SUBOPTIMAL TARGET BLOOD PRESSURE CONTROL AND ITS ASSOCIATION WITH THE SOCIODEMOGRAPHIC AND CLINICAL PROFILES OF HYPERTENSIVES ATTENDING A TERTIARY LEVEL HOSPITAL IN ADDIS ABABA, ETHIOPIA

Daniel Mengistu Bekele[1*], Rebecca A Gary[2], Dejuma Yadeta Goshu[3], Alemayehu Worku Yalew[4], Melinda K Higgins[2]

[1]Department of Nursing, Addis Ababa University, Ethiopia. Email: mengistudaniel@yahoo.com,* P. O. Box: 4412, Tele: +251-911119597,
[2]Nell Hodgson Woodruff School of Nursing, Emory University, USA. Email: ragary@emory.edu; mkhiggi@emory.edu
[3]Department of Internal Medicine, Addis Ababa University, Ethiopia. Email: dejuya@yahoo.com
[4]Department of Epidemiology and Biostatics, Addis Ababa University, Ethiopia. Email: alemayehuwy@yahoo.com

Corresponding Author:
mengistudaniel@yahoo.com

Abstract

Background: *Hypertensives' target blood pressure control remains suboptimal in many countries worldwide. Hence, determining patients' factors affecting target blood pressure control is critical.*

Objective: *The objective of study was to examine hypertensives' target blood pressure control and its associations with their sociodemographic and clinical characteristics.*

Methods: *The study employed a cross-sectional design. For the face-to-face data collection with standardized questionnaires, 384 hypertensives attending a tertiary-level hospital were selected using a systematic random sampling technique. Descriptive statistics were used to determine the target blood pressure control status and bivariate chi-square test and binary logistic regression were used to identify factors significantly associated with the target blood pressure control.*

Results: *The study consisted of nearly equal proportions of male (51.2%) and female (48.8%) participants with a mean age (±SD) of 53.61 ±12.34 years. Only 45.1% had achieved target blood pressure control. Absence of comorbidity (AOR = 1.911, 95% CI: 1.256, 2.908, p = .002), good medication adherence (AOR = 2.535, 95% CI: 1.078, 5.960, p = .033), and normal body mass index (AOR = 1.675, 95% CI: 1.094, 2.564, p = .018) were factors significantly associated with the achievement of the target BP control.*

Conclusion: *Intervention targeting hypertensives' body weight control, early comorbidity screening and management, and strict adherence to antihypertension medication may improve patients' blood pressure control status and should be among the priority of the hypertension care clinic specialists' team.*

Keywords: *Hypertension, blood pressure control, body mass index, comorbidity, clinical profile.*

INTRODUCTION

The prevalence of hypertension (HTN) is high with approximately 1.3 billion of the world's adult population affected [1] and is estimated to exceed 1.5 billion by 2025 [2,3]. Although the prevalence of HTN is slightly decreasing in high-income countries (HICs) with an estimated 349 million people, in contrast, it is rapidly increasing in low and middle-income countries (LMICs) with an estimated 1.04 billion people living with it currently [2]. In Sub-Saharan Africa (SSA), HTN currently affects over 20 million people and is the leading cardiovascular disease (CVD) risk factor, and is the most common reason for hospitalizations with poor clinical outcomes [4,5]. In Ethiopia, the prevalence of HTN is estimated to be between 13-30% [6,7] and is directly linked to higher CVD morbidity and mortality [5]. According to the Framingham Heart Study, individuals with a normal BP at the age of 55 years (men) and 65 years (women) have a 90% lifetime risk for developing HTN [8], which suggests that there will be an increase in the number of persons with HTN and with improving longevity an increase in the number of elderly adults at risk for adverse CVD outcomes.

Uncontrolled BP is the strongest contributor to adverse CVD outcomes (such as stroke, coronary heart disease [CHD], and heart failure [HF]) [9,10]. Of the major cardiovascular (CV) events; 51% and 45% of stroke and CHD deaths, respectively, occurred due to HTN [11] with an overall huge (80%) CVD burden occurring in LMICs [11]. In Addis Ababa, Ethiopia, of 51% of total adult noncommunicable diseases (NCDs) deaths, CVD was the leading one (24%) with most of these deaths occurring in young and middle-aged adults) [12] mainly due to uncontrolled BP [13] indicating that with the dramatic rise of CVD, Ethiopia will continue to bear a large disease burden [14,15]. Furthermore, among persons diagnosed with HTN in Ethiopia, up to 40% were reportedly non-adherent to pharmacological therapy, and in some studies, up to 80% had uncontrolled BP [16,17] indicating a high risk for adverse CVD outcomes.

The main goal of early HTN detection, therapy, and target BP control is to reduce the risk of CVD events in the hypertensive population. High BP has been shown to hasten the progression of atherosclerosis and destabilize vascular lesions, precipitating acute coronary events and directly causing myocardial ischemia (MI) even in the absence of CHD [18]. Even among patients with comorbidities like diabetes, early BP control in the first year following HTN start was associated with improved benefits and fewer major CV events [19] compared to patients with uncontrolled BP, who had significantly higher rates of major CV events (RR = 1.30, 95% CI: 1.01–1.69, P = 0.04) [19].

In many countries, the target BP control rate for hypertensives is still suboptimal. Unsatisfactory BP control rates (33% and 38% in HICs and LMICs, respectively) were seen in observational studies and a systematic review that examined the differences in HTN prevalence, its management and control across LIMICs and HICs countries. [20,21]. In Ethiopia, previous researches reported a suboptimal BP control rate among hypertensives despite being on pharmacological treatment and follow-up mostly in secondary level hospitals [17,22–24]. In general, inadequate education, low medication adherence, a poor of understanding of the goal BP, drug side effects, and inadequate support from medical professionals were the main causes of poor high BP control [20].

The rate of target BP control among patients with HTN and its association with the patients' sociodemographic and clinical profiles were not examined in previous studies, particularly among those receiving referral and tertiary level outpatient clinic care in Addis Ababa, Ethiopia. A better recognition of patients' sociodemographic and clinical characteristics that contribute to BP control are important for hypertension care clinic team to direct patient tailored interventions to achieve target BP control and avoid adverse CVD outcomes.

OBJECTIVES:

1. To examine the target blood pressure achievement status among hypertensives attending tertiary level hospital in Addis Ababa, Ethiopia.
2. To identify the demographic and clinical variables strongly associated with target blood pressure achievement among hypertensives attending tertiary level hospital in Addis Ababa, Ethiopia.

METHODS AND MATERIALS

Study design and setting

The cross-sectional study design was used. The study was conducted at a large academic and tertiary level Tikur Anbessa Specialized Hospital (TASH) in Addis Ababa, Ethiopia, and data were collected between February and August 2020.

Participants and eligibility criteria

The study participants were adult hypertensives attending to the outpatient Cardiac Clinic follow-up care of TASH. the inclusion criteria were: age of 30-year or older; a minimum of three follow-up visits in the clinic; the ability to hear and respond to questions in the local language (Amharic). The exclusion criteria were: pregnancy, active psychiatric condition, and aphasia.

Sample size determination

The sample size was determined based on one sample t-test (as the below formula) since it was part of the main Ph.D. dissertation project with the assumptions of observations are independent; data fit the normal distribution; homogeneity of variance and the power set at 0.80 (β=0.2) and α (two-sided) set at 0.05 and standardized effect size of 0.15 (small) [25] and considering a further 10% non-response rate for potential missing data due to the interview format.

Sample size, n = $(Z\alpha/2 + Z\beta)2/d2$
Where $Z_{\alpha/2} = 1.96$ (from Z table) at type 1 error of 5%
$Z_{\beta} = Z_{0.20} = 0.842$ (from Z table) at 80% power
ES^2 = effect size (small, 0.15)
$n = (1.96+0.842)^2/(0.15)^2 = 348.94 + 35$ (10% non-response) = 384

Sampling technique
The hypertensive patient clinic follow-up registry list containing 1200 patients was used to choose the sample using the systematic random sampling technique.

Data collection technique and data quality assurance procedure
Three research assistants who are Bachelor's degree holder and trained for two days on methods of data collection collected the data. Data were collected in a prearranged private room through a face-to-face interviewer-administered using the standardized instruments. To ensure the data quality, all instruments were translated from their original English language to the local language (Amharic) and then back to English by professional translators. The instruments were pilot tested in 10% of the Ethiopian hypertensive patients at a similar tertiary level hospital to determine potential participants' understanding of content included on the questionnaires. The principal investigator monitored the data collection process and checked for data completeness, consistency, and accuracy daily.

Variables and their measurements
Independent variables: Sociodemographic: Participants self-reported information on age, gender, marital status, level of education, and income on the interview questionnaire.
Clinical profiles: Participants' self-reports on the interview questionnaire and reviews of their medical records provided information on co-morbidities, prior CVD-related hospitalization, antihypertensive medicines, and family history of HTN. Participants' BP, height, weight, were measured with precision. The body mass index (BMI Kg/M^2) was computed and values were classified using the Centers for Disease Control and Prevention (CDC) system [26]. Lipid data (total cholesterol, triglyceride, HDL-c, and LDL-c values of the last 12 months), and current FBG, values were obtained from the patient's medical records.
Patient Health Questionnaire nine (PHQ-9): Screening for depressive symptoms was assessed by the PHQ-9 Amharic language (local language) version [27]. The tool has an internal consistency of Cronbach's alpha 0.85. Scores range from 0 to 27. A score of 10 or higher reflects moderate depressive symptoms while a score of ≥20 indicates severe symptoms.
Dependent variable: Target blood pressure control: The BP was measured five minutes after participants completed the interview questionnaire, sitting in an armchair and feet flat on the floor using normal cuffs for adult standardized aneroid sphygmomanometer by auscultatory method at the right brachial artery. Two readings were taken five minutes apart. If the two readings varied by more than 5 mmHg a third reading was obtained. The average of the last two readings was used for the analysis. Values were interpreted as target BP controlled if: SBP <140 mmHg (<130 mmHg for patients with diabetes and chronic kidney disease [CKD]), DBP <90mmHg (<80 mmHg for patients with diabetes and CKD), and target BP uncontrolled if SBP ≥140 mmHg (≥130 mmHg for patients with diabetes and CKD), DBP >90 mmHg (>80 mmHg for patients with diabetes and CKD) based on current Ethiopian HTN management protocol and other international current practice recommendations [28].

Statistical analysis
Epidata version 3.1 was used to cleaned data and SPSS version 25.00 statistical software package was used for the analysis.
Descriptive: univariate analysis was run to examine data and its plausible values, and assumptions of the logistic regression model, and to measure the variability in participants sociodemographic and clinical characteristics.
Inferential: Chi-square test was used to examine the association between sociodemographic and clinical profiles with target BP control. Variables that had p-values < 0.25 in the bivariate chi-square test analyses were moved into the final binary logistic regression model to ascertain predictors of target BP control. Variables with a p-value of < 0.05 level in the final regression model were considered statistically significant. Odds ratio (OR) at 95% CI was considered to declare that there exist the predictor variable effects on the target BP control. The findings are summarized in tables, graphs and text.

Ethical clearance
The study was approved by the institutional review board (IRB) of the College of Health Sciences of Addis Ababa University (AAU) (IRB protocol # 09/81). All participants reviewed and provided a signed consent before any study activities.

RESULTS
Data from 377 (98.18%) of the 384 participants were included in the analysis. Based on PHQ-9 scores of ≥20, data from seven participants were omitted from the study due to the likelihood of data bias. Men (51.2%, n=193) made up slightly more than half of the participants. The participants' mean age (± SD) was 53.61±12.34 years (range, 30-82 years). The mean age (± SD) at the time of the HTN diagnosis was 45.60±12.57 years that suggests young age HTN onset. Less than half (45.1%) of the participants achieved target SBP control while 66.84% achieved target DBP control. Overall, the proportion of patients with both systolic and diastolic BP control was low (45.1%). The mean (± SD) and median duration

of HTN were 8.01 ± 6.07 and 6 years, respectively, (range, 1-30 years). Data of the sociodemographic and clinical characteristics of participants are shown in Table 1 below.

Table1. ***Sociodemographic and clinical characteristics of the participants (n=377).***

Characteristics	Frequency	Percentage
Age category		
30-39	56	14.9
40-59	188	49.87
≥ 60	133	35.2
Gender		
Male	193	51.2
Female	184	48.8
Marital status		
Single	52	13.8
Married	284	75.3
Divorced	21	5.6
Widowed	20	5.3
Educational status		
Cannot read and write	26	6.9
Elementary	135	35.8
High school	133	35.3
Diploma & above	83	22
Monthly income in ETB		
< 1000	118	31.3
1000-3000	179	47.5
3001-6000	60	15.9
≥ 6001	20	5.3
Family history of HTN		
Yes	144	38.20
No	233	61.80
Physician visit frequency		
Every month	20	5.3
Every 2 months	272	72.1
Every 3 months	53	14.1
Every 4 months or longer	32	8.5
Target BP controlled		
SBP: Yes	170	45.1
No	207	54.9
DBP: Yes	252	66.8
No	125	33.2
Duration of HTN in years		
1-4	132	35.0
5-9	109	28.9
10-14	71	18.8
15-19	32	8.5
20-24	26	6.9
25+	7	1.9
BMI		
Normal weight	151	40.0
Overweight	171	45.4
Obese	55	14.6
Source of information on the seriousness of HTN		
Physician	289	76.7
Nurse	65	17.2
Media	7	1.8
Others	16	4.2
Comorbidity list (total 212)		
Diabetes	102	48.11
HHD	28	13.21
CKD	23	10.85
Others	59	27.83
Number of current BP medications		
One	138	36.60
Two	172	45.60
≥3	67	17.80
Adherence to med		
No	30	92.04
Yes	347	7.06

Note: *Target BP controlled (<140/90 mm Hg, or <130/80 mm Hg if CKD and/or diabetes); CI (confidence interval).*

Slightly over a third of participants had been diagnosed in the last 4 years. Overall, a staged pattern decline was observed as the duration of HTN extends. The proportion of patients with the duration of 14 and beyond years were remarkably low (Figure1).

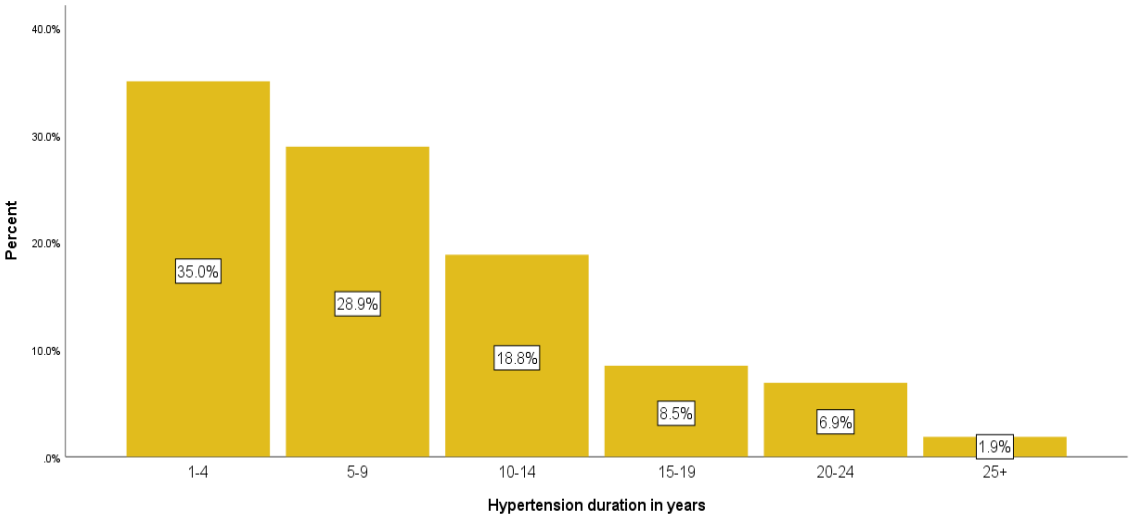

Figure 1. **Bar graph showing participants hypertension duration since diagnosis (n = 377).**

The overall target BP control rates were much higher among patients with HTN alone and/or having comorbidities other than diabetes or CKD. In fact, hypertensives with diabetes and CKD comorbidities had worse target control rates in both the systolic and diastolic BP. This observation is illustrated in the below bar graph (Figure 2).

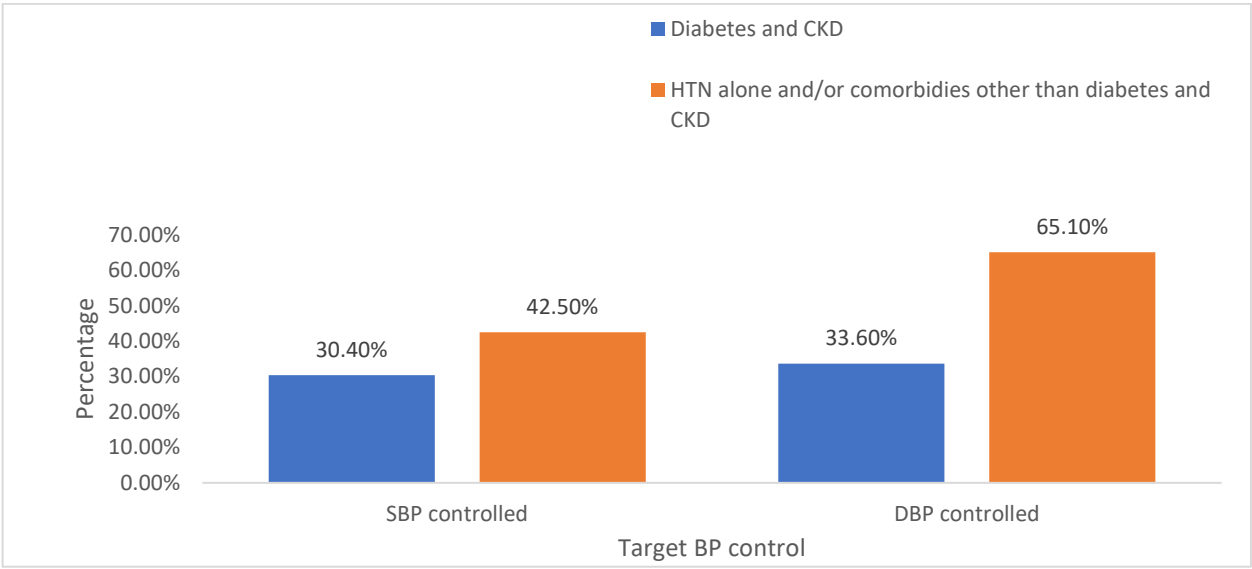

Figure 2. **Target SBP and DBP achieved among hypertensives with diabetes and CKD Vs those with HTN alone and/or comorbidities other than diabetes and CKD (n = 377).**

Fewer than half (57%) of patients had a record of their lipid profile check (Table 2). The mean (±SD) HDL-c level was 44.58 ± 12.64. The mean (±SD) LDL-c level exceeded the normal range 116.51 ± 43.08. The mean (±SD) FBG was 152.78 ± 53.92 showed the existence of uncontrolled glycemia among patients with comorbid diabetes, the data are depicted in Table 2.

Table 2. ***Study Participants' Clinical profiles***

Variable	N	Median	Mean ± SD	95% CI
Body weight (Kg)	377	70.00	69.97 ± 11.71	68.78, 71.15
Height (Cm)	377	165.00	164.02 ± 9.04	163.10, 164.94
BMI (Kg/M^2)	377	25.71	26.02 ± 4.09	25.61, 26.44
TC (mg/dl)	215	182.00	193.16 ± 83.39	181.95, 204.37
TG (mg/dl)	215	142.00	167.65 ± 103.16	153.78, 181.52
HDL-c (mg/dl)	215	42.00	44.58 ± 12.64	42.88, 46.27
LDL-c (mg/dl)	215	114.00	116.51 ± 43.08	110.72, 122.30

FBG (mg/dl)	102	140.00	152.78 ± 53.92	142.19, 163.37
Clinical Status	**n**	**%**		
BMI	377			
Overweight	171	45.1		
Obese	55	14.6		
TC	215			
>200mg/dl	80	37.2		
TG	215			
>150mg/dl	90	41.9		
HDL-c male	113			
<40mg/dl	49	43.4		
HDL-c female	102			
<50mg/dl	63	61.8		
HDL- both sexes	215			
>60mg/dl	20	9.3		
FBG	102			
>100mg/dl	87	85.3		

BMI (body mass index), TC (total cholesterol), TG (triglyceride), HDL-c (high density lipoprotein cholesterol), LDL-c (low density lipoprotein cholesterol), FBG (fasting blood glucose, SD (standard deviation), CI (confidence interval)

Table 3. ***Bivariate chi-square test showing the association between participants target BP control and their sociodemographic and clinical variables (n = 377)***

	Target BP		**χ^2**	**df**	**p - value**
Variable	**Controlled n (%)**	**Uncontrolled n (%)**			
Gender					
Male	79 (40.9)	114 (59.1)	2.764	1	.096
Female	91 (49.9)	93 (50.5)			
Age					
Young adult	31 (18.2)	25 (12.1)	2.807	2	.245
Middle age	81 (47.6)	107 (51)			
Elder	58 (34.1)	75 (36.2)			
Family history of HTN					
Yes	58 (34.1)	86 (41.5)	2.182	1	.140
No	112 (65.9)	121 (58.5)			
Hospitalization related to HTN					
Yes	37 (21.8)	56 (27.1)	1.405	1	.236
No	133 (78.2)	151 (72.9)			
No of current BP medication					
One	73 (42.9)	65 (31.4)	5.631	2	.060
Two	68 (40)	104 (50.2)			
Three or more	29 (17.1)	38 (18.4)			
Medication adherence					
Adherent	162 (95.3)	8 (4.7)	4.470	1	**.035***
Not adherent	185 (89.4)	22 (10.6)			
BMI					
Normal	80 (47.1)	71 (34.3)	6.329	1	**.012***
Overweight/obese	90 (52.9)	136 (65.7)			
Frequency of clinic follow-up					
Every month	10 (5.9)	10 (4.8)	6.604	3	.086
Every 2 months	132 (77.6)	140 (76.6)			
Every 3 months	17 (10)	36 (17.4)			
Every 4 months/longer	11 (6.5)	21 (10.1)			
Comorbidity					
Yes	80 (47.1)	132 (63.8)	10.589	1	**.001***
No	90 (52.9)	75 (36.2)			

*χ^2 (chi-square), df (degree of freedom), * bold figures indicate significant p-values.*

Independent variables with a p-value of < .25 in the chi-square test (Table 3) were transferred to a stepwise forward approach binary logistic regression to determine their effects on the probabilities that they have on the target BP control. The logistic regression model was statistically significant, Omnibus Test of Model Coefficient, $\chi^2(3) = 20.79$, $p < .000$. The Hosmer and Lemeshow Test of Model Fit also produced a nonsignificant value, $\chi^2(4) = .73$, $p = .947$ that means there was no difference between the observed and predicted model indicating the model adequately fits the data. History of no comorbidity, medication adherent, and normal BMI were statistically significant predicators of the target BP control in the adjusted regression model (Table 4).

Table 4. ***Binary logistic regression showing participants' predictors of the target BP control.***

Variable	AOR	95% CI	p -value
Comorbidity			
No	1.911	1.256 - 2.908	.002
Yes	Reference		
Medication adherence			
Adherent	2.535	1.078 - 5.960	.033
Non adherent	Reference		
BMI			
Normal	1.675	1.094 - 2.564	.018
Overweight/obese	Reference		

CI = confidence interval; AOR= adjusted odds ratio. In adjusted for gender (male/female, referent: male), age category (young adult, middle age adult, older; referent: young adult), clinic follow-up (every month, every 2 months, every 3 months, every 4 months or longer; referent: every 4 months or longer), number of current BP medications (one, two, three or more; referent: one), hospitalization related to HTN (yes/no; referent: no), family history of HTN (yes/no; referent: no), comorbid diabetes and/or CKD present (no/yes; referent: yes), medication adherence (adherent/not adherent; referent: not adherent), BMI (normal/overweight or obese: referent: overweight or obese)

DISCUSSION

Achievement of target BP control is crucial to avert CVD in hypertensives. In this study, adult hypertensives getting specialized follow-up care were assessed for target BP control status and its relationships with their sociodemographic and clinical characteristics. The main findings were low target BP control achievement and that characteristics including normal BMI, absence of comorbid diabetes and/or CKD, and strict medication adherence were significantly related to achieving target BP control of participants.

In the present study, despite participants were receiving specialists' treatment and care, the target BP control rates were poor, especially for SBP, and did not differ by gender (p =.196). The findings are alarming since patients were being referred from general and community level hospitals when they failed to achieve optimal BP control and possibly had complicating conditions for their referral. The present finding is consistent with plenty of studies that have documented lower rates of target BP control among hypertensives receiving long-term follow-up care from hospitals [29,30]. The lower rate of BP control among hypertensives found in the current study and in several other earlier studies suggests that the problem was perennial and unwelcome, necessitating due consideration for the reduction of the harmful end of CVD caused in particular by the uncontrolled SBP. After the age of 50-year, SBP control is more crucial than DBP as a major CVD risk factor [31]. The different rates of target BP control between systolic and diastolic BP that we observed in our study are in line with several important findings from clinical trials and observational data that consistently showed that the target SBP control was less consistently attained than the target DBP control and that the poor SBP control was largely responsible for the overall low-rate target BP control [32]. This is mainly due to managing the SBP to the target level is more problematic than lower the DBP [33] since it requires two or more drugs in the majority to get it to the normal level [34]. Despite the fact that nearly half (Table 1) of the patients were taking two antihypertensive medications, and that those taking two drugs were more likely to have their blood pressure controlled than those taking only one, the target BP control associated with the patients' numbers of drugs used in our study did not reach the significant level (p =.054). In our binary logistic regression analysis, controlling for medication adherence and BMI, patients who had no comorbidity were nearly two times more likely to have target BP control compared to those with comorbidity. Patients with comorbid diabetes and CKD were less likely to have the target BP control possibly due to the complicating effects of the diseases on BP and pill burden from the numbers of disease conditions needing multiple drugs [35,36]. The finding of diabetes as the common comorbid condition in the present study is consistent with several previous studies [37] and documented among patients with lower rates of target BP control [38–40]. Hypertensives with comorbid diabetes were also at increased risk for microalbuminuria with progression to CKD, which was present in a tenth of the current study participants with poorer target BP control and potential for an increased risk of CVD complications and CV mortality at every BP level [41]. Though majority of our study participants had a reasonably good bi-monthly clinic-based follow-up, studies recommend much closer follow-up visits for better management of difficult to control HTN and comorbidities [28,42].

In the present study, patients who had a strict adherence to antihypertensive medications were two times more likely to have target BP control compared to those who were nonadherent to antihypertensive medications controlling for other variables in the model, which is consistent with earlier studies [43,44]. Previous studies reported the existence of significant association between pill burden and lower rates of medication adherence [35,36]. Fixed dose combinations (though costly) was suggested to lower patients' pill burden, ease medication administration for caregivers and enhance medication adherence that improve the target BP control [36,45].

In present study, when other factors in the model were controlled, patients with normal BMI were nearly twice as likely to achieve target BP control as patients who were overweight or obese. The fact that there were more overweight and obese hypertensives in this study may indirectly explain why the BP control rate was low. Our finding is consistent with several previous studies [46–48].

The finding of majority (60%) of participants in the present study being overweight or obese shows a much prevalent modifiable CVD risk among the studied population, and is comparable to a recent study that reported a high (71.6%) overweight/obesity rate among hypertensives on a follow-up in Ethiopia [23]. Previous epidemiological studies in Ethiopia documented a higher (30%) prevalence of overweight and obesity among the urban population of Addis Ababa [7], which may also account for the high proportion of overweight and obesity in the present study. Other researches from lower levels and regional town hospitals in Ethiopia also showed considerable rates (38% - 48%) of overweight and obesity among patients with HTN with poorer BP control rates [37,49,50] though lower compared to the present finding. Similarly, South African and other large samples (n=30044) multi-sites African studies that examined the association between obesity and HTN discovered that hypertensives had a greater rate of obesity (70%) and a three-fold higher likelihood of having uncontrolled BP [51,52]. The present study was conducted at a tertiary level hospital where patients are primarily referred for better evaluation and likely have more risk factors than those monitored at the primary and secondary care levels and in urban Ethiopian settings (where the former studies were conducted), which may account for the present finding of a higher proportion of overweight and obesity. Given the higher prevalence of overweight and obesity in the study area and the present finding's confirmation of previously published data attesting to the association between overweight/obesity and low target BP control, our observation of a higher proportion of hypertensives who are overweight or obese with low target BP control is well-supported. The obesity link with high BP is currently better understood in that adipose tissue produce molecules that signal inflammation and oxidative stress in the adipose tissue that interact with microvascular endothelium resulting in microvascular resistance raising the BP [53].

CONCLUSIONS

Intervention targeting hypertensives' body weight control, early comorbidity screening and management, and strict adherence to antihypertension medication should be among the priority care of hypertensive clinic specialists' team. Large scale research that delves into root causes of low target BP control using a better methodological approach including both the office and ambulatory BP measurements is worth considering.

IMPLICATIONS

Since the study was carried out at the highest (a tertiary level) referral hospital care setting, the findings have a number of importance to practice, education, and future research policies. For the optimum management of HTN, the specialist team should focus on patients' self-sustained goal BP control. Evidence shows motivational and behavioral techniques were most effective in enabling patients to behavioral adjustments for risk factors and the difficult to control high BP, such as those overweight/obese, and patients with comorbid conditions [54,55]. There is also a need to advance the role of nurses and other HCPs in HTN care and management through a collaborative/interdisciplinary practice team approach, which was most successful in bringing BP under control in a short amount of time and was successful in reducing CV events [56]. Furthermore, to reach the goal BP for the specific adult group (young, middle-aged, and elderly adults) in hypertensives, future research should concentrate on the individual level assessment of self-efficacy on target BP; gender-specific risk, and lifestyle factors that cause HTN to begin at a young age.

LIMITATIONS OF THE STUDY

The study was a single site cross-sectional that restricts generalization of the findings to other tertiary level hospital hypertensive patient attendees.

AUTHORS CONTRIBUTIONS

DMB and RAG contributed to the conceptualization, data collection, analyses and draft writing of the manuscript. DYG, AWY, and MKH contributed to methodological design, critical revision and edition of the final version. All authors have agreed on the final version of the manuscript.

DECLARATION OF CONFLICT OF INTERESTS

The authors declare on potential conflict of interests with respect to this research.

REFERENCES

[1]. Zhou B, Carrillo-Larco RM, Danaei G, Riley LM, Paciorek CJ, Stevens GA, et al. Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. The Lancet 2021;398: 957–980. https://doi.org/10.1016/S0140-6736(21)01330-1.

[2]. Mills KT, Stefanescu A, and He J. The global epidemiology of hypertension. Nature Reviews Nephrology 2020;16: 223–237. https://doi.org/10.1038/s41581-019-0244-2.

[3]. Dzudie A, Njume E, Mfekeu LK, Djomou A, Ba H, Ndom MS, et al. May Measurement Month 2019: an analysis of blood pressure screening results from Cameroon. European Heart Journal Supplements 2021;23: B33–B36. https://doi.org/10.1093/eurheartj/suab056.

[4]. Cappuccio FP, and Miller MA. Cardiovascular disease and hypertension in sub-Saharan Africa: burden, risk and interventions. Internal and Emergency Medicine 2016;11: 299–305. https://doi.org/10.1007/s11739-016-1423-9.

[5]. Hailemariam T. Prevalence of Cardiovascular Emergencies in Specialized Hospital, Addis Ababa Ethiopia. Emergency Medicine: Open Access 2014;04: 8–12. https://doi.org/10.4172/2165-7548.1000198.

[6]. Kibret KT, and Mesfin YM. Prevalence of hypertension in Ethiopia : a systematic meta-analysis 2015.

https://doi.org/10.1186/s40985-015-0014-z.
[7]. Tesfaye F. Epidemiology of Cardiovascular Disease Risk Factors in Ethiopia : The rural-urban gradient. Epidemiology & Public Health Sciences, Department of Public Health and Clinical Medicine Umeå University, Sweden. http://www.diva-portal.org/smash/get/diva2:141340. 2008.
[8]. Vasan RS, Beiser A, Seshadri S, Larson MG, and Kannel, W. B. et al. Residual Lifetime Risk for Developing Hypertension in Middle-agedWomen andMen The Framingham Heart Study. American Medical Association 2002;287: 1003–1010.
[9]. Yau JA, Karaye KM, and Okeahialam BN. Profile of Cardiovascular Risk Factors in Nigerians with Stroke 2016: 125–137. https://doi.org/10.4236/wjcs.2016.610020.
[10]. Alkali N, Bwala S, Akano A, Osi-Ogbu O, Peter Alabi P, and Ayeni O. Stroke risk factors, subtypes, & 30-day case fatality in Abuja, Nigeria. 2013: 54(2): 129–135. https://doi.org/doi: 10.4103/0300-1652.110051.
[11]. WHO. A global brief on Hypertension: Silent killer, global public health crisis World Health Day 2013. www.who.int. World Health Organization 2013: 1–40. https://doi.org/10.1136/bmj.1.4815.882-a.
[12]. Misganaw A, HaileMariam D, and Araya T. The double mortality burden among adults in Addis Ababa, Ethiopia, 2006-2009. CDC-Preventing Chronic Disease 2012;9: 1–10. https://doi.org/10.5888/pcd9.110142.
[13]. WHO. WHO methods and data sources for country - level causes of death 2000-2012:Department of Health Statistics and Information Systems WHO, Geneva. http://www.who.int/gho/mortality_burden_disease/en/index.html 2014.
[14]. Ethiopian Public Health Institute: Ethiopian STEPS Report on Risk Factors for Non-communicable Diseases. 2016: 1–13.
[15]. Tolla MT, Norheim OF, Memirie ST, Abdisa SG, Ababulgu A, Jerene D, et al. Prevention and treatment of cardiovascular disease in Ethiopia: a cost-effectiveness analysis. Cost Effectiveness and Resource Allocation : C/E 2016;14: 10. https://doi.org/10.1186/s12962-016-0059-y.
[16]. Gebrihet TA, Mesgna KH, Gebregiorgis YS, Kahsay AB, Weldehaweria NB, and Weldu MG. Awareness, treatment, and control of hypertension is low among adults in Aksum town, northern Ethiopia: A sequential quantitative-qualitative study. PLoS ONE 2017;12: 1–16. https://doi.org/10.1371/journal.pone.0176904.
[17]. Berhe DF, Taxis K, Haaijer-Ruskamp FM, Mulugeta A, Mengistu YT, and Mol PGM. Hypertension treatment practices and its determinants among ambulatory patients: retrospective cohort study in Ethiopia. BMJ Open 2017;7: e015743. https://doi.org/10.1136/bmjopen-2016-015743.
[18]. Olafiranye O, Zizi F, Brimah P, Jean-louis G, Makaryus AN, Mcfarlane S, et al. Management of Hypertension among Patients with Coronary Heart Disease. International Journal of Hypertension 2011;dio:10.406. https://doi.org/10.4061/2011/653903.
[19]. O'Connor PJ, Vazquez-Benitez G, Schmittdiel JA, Parker ED, Trower NK, Desai JR, et al. Benefits of early hypertension control on cardiovascular outcomes in patients with diabetes. Diabetes Care 2013;36: 322–327. https://doi.org/10.2337/dc12-0284.
[20]. Adebolu, F. A. & Naidoo M. Blood pressure control amongst patients living with hypertension presenting to an urban district hospital outpatient clinic in Kwazulu-Natal 2014: 6–11. https://doi.org/10.4102/phcfm.v6i1.572.
[21]. Kayima J, Wanyenze RK, Katamba A, Leontsini E, and Nuwaha F. Hypertension awareness, treatment and control in Africa: a systematic review. BMC Cardiovascular Disorders 2013;13: 54. https://doi.org/10.1186/1471-2261-13-54.
[22]. Abebe SM, Berhane Y, Worku A, and Getachew A. Prevalence and associated factors of hypertension: A crossectional community based study in Northwest Ethiopia. PLoS ONE 2015;10: 1–11. https://doi.org/10.1371/journal.pone.0125210.
[23]. Asgedom SW, Gudina EK, and Desse TA. Assessment of blood pressure control among hypertensive patients in Southwest Ethiopia. PLoS ONE 2016;11: 1–12. https://doi.org/10.1371/journal.pone.0166432.
[24]. Aberhe W, Mariye T, Bahrey D, Zereabruk K, Hailay A, Mebrahtom G, et al. Prevalence and factors associated with uncontrolled hypertension among adult hypertensive patients on follow-up at Northern Ethiopia, 2019: Cross-sectional study. Pan African Medical Journal 2020;36: 1–14. https://doi.org/10.11604/pamj.2020.36.187.23312.
[25]. Hulley SB, Cummings SR, Browner WS, Grady DG, and Newman TB. Designing Clinical Research. Fouth edition; Lippincott Williams & Wikins, Philadelphia. 2013.
[26]. CDC. Body mass index: Considerations for practitioners. Cdc 2011: 4.
[27]. Gelaye B, Williams MA, Lemma S, Deyessa N, Bahretibeb Y, Shibre T, et al. Validity of the Patient Health Questionnaire-9 for Depression Screening and Diagnosis in East Africa. Psychiatry Res. 15;210 (2): dio:10.1016/j.psychres.2013.07.015 2013;210. https://doi.org/10.1007/s10439-011-0452-9.Engineering.
[28]. Williams B, Mancia G, Spiering W, Rosei EA, Azizi M, Burnier M, et al. 2018 Practice guidelines for the management of arterial hypertension of the European Society of Cardiology and the European Society of Hypertension. Blood Pressure 2018;27: 314–340. https://doi.org/10.1080/08037051.2018.1527177.
[29]. Teshome DF, Demssie AF, and Zeleke BM. Determinants of blood pressure control amongst hypertensive patients in Northwest Ethiopia 2018: 1–11. https://doi.org/10.1371/journal.pone.0196535.
[30]. Goverwa TP, Masuka N, Tshimanga M, Gombe NT, Takundwa L, Bangure D, et al. Uncontrolled hypertension among hypertensive patients on treatment in Lupane District , 2014: 1–8.
[31]. Mancia G, Fagard R, Narkiewicz K, Redán J, Zanchetti A, Böhm M, et al. 2013 Practice guidelines for the management of arterial hypertension of the European Society of Hypertension (ESH) and the European Society of Cardiology (ESC). Journal of Hypertension 2013;31: 1925–1938. https://doi.org/10.1097/HJH.0b013e328364ca4c.
[32]. Hisamatsu T. Control rates of systolic and diastolic blood pressure among hypertensive adults in Korea. Korean

Circulation Journal 2019;49: 1049–1051. https://doi.org/10.4070/kcj.2019.0197.
[33]. Chobanian A V, Bakris GL, and Black HR. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: The JNC 7 Report 2009. https://doi.org/10.1001/jama.289.19.2560.
[34]. Guerrero-García C, and Rubio-Guerra AF. Combination therapy in the treatment of hypertension. Drugs in Context 2018;7: 1–9. https://doi.org/10.7573/dic.212531.
[35]. Asgedom SW, Atey TM, and Desse TA. Antihypertensive medication adherence and associated factors among adult hypertensive patients at Jimma University Specialized Hospital, southwest Ethiopia. BMC Research Notes 2018;11: 1–8. https://doi.org/10.1186/s13104-018-3139-6.
[36]. Verma AA, Khuu W, Tadrous M, Gomes T, and Mamdani MM. Fixed-dose combination antihypertensive medications, adherence, and clinical outcomes: A population-based retrospective cohort study. PLoS Medicine 2018;15. https://doi.org/10.1371/journal.pmed.1002584.
[37]. Fekadu G, Adamu A, Gebre M, Gamachu B, Bekele F, Abadiga M, et al. Magnitude and determinants of uncontrolled blood pressure among adult hypertensive patients on follow-up at nekemte referral hospital, western ethiopia. Integrated Blood Pressure Control 2020;13: 49–61. https://doi.org/10.2147/IBPC.S245068.
[38]. Abegaz TM, Abdela OA, Bhagavathula AS, and Teni FS. Magnitude and determinants of uncontrolled blood pressure among hypertensive patients in Ethiopia: Hospital-based observational study. Pharmacy Practice 2018;16: 1–7. https://doi.org/10.18549/PharmPract.2018.02.1173.
[39]. Gebremichael GB, Berhe KK, and Zemichael TM. Uncontrolled hypertension and associated factors among adult hypertensive patients in Ayder comprehensive specialized hospital, Tigray, Ethiopia, 2018. BMC Cardiovascular Disorders 2019;19: 1–10. https://doi.org/10.1186/s12872-019-1091-6.
[40]. Li YT, Wang HHX, Liu KQL, Lee GKY, Chan WM, Griffiths SM, et al. Medication Adherence and Blood Pressure Control Among Hypertensive Patients With Coexisting Long-Term Conditions in Primary Care Settings. Medicine (United States) 2016;95: 1–10. https://doi.org/10.1097/MD.0000000000003572.
[41]. Kang CD, Tsang PPM, Li WTL, Wang HHX, Liu KQL, Griffiths SM, et al. Determinants of medication adherence and blood pressure control among hypertensive patients in Hong Kong: a cross-sectional study. International Journal of Cardiology 2015;182: 250–257. https://doi.org/10.1016/j.ijcard.2014.12.064.
[42]. Visco V, Finelli R, Pascale AV, Mazzeo P, Ragosa N, Trimarco V, et al. Difficult-to-control hypertension: identification of clinical predictors and use of ICT-based integrated care to facilitate blood pressure control. Journal of Human Hypertension 2018;32: 467–476. https://doi.org/10.1038/s41371-018-0063-0.
[43]. Desta M, Yibeltal D, Memiah P, Ayenew T, Mulugeta H, Gedefaw M, et al. Antihypertensive medications adherence and associated uncontrolled blood pressure among hypertensive patients in Ethiopia: Systematic review and meta-analysis. International Journal of Africa Nursing Sciences 2022;16: 100404. https://doi.org/10.1016/j.ijans.2022.100404.
[44]. Khayyat SM, Khayyat SMS, Hyat Alhazmi RS, Mohamed MMA, and Hadi MA. Predictors of medication adherence and blood pressure control among Saudi hypertensive patients attending primary care clinics: A cross-sectional study. PLoS ONE 2017;12: 1–12. https://doi.org/10.1371/journal.pone.0171255.
[45]. Adu-Boakye Y, Gyabaah S, Arthur J, Nyarko O, Boateng F, Nkyi C, et al. Hypertension Clinic Registry : Blood Pressure Control Among Hypertensives In A Specialist-Led Clinic In Ghana 2021;10: 1–8. https://doi.org/10.5580/IJCVR.55734.
[46]. Bernabe-Ortiz A, Carrillo-Larco RM, and Miranda JJ. Association between body mass index and blood pressure levels across socio-demographic groups and geographical settings: Analysis of pooled data in Peru. PeerJ 2021;9. https://doi.org/10.7717/peerj.11307.
[47]. Reisin E, Graves J, Yamal J-M, Barzilay JI, Pressel S, Einhorn PT, et al. Blood Pressure Control and Cardiovascular Outcomes in Normal, Overweight, and Obese Hypertensives Treated with Three Different Anti-Hypertensives in ALLHAT. J Hypertens 2017;32: 1503–1513. https://doi.org/10.1097/HJH.0000000000000204.
[48]. Bhagavathula AS, Shah SM, Suliman A, Oulhaj A, and Aburawi EH. Hypertension control and guideline-recommended target blood pressure goal achievement at an early stage of hypertension in the UAE. Journal of Clinical Medicine 2022;11. https://doi.org/10.3390/jcm11010047.
[49]. Amare F, Nedi T, and Berhe DF. Blood pressure control practice and determinants among ambulatory hypertensive patients attending primary health care facilities in Addis Ababa. SAGE Open Medicine 2020;8: 205031212094652. https://doi.org/10.1177/2050312120946521.
[50]. Bekele etabalew E, Tadesse T, Negaw R, and Zewde T. Magnitude and associated factors of hypertension in Addis Ababa public health facilities, Ethiopia. MOJ Public Health 2018;7: 280–286. https://doi.org/10.15406/mojph.2018.07.00252.
[51]. Masilela C, Pearce B, Ongole JJ, Adeniyi OV, and Benjeddou M. Cross-sectional study of prevalence and determinants of uncontrolled hypertension among South African adult residents of Mkhondo municipality. BMC Public Health 2020;20: 1–10. https://doi.org/10.1186/s12889-020-09174-7.
[52]. Akpa OM, Made F, Ojo A, Ovbiagele B, Adu D, Motala AA, et al. Regional patterns and association between obesity and hypertension in Africa: Evidence from the H3Africa Chair study. Hypertension 2020: 1167–1178. https://doi.org/10.1161/HYPERTENSIONAHA.119.14147.
[53]. Kang YS. Obesity associated hypertension: New insights into mechanism. Electrolyte and Blood Pressure 2013;11: 46–52. https://doi.org/10.5049/EBP.2013.11.2.46.
[54]. Vance DE. Motivational Interviewing in Health Care: Helping Patients Change Behavior, by Stephen Rollnick, PhD,

William R. Miller, PhD, & Christopher C. Butler, MD. Guilford Press, New York, NY, 2007, 210 pages, softcover, $25.00, hardcover $45.00, ISBN: 978-1-5938. Physical & Occupational Therapy In Geriatrics 2010;28: 101–102. https://doi.org/10.3109/02703180903041339.

[55]. RNAO. Nursing Management of Hypertension. Nursing Best Practice Guideline 2009: 1–134. https://doi.org/10.5860/choice.26-4812.

[56]. Carter BL. Collaborative care model for hypertension. Journal of Clinical Hypertension 2018;20: 96–97. https://doi.org/10.1111/jch.13142.