knowledge was 4.73 times more likely to result in adherence than low knowledge (COR: 4.73; CI 2.49-9.01; p<0.001). Higher medication adherence (≥ 80%) was 1.98 times more likely to result in BP control than lower adherence (COR: 1.98; CI 1.03-3.80; p<0.05)

Conclusion: This study revealed that hypertension treatment knowledge and medication adherence were inadequate, and BP control was low. Hypertension treatment knowledge was not significantly associated with BP control but was significantly associated with medication adherence. Adherence significantly predicted BP control. These findings underscore the need to take steps to improve antihypertensive treatment knowledge and adherence to lead to better BP control. These findings also suggest the need for patient care providers to prioritize patient education and counseling in the management of hypertension.

Keywords: medication adherence, hypertension, blood pressure control, hypertension knowledge, antihypertensive, Ghana

Background

Hypertension is a leading risk factor for cardiovascular disease (CVD), premature death, and disability globally.[1,2] In Sub-Saharan Africa, the disease is a significant public health problem.[3,4] In Ghana, about one third of the adult population has hypertension, and hypertension is a leading cause of hospital attendance and admission.[5] The disease can be controlled with drug therapy and non-pharmacological management. While a broad armamentarium of medicines is available for the management of hypertension, blood pressure (BP) control rates are low.[2,6]

Corresponding Author:
Mark Amankwa Harrison
Pharmacy Department, Korle Bu Teaching Hospital
P.O. Box 77, Korle Bu, Accra, Ghana
+233268471406
markharry02@yahoo.com
ORCID ID: https://orcid.org/0000-0002-8774-1324

In Ghana, studies report hypertension control in less than half of patients.[6-12] Boima et al. reported hypertension control in about 30% of patients, lower than the findings of Sarfo et al. (42%) in tertiary and district hospitals; however, subsequent studies reported a 49% rate of BP control in hypertensive patients in Ghana.[7-9] Published findings report higher odds of uncontrolled BP in tertiary facilities compared to other facilities in Ghana.[8]

Various factors such as complexity of hypertension treatment and treatment intensification can influence BP control.[6-8,10-12] Hypertensive patients need to adhere to their BP medication to achieve BP control.[7,12] Despite the importance of adherence for BP control, studies report sub-optimal adherence to antihypertensive treatment among patients.[7,8,12,13] While some studies report less than 50% rate of antihypertensive medication adherence, the adherence rate varies.[7,12-15] Some studies report higher than 50% adherence.[15-17]

In Ghana, antihypertensive medication adherence varies largely. The work of Boima et al. showed low medication adherence.[7] Prior to this, Kretchy et al. had reported good adherence in less than 10% of hypertensive patients.[13] The authors reported 38.3% adherence rate. Adomako et al. found antihypertensive medication adherence rate of 47% and 50.8% in two major hospitals in Ghana.[12] A more recent study reported medication adherence in more than 90% of hypertensive patients in Ghana.[15] These studies used different methods to measure adherence. While self-reported measurements have been largely used, different self-reporting adherence scales such as Morisky Medication Adherence Scale (MMAS), Medication Adherence Rating Scale (MARS), and Hill Bone Adherence scale have been used.[7,8,12,15] Medication adherence may be influenced by socio-economic and clinical factors.[14] Complex drug therapy, perceived adverse effects, and comorbidities, among others have been reported as factors associated with non-adherence.[14]

Hypertensive patients' knowledge of their treatment is one of various factors that may influence adherence. The association between hypertensive patient knowledge of their medication and adherence has been reported by some studies.[9,15,17-21] Sudharsanan et al. showed that patients who had knowledge that BP medication use was the most effective way to reduce their BP were more likely to adhere to their medication.[17] The influence of knowledge of antihypertensive medication on adherence may, however, differ depending on the content of the knowledge assessment tool.

Good knowledge of hypertension treatment may have a beneficial association with BP control. While knowledge of hypertension treatment may have a positive influence on adherence to antihypertensive medicines and BP control, there is limited evidence on this relationship. In Ghana, evidence on hypertension treatment knowledge and its relationship with antihypertensive medication adherence and BP control is sparse. Evidence on antihypertensive medication adherence shows wide variation in findings. Limited evidence on hypertension treatment knowledge among hypertensive patients in Ghana shows limited scope. Due to low rates of hypertension control reported globally as well as in Ghana, determinants of BP control need to be investigated. Evidence on the degree of hypertension treatment knowledge, adherence to medication, and BP control, and the relationship between these variables can inform strategies including patient education and counseling for improving BP control. The aim of this study was to investigate hypertension treatment knowledge and medication adherence and their relationship with BP control among hypertensive patients at the Korle Bu Teaching Hospital.

Methods

Study design

This was a cross-sectional study using a structured questionnaire. Hypertension treatment knowledge and antihypertensive medication adherence were evaluated based on a 14-item questionnaire and the Hill-Bone Compliance to High Blood Pressure Therapy Scale (HB-CHBPT), respectively.

Study setting

This study was conducted at the polyclinic/family medicine department (FMD) of the biggest referral hospital in Ghana, the Korle Bu Teaching Hospital (KBTH), which has a bed capacity of over 2,000. The KBTH is one of Africa's largest teaching hospitals. The 42-bed FMD has a family physician clinic and is a centre for training family physicians enrolled in the Ghana and West Africa colleges of physicians. KBTH has 21 clinical and diagnostic departments and three centres of excellence. With an average outpatient attendance of 59,000 per year, hypertension is one of the highest causes of hospital attendance at the FMD, which receives about 1300 hypertensive patient visits per month. In 2017, FMD recorded 14,549 visits for hypertension.

Study population

Adult hypertensive outpatients attending the Polyclinic/FMD clinic of the KBTH for hypertension management participated in the study.

Inclusion criteria

Hypertensive outpatients who were 18 years and above who had been on treatment for at least two months were eligible to be included.

Exclusion criteria

Patients who had difficulty communicating, those with cognitive disorders, patients less than 18 years of age, and those not receiving drug therapy for hypertension were excluded. Patients were not included if it was their second time attending the clinic within the study period.

Sample size and sampling

The minimum sample size for this study was determined using the formulae by Sullivan et al.[22] Per the formulae, minimum sample size for this study was 334.

Systematic sampling was used to include study participants. The first participant was selected by random sampling. Subsequently, every third hypertensive patient meeting the study's inclusion criteria was included until the sample was obtained. The study was conducted in two months.

Data collection

Data were collected using a structured questionnaire. The questionnaire was pre-tested and revised to ensure validity. Clinical pharmacists were recruited as data collectors and trained by the principal investigator. A training manual with illustrations and examples was used to train data collectors. Content of the training manual included data elements, their location in the medical folders, abbreviations, synonyms, and interpretation. Data collectors obtained data on patient

demographics, clinical characteristics, knowledge about hypertension treatment, and adherence to antihypertensive medicines. Data on clinical characteristics were obtained from patient electronic medical records. Data on demographics, hypertension treatment knowledge (HTK), and medication adherence were collected by administering a questionnaire.

Hypertension treatment knowledge was evaluated with a 14-item instrument that tested participants' knowledge on drug therapy and compliance. This instrument was based on the Hypertension Knowledge-Level Scale (HK-LS).[23] After developing the HTK instrument, it was evaluated by hypertension treatment experts (cardiologists and specialist cardiovascular pharmacists) to ensure validity before it was administered. Participants were asked to evaluate each statement in the questionnaire as "correct," "incorrect," or "I do not know." Correct answers were worth one point, wrong answers or "I do not know" were worth zero points. The total score that could be obtained from the HTK questionnaire varied between 0-14, with score increases indicating increased level of hypertension knowledge.

The HB-CHBPT was used to evaluate adherence to antihypertensive medicines.[24] An eight-item medication-taking behaviour sub-scale of the Hill-Bone adherence scale was used in this study.[15, 25] Woode et al. showed that the only influential factor that could be interpreted in acceptability, reliability, and validity analysis of the HB-CHBPT scale in their study of Ghanaian patients was the medication-taking sub scale (Hill-Bone Medication Adherence Scale).[15] Woode et al. used an 8-item scale.[15] The item "How often do you take someone else's hypertensive pills" has shown low total item correlation and factor loading in the scale, with its exclusion increasing the Cronbach's alpha of the scale (Cronbach's alpha = 0.80). Hence, it was excluded to provide an eight-item scale. The scale was scored on four-point Likert scale (1 = none of time, 2 = some of the time, 3 = most of time, and 4 = all the time). A total score ranged from eight to 32 with lower scores indicating better adherence.

During the study period, hypertensive patients were identified during outpatient clinic attendance from the polyclinic portal of the hospital's electronic health system, and their eligibility for inclusion was assessed. Systematic sampling was used to include study participants. To select the first hypertensive patient, random sampling was used, and then every third hypertensive patient who met the inclusion criteria was included. Patients who met the inclusion criteria were then contacted at the clinic (outpatient department) for inclusion by the principal investigator. Codes were assigned to patients selected for the study. The questionnaire was administered after patients had consulted with the doctor. For patients who had prescriptions that were to be dispensed at the polyclinic pharmacy, the questionnaire was administered to them after receiving pharmaceutical services. Consent was sought from participants by first explaining the study to them and allowing them to read, understand, and sign the consent form. At the end of the data collection, a total number of 371 questionnaires had been completed by patients via the data collectors.

Main outcome measures

Hypertension treatment knowledge

Higher scores on the 14-item questionnaire represented higher knowledge and vice versa. Knowledge was classified as low level of knowledge with scores < 8 points; moderate level of knowledge with scores 8 to 11 points; and adequate level of knowledge with scores ≥ 12 points [26].

Adherence to antihypertensive medication

Lower scores on the eight-item scale indicated better adherence. The percentage adherence level per patient was subsequently calculated from the total score divided by maximum score, multiplied by 100. Adherence to antihypertensive medication was categorized as high (100%), moderate (80% to less than 100%), or low (< 80%) in line with previous studies.[27, 28]

Blood pressure control

Blood pressure control was classified based on the 2018 European Society of Cardiology guidelines. Blood pressure of < 140/90 was classified as controlled, and vice versa.[29]

Data analysis

Data were analysed using IBM SPSS Statistics (version 22.0, International Business Machines Corp , Armonk, NY). Descriptive statistics were used to determine frequencies and percentages as well as means and their standard deviations. Inferential statistics were used to test relationships between variables. Confidence intervals and p-values were determined. $P<0.05$ represented statistical significance. The association between categorical variables was tested using Chi square tests. The strength of relationships between dependent binary and other variables was tested using logistic regression. The relationship between continuous dependent and independent variables was tested with linear regression. Multivariate analysis was employed to account for confounding. The relationship between BP control and knowledge was tested using logistic regression. The analysis was then adjusted to account for the influence of confounders (clinical and demographic variables) on adherence in multivariate analysis.

Ethical considerations

Ethical approval (ethical approval number: KBTH-IRB 00069/2023) was sought from the KBTH Institutional Review Board. Patient consent was sought before the participants were recruited. Confidentiality of patient records was ensured and only codes were to identify patient information obtained from the electronic records. Prior to consenting, data collectors ensured that patients were aware that their refusal to participate in the study or complete the interview during the study would not influence their treatment by healthcare

professionals at the hospital. Patients were informed that they had the liberty to withdraw their consent during the interview and that such a decision would not influence his/her care at the facility. Access to study data was restricted to the principal investigator.

Results

Sociodemographic characteristics

Majority of respondents were females (72.8%; n=270). Nearly half of patients (48.5%; n=180) were at least 65 years old. About one fifth of patients had no formal education (20.5%; n=76), while 55% had only basic education (n=204). Most patients (97%; n=360) had national health insurance. About a third of patients (31.5%; n=117) had never had any physical exercise, and 46.6% (n=173) had only exercised their body occasionally. Table 1 has more detail on sociodemographic characteristics of respondents.

Table 1. Sociodemographic characteristics of respondents

Variable	Frequency	Percentage
Sex		
Male	101	27.2
Female	270	72.8
Age		
Young (<50 years)	42	11.3
Middle age (50 – 64 years)	149	40.2
Old age (65 – 79	132	35.6
Very old (80 years and above)	48	12.9
Educational level		
No formal education	76	20.5
Basic	204	55.0
Secondary	57	15.4
Tertiary	34	9.2
Employment status		
Unemployed	223	60.1
Employed	148	39.9
NHIS subscription		
No	11	3.0
Yes	360	97.0
Ever smoked		
No	367	98.9
Yes	4	1.1
Takes alcohol		
No	316	85.2
Yes	55	14.8
Frequency of exercise		
Never	117	31.5
Occasionally	173	46.6
1-2 times	30	8.1
3 times or more	51	13.8

Clinical characteristics of respondents

Majority of respondents (68.4%; n=254) had been hypertensive for five years or more, and 42.3% (n=157) had been hypertensive for more than 10 years. About 39% (n=144) of respondents were diabetic. More than 90% of respondents (93.5%; n=347) had not received antihypertensive medication counselling. More than two thirds of respondents (71.2%; n=264) were treated with two or more antihypertensive drugs. One hundred and two respondents (27.5%) had never self-monitored their BP. One fifth of respondents (76%; n=20.5) used some herbal medication. Table 2 provides greater detail on respondents' clinical characteristics.

Table 2. Clinical characteristics of respondents

Variable	Frequency	Percentage
Duration of hypertension		
2 months to less than one year	37	10
1 year to less than 2 years	18	4.9
2 years to less than 5 years	62	16.7
5-10 years	97	26.1
More than 10 years	157	42.3
Takes herbal medications		
No	295	79.5
Yes	76	20.5
Number of drugs prescribed		
0	2	0.5
1	105	28.3
2	178	48.0
3	65	17.5
4	18	4.9
5	3	0.8
Monitoring of BP at home		
Everyday	38	10.2
Once in a while	106	28.6
Every week	99	26.7
Every month	26	7.0
Not at all	102	27.5
Ever been counselled		
No	347	93.5
Yes	24	6.5
Single pill combination (SPC)		
No SPC	354	95.4
SPC only	4	1.1
Some SPC	13	3.5
Number of other drugs		
0	96	25.9

Variable	Frequency	Percentage
1	95	25.6
2	80	21.5
3	67	18.1
4	22	5.9
5 or more	11	3.0
Have Diabetes		
No	227	61.2
Yes	144	38.8
Blood pressure control		
Controlled blood pressure	171	46.1
Uncontrolled blood pressure	200	53.9

Table 3. Respondent's overall level of knowledge

Level of knowledge	Frequency	Percentage
Low (less than 8)	93	25.1
Moderate (8 - 11)	264	71.2
Adequate (12 and above)	14	3.7

Table 4. Hypertension treatment knowledge level of respondents

Knowledge	Frequency	Percentage
Drugs for high blood pressure must be taken everyday		
Incorrect	11	3.0
Correct	360	97.0
Individuals who have high blood pressure must take their medication only when they feel ill.		
Incorrect	42	11.3
Correct	329	88.7
Individuals who have high blood pressure must take their medication throughout their life		
Incorrect	78	21.0
Correct	293	79.0
Some high blood pressure medicines do not have side effects.		
Incorrect	278	74.9
Correct	93	25.1
Most people with hypertension need more than one kind of blood pressure medicine to control their blood pressure		
Incorrect	195	52.6
Correct	176	47.4
If you are taking medication for high blood pressure, your blood pressure target should be below 140/90		
Incorrect	115	31.0
Correct	256	69.0
Medication is the most effective way to control BP		
Incorrect	41	11.1
Correct	330	88.9
If the medication for high blood pressure can control blood pressure, there is no need to change lifestyles		
Incorrect	65	17.5
Correct	306	82.5
Taking high blood pressure medicines can prevent a high blood pressure patient from getting a stroke		
Incorrect	102	27.5
Correct	269	72.5
If individuals who have high blood pressure change their lifestyles, there is no need for treatment		
Incorrect	370	99.7
Correct	1	0.3
Individuals who have high blood pressure can eat salty foods as long as they take their drugs regularly		
Incorrect	114	30.7
Correct	257	69.3
Individuals who have high blood pressure do not have to take a different brand of their high blood pressure drugs		
Incorrect	163	43.9
Correct	208	56.1
Blood pressure medicines can only be taken in the morning		
Incorrect	137	36.9
Correct	234	63.1
If you have not achieved target blood pressure with the medication you are taking you can stop taking it.		
Incorrect	61	16.4
Correct	310	83.6

Antihypertensive medication adherence among respondents

About 40% of patients (n=148) had high adherence (scored a total of 8 or percentage adherence of 100%). About 16% of respondents (n=59) had low adherence to medication, while 44.2% (n=164) had moderate adherence (Table 5). About a quarter of patients (26.7%; n=99) run out of antihypertensive medication. About 30% (n=108) forgot to take the medicines. The mean adherence score was 9.95 (SD=0.1256). The mean percentage adherence was 91.86 (SD=0.52).

Table 5. Medication adherence of respondents

Adherence	Frequency	Percentage
Low adherence (< 80%)	59	15.9
Moderate (80% to less than 100%)	164	44.2
High (100%)	148	39.39

Relationship between patient's knowledge and blood pressure control

Moderate knowledge of hypertension treatment was associated with a 1.57 times higher odds of BP control, but significance was narrowly missed in logistic regression analysis (COR: 1.57; CI 0.98-2.53). When the analysis was adjusted for confounding, the association between knowledge and BP control was lost (AOR: 1.59, CI 0.90-2.47). Male sex and employment were significantly associated with higher odds of BP control (Male sex OR: 0.53, CI 0.30-0.91; p<0.05; employment OR: 1.73, CI 1.02-2.95, p<0.05) (Table 6).

Table 6. Logistic regression between patient's knowledge and blood pressure control

Knowledge	COR (95% CI)	AOR (95% CI)
Low	Reference	Reference
Moderate	1.57 (0.98-2.53)	1.59 (0.90-2.47)
Adequate	2.19 (0.68-7.03)	2.25 (0.59-8.62)
Age		
Young		Reference
Middle age		0.74 (0.33-1.67)
Old age		0.87 (0.36-2.14)
Very old		0.89 (0.31-2.55)
Sex		
Female		Reference
Male		0.53[a] (0.30-0.91)
Educational level		
No formal education		Reference
Basic		1.05 (0.60-1.90)
Secondary		1.90 (0.86-4.16)
Tertiary		1.35 (0.50-3.65)
Employment status		
Unemployed		Reference
Employed		1.73[a] (1.02-2.95)
Ever smoked		
No		Reference
Yes		0.52 (0.08-3.41)
Takes alcohol		
No		Reference
Yes		1.06 (0.57-1.99)
Frequency of exercise		
Never		Reference
Occasionally		1.47 (0.89-2.42)
1-2 times		1.57 (0.62-3.97)
3 times or more		0.78 (0.37-1.64)

[a]p<0.05

Relationship between socio-demographic, clinical factors and patients' knowledge level

Education level (X^2 16.80; p=0.010), history of counseling on antihypertensive medication (X^2 10.18; p=0.006) and herbal medication (X^2 15.45; p<0.001) had an association with patients' HTK (Table 7).

Table 7. Chi-Square test between socio-demographic characteristics, clinical characteristics and knowledge level of respondents

	Level of knowledge			
Variables	**Low**	**Moderate**	**Adequate**	**Chi-square (p-value)**
Age				8.69 (0.192)
Young	8 (19.1)	33 (79.6)	1 (2.4)	
Middle age	30 (20.1)	112 (75.2)	7 (4.7)	
Old age	44 (33.3)	83 (62.9)	5 (3.8)	
Very old	11 (22.9)	36 (75.0)	1 (2.08)	
Educational level				16.80 (0.010)
No formal education	29 (38.2)	45 (59.2)	2 (2.6)	
Basic	51 (25.0)	145 (71.1)	8 (3.9)	
Secondary	10 (17.5)	43 (75.4)	4 (7.0)	
Tertiary	3 (8.8)	31 (91.2)	0 (0.0)	
Takes herbal medications				15.45 (<0.001)
No	61 (20.7)	221 (74.9)	13 (4.4)	
Yes	32 (42.1)	43 (56.6)	1 (1.3)	

	Level of knowledge			
Variables	**Low**	**Moderate**	**Adequate**	**Chi-square (p-value)**
Ever been counselled				10.18 (0.006)
No	92 (26.5)	224 (70.3)	11 (3.2)	
Yes	1 (4.2)	20 (83.3)	3 (12.5)	
Number of drugs prescribed				10.86 (0.369)
0	1 (50.5)	1 (50.0)	0 (0.0)	
1	30 (28.6)	74 (70.5)	1 (1.0)	
2	39 (31.9)	131 (73.6)	8 (4.5)	
3	21 (32.3)	40 (61.5)	4 (6.2)	
4	2 (11.1)	15 (83.3)	1 (5.6)	
5	0 (0.0)	3 (100.0)	0 (0.0)	

Relationship between knowledge level and adherence

In logistic regression analysis, respondents' knowledge was significantly associated with their adherence to antihypertensive medication. Moderate knowledge was 4.73 times more likely to result in adherence than low knowledge (COR: 4.73; CI 2.49-9.01; p<0.001) (Table 8). When the regression model was adjusted for confounding, moderate knowledge was 5.86 times more likely to result in adherence to antihypertensive medication than low knowledge (OR: 4.73; CI 2.75-12.51 p<0.001). In the multivariate analysis, tertiary education predicted adherence (OR: 0.26; CI 0.07-0.95; p<0.05). Males were more likely to adhere to treatment than females.

Relationship between adherence and blood pressure control

Antihypertensive medication adherence was significantly associated with BP control in logistic regression analysis. Higher medication adherence (adherence ≥ 80%) was 1.98 times more likely to result in BP control than lower adherence (COR: 1.98; CI 1.03-3.80; p<0.05) (Table 9). Similar results were obtained from adjusted odds ratios (AOR: 2.10; CI 05-4.18; p<0.05). Except respondent's sex, demographic factors were not significantly associated with BP control. Male patients were 1.88 times more likely to have BP control than females (AOR: 1.88; CI 1.03-3.28; p<0.05).

Table 8. Logistic regression between knowledge level and adherence

Knowledge	**COR (95% CI)**	**AOR (95% CI)**
Low	Reference	Reference
Moderate	4.73[b] (2.49-9.01)	5.86[b] (2.75-12.51)
Adequate	5.05 (0.63-40.65)	4.91 (0.57-41.98)
Age		
Young		Reference
Middle age		1.13 (0.37-3.47)
Old age		1.33 (0.54-5.24)
Very old		2.14 (0.46-10.01)
Sex		
Female		Reference
Male		1.34 (0.61-2.93)
Educational level		
No formal education		Reference
Basic		0.82 (0.32-2.12)
Secondary		0.89 (0.25-3.15)
Tertiary		0.26[a] (0.07-0.95)
Employment status		
Unemployed		Reference
Employed		1.31 (0.54-3.23)
Ever smoked		
No		Reference
Yes		1.42 (0.98-2.07)
Takes alcohol		
No		Reference
Yes		1.12 (0.52-2.44)
Frequency of exercise		
Never		Reference
Occasionally		1.12 (0.52-2.44)
1-2 times		2.59 (0.55-12.12)
3 times or more		1.06 (0.30-3.76)

[a]p<0.05; [b]p<0.001

Table 9. *Logistic regression between adherence and BP Control*

Adherence	COR (95% CI)	AOR (95% CI)
Adherence less than 80%	Reference	Reference
Adherence ≥ 80%	1.98[a] (1.03-3.80)	2.10[a] (1.05-4.18)
Age		
Young		Reference
Middle age		1.33 (0.60-2.94)
Old age		1.22 (0.51-2.93)
Very old		1.08 (0.39-3.00)
Sex		
Female		Reference
Male		1.88[a] (1.03-3.28)
Educational level		
No formal education		Reference
Basic		0.90 (0.51-1.58)
Secondary		0.47 (0.21-1.04)
Tertiary		0.72 (0.27-1.90)
Employment status		
Unemployed		Reference
Employed		0.60 (0.35-1.01)
Ever smoked		
No		Reference
Yes		1.79 (0.25-12.63)
Takes alcohol		
No		Reference
Yes		0.98 (0.51-1.89)
Frequency of exercise		
Never		Reference
Occasionally		0.68 (0.41-1.12)
1-2 times		0.56 (0.22-1.39)
3 times or more		1.19 (0.58-2.45)

[a]p<0.05

Discussion

In this study, most patients had inadequate knowledge about hypertension treatment. Majority of patients did not adhere to their antihypertensive treatment and BP was uncontrolled in more than half of patients. Knowledge was not significantly associated with BP control but was significantly associated with medication adherence. Medication adherence significantly predicted BP control.

This study showed gaps in patients' knowledge about hypertension treatment. This finding is consistent with those found in some other studies.[15,17,20,30,31] Four studies, including recent reports, showed low to moderate hypertension treatment knowledge.[17,20,30,31] Sudharsanan et al. reported 23-57% knowledge among hypertensive patients.[17] In primary and specialized care hospitals in Spain, Estrada et al. reported that nearly 60% of hypertensive patients did not know that antihypertensive drugs should be taken for life.[32] Two studies reported antihypertensive medication knowledge in about one third to 70% of patients.[20,31] The authors showed that two-thirds of patients had good or adequate knowledge.[20,31] Gaps in hypertension treatment knowledge has been reported in Ghana. A recent study in a university hospital in Ghana showed 54-80% antihypertensive medication knowledge.[15] Nyantakyi et al. found high knowledge of hypertension treatment in only half of patients studied at a teaching hospital in Ghana.[33] Available evidence shows that gaps in knowledge about hypertension treatment may be influenced by demographic factors and healthcare provider communication of information. Inadequate patient education and counseling can contribute to poor patient knowledge. In settings where healthcare professionals are burdened with heavy workload, hypertensive patients may not have adequate contact for counseling. Gaps in healthcare professional continuing training on non-pharmacological management of hypertension probably contributes to poor patient knowledge. Patient education level has been reported as a determinant of hypertensive patient knowledge.[34] Family history and duration of treatment for hypertension may also account for hypertension treatment knowledge scores.[35] In our study, education level and use of herbal medication were associated with level of hypertension treatment knowledge. This finding corroborates what Chimberengwa et al. found in their study of hypertensive patients in Zimbabwe.[36] In our study, an important association was found between a previous antihypertensive medication counseling status of patients and level of knowledge about treatment. These findings throw light on the need for healthcare providers to educate and counsel hypertensive patients on their medication. Therapeutic patient education involves the patient competency framework which has three key domains including knowledge. Health professionals need to use language that is appropriate for different patients' needs.

Majority of patients in this study did not adhere to their antihypertensive medication. Several studies have shown sub-optimal antihypertensive medication adherence among patients.[7,8,12-14,17] In several studies, less than 50% rate of antihypertensive medication adherence was reported.[7,12-14] Although some studies reported higher than 50% adherence, this rate was found to be sub-optimal.[15-17] In Ghana, the work of Boima et al. showed low medication adherence. Prior to this, Kretchy et al. had reported good adherence in less than 10% of hypertensive patients.[7,13] Adomako et al. found low rates of BP medication adherence at a tertiary and secondary facility in Ghana.[12] Some authors, however, have reported high medication adherence among hypertensive patients.[9,15] Woode et al. and Sarkodie et al. reported good medication adherence among hypertensive patients in Ghana.[9,15] The contrary findings suggest that adherence to medication varies between levels of care. Similar to our study, Adomako et al. conducted their study in a tertiary hospital. Woode et al. and Sarkodie et al., on the other hand, conducted their study in non-tertiary facilities. Patients at tertiary facilities are likely to

receive more complex treatment or higher number of medicines to treat comorbidities. The high antihypertensive pill burden in our study may account for the low adherence found in this study. Although more than 70% of patients were taking two or more antihypertensive drugs, only 5% of patients were receiving a single-pill combination. Half of patients were receiving two or more concomitant drugs. This significant pill burden could result in low adherence to antihypertensive medication. Economic, therapy-related, health system-related, patient-related and condition-related factors may account for poor adherence.[13,18] Therapy-related factors such as complexity of the prescribed treatment regimen influence antihypertensive medication adherence. In one study, adherence to treatment was strongly influenced by the number of pills prescribed for hypertension. Non-adherence was usually <10% with a single pill. However, this rose to 20% with two pills and 40% with three pills, and it was very high in patients receiving five or more pills.[37] Adverse effects of antihypertensive medication and the need for long term (life-long) medication use may lead to discontinuation of antihypertensive medication by patients.[17,38] Health system-related factors such as challenges in access to medicines, inadequate use of team-based care, lack of quality improvement support or gaps in clinician expertise, healthcare professional burn-out and poor clinician-patient relationship could account for non-adherence among patients in this study. Although most patients had subscribed to national health insurance, access to medicines may be a challenge in public hospitals in low and middle-income settings such as Ghana.[39] This leads to the need for out-of-pocket payments in private facilities.[11] The likely outcome of such a challenge in a resource-limited setting is that patients may not obtain their medication. Low health literacy, poor language proficiency and lack of social or family support probably contributed to the low proportions of "high adherence" found in this study. Psychological and behavioural factors, cognitive and mobility impairment (especially in elderly patients), health beliefs and perceived benefit of treatment and susceptibility to disease, and long waiting times may also contribute to non-adherence.[14] Boima et al. found an association between depression and antihypertensive medication non-adherence.[7] They showed a relationship between herbal medication use and non-adherence. Multi-morbidity often leads to polypharmacy, which contributes to non-adherence. While socio-economic, therapy-related, health system-related, patient related and condition-related factors may account for low adherence, our study showed a relationship between education level and adherence. This finding provides insight into interventions for improving antihypertensive medication adherence.

Majority of patients had uncontrolled BP in our study. Globally, BP control rates are low.[2,6] Less than half of hypertensive patients achieve BP control.[2,40] Chow et al. in an earlier study showed that globally, about 35% of treated hypertensive patients achieve an SBP < 140mmHg and DBP < 90mmHg.[2] Results from our study show a higher rate of BP control than recently reported global BP control rates among hypertensive patients in 2019, which were 23% for women and 18% for men.[40,41] Previous studies in Ghana reported hypertension control rates similar to our findings.[7-12] This study shows higher BP control rate compared to rates in non-tertiary (lower level) facilities.[6] BP control rates found by Boima et al. at a tertiary hospital in Ghana in 2015 were lower than what was found in our study, suggesting that BP control has probably improved. Various factors may have accounted for the low BP control found in this study.[7,8,10-12] Sub-optimal adherence to medication which was found in this study may have accounted for low BP control. We also found a high pill burden resulting from the use of multiple antihypertensive and concomitant prescribed medicines among patients. This may also account for the low BP control because high pill burden is associated with medication non-adherence. Sub-optimal treatment intensification by physicians, pill burden, or drug choice as well as limited access to medicines have been reported to influence BP control and may explain the low BP control.[8,14] Male patients were more likely to have controlled BP in our study. This reflects a similar relationship between male sex and antihypertensive medication adherence in our study. Medication adherence was shown to be associated with BP control in our study. Males may be more educated and employed than females in Sub-Saharan Africa. This probably explains why we found males to more likely to adhere to treatment.

Knowledge of hypertension treatment was associated with adherence in this study. The association between HTK and medication adherence has been reported in literature.[9,15,18-21] Sudharsanan et al. showed that patients who had knowledge that BP medication use was the most effective way to reduce their BP were more likely to adhere to their medication.[17] Sarkodie et al. and Woode et al. reported a link between knowledge and antihypertensive medication adherence in hospitals in Ghana.[8,15] Hamrahian et al. in their review showed that poor understanding or lack of knowledge is one of the patient-related factors that influence adherence.[42] The influence of knowledge of antihypertensive medication on adherence may however, differ depending on the content of the knowledge assessment tool. In one study, knowing the name and duration of use of the antihypertensive medicine was not significantly associated with adherence.[16] The relationship between knowledge and adherence suggests that interventions for improving medication adherence among hypertensive patients need to take patient education into consideration.

The relationship between adherence to antihypertensive medication and BP control reflects previous study reports and underscores the importance of interventions to improve adherence. Recently, Adomako et al. reported a relationship between medication adherence and BP control in two hospitals in Ghana.[12] Earlier, the relationship between

adherence and BP control had been shown by Boima et al.[7] Cummings et al. and Yul et al. have also shown the positive relationship between adherence to BP-lowering medication and control of BP. These findings suggest that adherence to antihypertensive medication is becoming a more important factor for BP control.[43,44] Despite substantial evidence of the influence of medication adherence on BP control, however, some studies suggest that failure of physicians to intensify drug therapy regimen (clinical inertia) may be a stronger contributor to uncontrolled BP than hypertensive patient non-adherence to pharmacotherapy.[45] For example, a study in two US health systems showed that whereas an association was found between treatment intensification and BP control, medication adherence was not associated with BP control.[46] This conflicting evidence reflects literature findings that BP control is influenced by more than one factor. The 2018 European Society of Cardiology hypertension guidelines highlighted non-adherence, complexity of treatment and treatment inertia as factors which clinicians needed to address to achieve better BP control.[47] The significant pill burden found in our study is likely to contribute to the sub-optimal BP control among patients. In our study, more than two-thirds of patients were taking two or more antihypertensive drugs and more than half were taking two or more concomitant medicines. However, only 5% were taking single-pill combination drugs. In our previous study, we showed a relationship between pill burden and BP control.[48]

Although hypertension treatment knowledge predicted medication adherence, it did not significantly influence BP control. Some studies have also reported a lack of association between knowledge and BP control among hypertensive patients.[26,49] A cross-sectional study of hypertensive patients in South Africa reported a lack of relationship between antihypertensive treatment knowledge and medication adherence.[50] There are, however, conflicting findings from some studies showing a relationship between hypertension treatment knowledge and BP control.[20,51,52] Differences in knowledge measurements may account for differing findings in these relationship tests. While some studies used validated specific knowledge assessment tools, others did not. The conflicting finding probably also reflects differences in baseline characteristics that have a potential to influence BP control.

Limitations of the study

This study was conducted at a single centre of the hospital. This may limit generalizability of the findings. Future studies need to include other centres in the hospital. This study did not investigate BP medication access which may influence adherence and BP control. The study excluded patients with inability to communicate and cognitive disorders. This may affect generalizability of results on adherence. The small size of some groups in the number of drugs and knowledge variables may influence power of the test of association. A large proportion of patients in this study had only basic education or no formal education. Our findings may need to be interpreted in this context.

Conclusion

Most patients had inadequate knowledge about hypertension treatment. There was significant non-adherence to antihypertensive medication and BP control was low. Knowledge was not significantly associated with BP control but was significantly associated with medication adherence. Medication adherence significantly predicted BP control. These findings underscore the need for facility contextualized interventions that address gaps in antihypertensive medication knowledge and adherence. There is more room for improving BP control. These findings also suggest the need for patient care providers to prioritize patient education and counseling in the management of hypertension. Studies in this patient population to determine the most effective educational intervention delivery should be urgently conducted. Further research on the influence of hypertension treatment knowledge on BP control is needed.

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