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RESEARCH ARTICLE

Magnitude and Factors Associated with Uncontrolled Blood Pressure among Adult Hypertensive Patients Attending at Medical Referral Clinic of Hawassa University Comprehensive Specialized Hospital, Sidama Regional State of Ethiopia, 2021

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Abstract

Background: Hypertension is a worldwide public health problem. Uncontrolled blood pressure contributes to the burden of cardiovascular diseases, stroke, and renal failure leading to early mortality and disability. Good control of blood pressure (BP) is vital to prevent the complications mentioned above. However, the blood pressure control rate in adult hypertensive patients is poor, and the reasons for poor BP control are not fully understood globally.

Objective: This study aimed at determining the magnitude of uncontrolled blood pressure and associated factors among adult hypertensive patients attending the cardiovascular clinic of Hawassa University Comprehensive Specialized Hospital, southern Ethiopia, 2021.

Methods: A hospital-based cross-sectional study was conducted from July to September2021 on 227 adult hypertensive patients attending the cardiovascular clinic of Hawassa University Comprehensive Hospital. Data was collected using a structured questionnaire through face-to-face interviews and chart review. Data was entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 22 software. A logistic regression model (p-value of ≤ 0.05 and adjusted odds ratio with a 95% confidence interval) was used to measure the strength of the association.

Result: Of the total respondents, 147 (64.8%) were males. The mean age of the respondents was 51.4 ± 12years. The magnitude of uncontrolled hypertension was found 57.3%. Overweight (AOR = 7.526, 95% CI: 2.932, 19.317), lack of health education (AOR =3.3, 95% CI: 0.137, 8.03), non-adherence to anti-hypertensive medication (AOR = 5.588, 95% CI: 1.160, 26.918), non-adherence to physical activity (AOR =2.619, 95% CI: 1.089, 6.300) and use of top added salt (AOR = 2.6, 95% CI: 1.019, 6.707) were independent predictors of uncontrolled hypertension.

Conclusion: The magnitude of uncontrolled hypertension is high. Patients' adherence to antihypertensive medication, physical exercise, and weight reduction can significantly reduce the risk of hypertension. Salt reduction and health education are also vital.

Keywords: Associated factors, Blood pressure control, Cross-Sectional Study

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Background

Hypertension (HTN), also known as high or raised blood pressure (BP), is one of the leading causes of the global burden of disease [1]. It is usually an asymptomatic and chronic disorder needing lifelong treatment [2,3]. It is defined as when a Person's systolic blood pressure (SBP) in the office or clinic is ≥140 mm Hg and/or their diastolic blood pressure (DBP) is ≥90 mm Hg following repeated examinations [1,4]. There are around 1 billion people affected by hypertension in the world. Almost all regions & races of the world are affected. It is known as uncontrolled if SBP is ≥140 mm Hg and/or DBP ≥90 mm Hg in patients taking anti-hypertensive medications [4].

Uncontrolled hypertension is the major public health problem among hypertensive patients in developed and developing countries [5,6]. Despite the availability of effective medical therapeutic interventions for hypertension with proven benefits in reducing cardiovascular morbidity and mortality, more than half of the hypertensive patients on treatment have blood pressures above 140/90 mm Hg threshold. [7-9]. Worldwide, hypertension is not adequately controlled, and control is worse in lower-income countries [10]. In 2010, control of hypertension was estimated to be 28% in high-income and 8% in middle- and low-income countries [11].

Most studies in Africa showed that less than a third of patients achieve treatment goals [12]. A meta-analysis also showed that in most of Sub-Saharan Africa (SSA), the control of BP to the target level (140/90) is less than 30% [13]. Few studies conducted in Ethiopia revealed that the prevalence of uncontrolled hypertension among patients on treatment varied from 11.4% in Gondar University Hospital to 59.9% in Tikur Anbessa Hospital and 69.9% in Zewditu Memorial Hospital [14-16].

Systolic Blood Pressure Intervention Trial (SPRINT) reported intensive versus standard BP control (systolic BP of <120 vs. <140 mm Hg) in adults with hypertension results in a 25% risk reduction in major cardiovascular events and a 27% reduction in all-cause mortality [17]. However, when hypertension remains uncontrolled, risks for long-term sequelae such as myocardial infarction, heart failure, stroke, and kidney disease significantly increase. For every 20 mm Hg increase in systolic BP to >115 mm Hg or 10 mm Hg increase in diastolic BP to >75 mm Hg, the risk of major cardiovascular and stroke events doubles [18]. Uncontrolled hypertension increases the risk of all-cause and cardiovascular disease mortality [19].

Multiple factors were found to contribute to uncontrolled hypertension. Non-adherence to anti-hypertensive therapy and dietary approach to stop hypertension (DASH diet), high salt intake, alcohol intake, smoking, physical inactivity, and overweight/obesity are among the major contributing factors to uncontrolled hypertension [14,20]. The benefits of comprehensive lifestyle modification, including the DASH diet and increased exercise, were tested in the PREMIER trial and demonstrated that individuals with multiple lifestyle modifications have the potential to control BP and reduce the risk of chronic disease [21].Other factors such as sex, age, disease duration, and co-morbidities also have an association with uncontrolled hypertension [20,22].

Limited information exists on BP control factors and adherence to antihypertensive drug therapy in developing countries [13]. Current disease estimates for SSA are based on limited data and hypertension control assumes a relatively low priority, and little experience exists in implementing sustainable and successful programs [23]. Although several studies have shown the prevalence and factors associated with HTN in Ethiopia, there is limited information about the magnitude and determinants of blood control status in Ethiopia. [23-25] .The lack of adequate studies on HTN significantly affects HTN management and the care of hypertensive patients in Ethiopia [26].

Improvement in the management and control of HTN will require an understanding the fac-

tors that affect BP control [25]. So, knowing the BP control status of hypertensive patients is very important for policymakers and clinicians responsible for designing appropriate strategies for better management of hypertensive patients [27]. Therefore, this study aimed to assess the magnitude and associated factors of uncontrolled BP among adult hypertensive patients attending at cardiovascular (CVS) clinic of Hawassa university comprehensive specialized hospital (HUCSH), Hawassa southern Ethiopia.

Methods and Materials

The Study Area

The study was conducted at Hawassa University's comprehensive specialized referral hospital, Hawassa, which is one of the teaching hospitals located in the Sidama Region of Ethiopia. This tertiary level Public University Hospital is the biggest in the region and serves as the last referral destination to more than 15 million people coming from Sidama, Southern Nations Nationalities & Peoples (SNNP) & neighboring Oromia regions. Hawassa is located 275 km south of the capital Addis Ababa [28].

Study Design and study period

A hospital-based cross-sectional design was conducted among adult hypertensive patients from July to September 2021.

Source Population

All adult hypertensive patients on pharmacologic therapy who have at least 6 months of follow-up at the CVS clinic of HUCSH.

Study Population

All selected adult hypertensive patients on antihypertensive treatment who have a follow-up at the CVS clinic of HUCSH at the time of data collection and have at least six months of follow-up.

Eligibility

Inclusion Criteria

Adult hypertensive patients of at least 18 years on pharmacologic therapy at least for six months or more.

Exclusion Criteria

- Hypertensive patients with only one visit to the clinic
- Hypertensive patients on pharmacologic therapy for less than six months
- Seriously ill patients not able to complete the interview and patients with incomplete medical records such as demographics and BP
- Those who will revisit the clinic during the data collection

Sample Size Determination and Sampling Technique

The sample size for the study was determined using single proportion population sample size determination considering the following assumptions: Prevalence (p) of uncontrolled hypertension 0.7 from a study conducted at hypertensive patients attending primary health care facilities in Addis Ababa [28], at 95% level of confidence and margin of error 5%. The total populations of hypertensive patients on follow-up at CVS clinic are 565.

The sample size is calculated by using the following formula. Where sample size (n), 565(N), 0.05(d), 0.7(p), 0.3(q) and 1.96(z).

$$\text{n}=\frac{Nz^2pq}{d^2(N-1)+z^2pq} = \frac{565*1.96^2*0.3*0.7}{0.05^2*564+1.96^2*0.7*0.3} = 206$$

Finally, the sample size was calculated according to the above formula, and 10% the addition of non-response brought the final sample size to 227. The estimated number of hypertensive patients during the study period was around 260; therefore, using consecutive sampling techniques the first 227 eligible hypertensive patients during the study period were included.

Study Variables

1. Dependent variable
   Uncontrolled blood pressure
2. Independent variable
   (a) Socio-demographic variables:- Sex, Age, Religion, BM, Residence, Educational status, Occupation, Marital status, Monthly family income
   (b) Health profile and related factors:- Type of diet, Alcohol consumption, Smoking, Adherence to physical activity, salt restrictions
   (c) Medication adherence related variables:- Number of antihypertensive drugs, Type(s) of antihypertensive drugs,
   (d) Presence of comorbid condition(s):- diabetes mellitus, cardiovascular diseases, and chronic kidney diseases

Operational definition

Hypertension: is defined as persistent systolic blood pressure (BP) reading (SBP) $\geq$140 mm Hg and/or a diastolic blood pressure reading (DBP) $\geq$90 mm Hg. It is known as uncontrolled if SBP is $\geq$140 mm Hg and/or DBP $\geq$90 mm Hg for the general hypertensive population who are on anti-hypertensive medications [4].

Adherence to medications: patients with a score of $\geq$3 (range: 0$\pm$4) on the 4-item Morisky Green Levine Scale self-reported measures of medication-taking behavior were assessed as having good adherence to medications, otherwise classified as non-adherent [29].

Alcohol: adherence to JNC7 recommendations was deemed to be alcohol abstinent. Participants who reported not drinking alcohol in the last 7 days or indicated that they usually didn't drink at all were considered abstainers.

Moderation of alcohol consumption: consuming no more than two standard drinks (1 oz or 30 mL ethanol) for males and no more than one drink for females over seven days. All others were non adherent [30].

Tobacco use: a participant who smoked at least one cigarette per day at the time of the study was considered a smoker [30].

Salt intake: according to WHO recommendations, optimal salt intake is defined as consumption below 5 grams equivalent to one teaspoonful. High salt intake represents a daily salt consumption of more than one teaspoonful or 5grams per day and added salt is defined as when a person uses additional salt on a plate after food preparation. Participants who used additional salt on a plate after food preparation were considered non-adherent to salt consumption, and all others were adherent.

Body mass index (BMI): - is calculated as weight in kilograms divided by height in meters squared and interpreted as underweight (BMI<18.5), normal (18.5-24.9), overweight (25.0 - 29.9), and obese ($\geq$30.0) [31].

Physically active: an individual performs regular physical activities for >150 min/week, or if they reported that they exercise more than 30 minutes/ day for greater than five days of the week, otherwise, they were classified as physically inactive. Physical activity refers to all movement that includes during leisure time, to access transport to and from places, or as part of a person's work.

Moderate-level activities: makes you breathe somewhat harder than the normal and include routine activities like (Walking very briskly, washing clothes, bicycling with light effort, farming activities, *etc.*) [32]. Respondents who performed such activities were assessed as having moderate-level physical activities.

Vigorous-level activities: makes you breathe much harder than normal. These are resistance activities like Jogging, Carrying heavy loads, Soccer games, *etc.* [32]. Respondents who perform such activities were assessed as having Vigorous-level physical activities.

Health Education (HE): is referred to as the process by which individuals and groups of people learn to behave in a manner conducive to the

promotion, maintenance, or restoration of health [33]. Participants who had participated in individual or group activities of the HE program/s either in person or through any media of communication within six months were considered as having HE.

Data Collection tools and Procedures

Data was collected using document review and a structured interviewer-administered questionnaire adopted from the WHO STEP-wise approach for chronic disease risk [32] and the Morisky Green Levine Scale. The questionnaire was prepared in English and translated into Amharic and contained variables on sociodemographic characteristics, smoking status, physical activity, alcohol consumption, BMI, medication adherence, and Blood pressure measurements. The dietary data were collected based on the participant's responses for which type of diet did they eat on most days (4 to 5 times per week) during the last six months after grouping it into five categories (Meat, Fruits, Vegetables, Cereal products, and Others to specify) based on WHO healthy diet guidelines. *Data for BMI was calculated after height and weight were measured and categorized into* underweight, normal, overweight, and obese.

Two BP recordings were taken from the charts of patients before six and three months, respectively. The 3^{rd} BP was measured by the data collectors (clinical nurses and medical residents) using an automated digital sphygmomanometer BP cuff with the appropriate cuff size that covered two-thirds of the upper arm, while the patient was in a sitting position, had rested for at least five minutes, and consumed no cigarettes or caffeine 30 minutes before the measurement and the average of the three was used to assess BP control. Two trained health professionals were recruited for data collection. The clarity and completeness of data were supervised by the investigator.

Data Quality Assurance

One day of training was given to the data collectors. A pretest was conducted one week before actual data collected by the investigator on 5% of the sampled patient attending a medical referral clinic (MRC) and checked for consistency, and accuracy, and any ambiguity in the checklist was corrected for final data collection. The whole data collection period was supervised by the principal investigator and any incomplete checklist was returned and corrected daily.

Data Processing and Analysis

All the collected data were checked for completeness and consistency. The data were entered into Epi Info version 7, coded, cleaned, and then analyzed using SPSS version 22. Univariate analysis was conducted to summarize data using tables and graphs. Descriptive statistics were computed for all variables according to type. Frequency, mean and standard deviation were calculated for continuous variables and categorical variables were assessed by computing frequencies. Bivariate logistic regression was used to determine the association between each independent and outcome variable, and variables with a p-value ≤ 0.25 were candidates for the multivariable logistic regression. A p-value < 0.05 was considered to be statistically significant. Adjusted odds ratio (AOR) with a 95% confidence interval was used to measure the strength of the association between exposure and outcome variables.

Results

Socio-demographic characteristics

A total of 227 adult hypertensive patients were included in this study with a response rate of 100%. The majority of the respondents 147 (64.8%) were males. The mean age of the respondents was 51.4 (SD$\pm$12) years with a minimum age of 22 years old and maximum of 82 years old. One hundred eighty (79.3%) of the participants were married. Most of the respondents 117 (51.5%) were protestant followers. The majority of the respondents, 56.4%, were urban dwellers, and 76 (33.5%) of the respondents were government employed. The majority of the study participants 116 (51.1%) earned more than 3500 ETB monthly income, and 93 (41%) of the respondents had access to higher education (Table 1).

Table 1 Sociodemographic characteristics of hypertensive patients attending at MRC of HUCSH, Hawassa, Ethiopia 2021 (n = 227)

Variables	Categories	Frequency	Percentage
Age	18-34	15	6.6
	35-49	88	38.8
	≥50	124	54.6
Sex	Male	147	64.8
	Female	80	35.2
Marital status	Single	11	4.8
	Married	180	79.3
	Widowed	22	9.7
	Divorced	14	6.2
Occupation	Government employee	76	33.5
	Retired	33	14.5
	Merchant	40	17.6
	Farmer	50	22.0
	Housewife	23	10.1
	Others	5	2.2
Religion	Protestant	117	51.5
	Orthodox	73	32.2
	Muslim	37	16.0
Residence	Urban	128	56.4
	Rural	99	43.6
Monthly Family Income	Very Low (<600)	8	3.5
(ETB)	Low (601-1500)	35	15.4
	Average (1501-3500)	60	30.0
	Above Average (>3500)	116	51.1
Educational level	Cannot read and write	12	5.3
	Primary (1-8)	24	10.6
	Secondary (9-12)	49	21.6
	Higher Education	93	41.0
	Can read and write	49	21.6

Medication adherence and BP control

The majority, 141 (62.1%) of the participants had been taking two ant-hypertensive medications per day, whereas72 (31.7%) of the participants had been put on one anti-hypertensive drug, and the remaining 14 (6.2%) of the participants had been taking three or more drugs per day. Frequently used drugs were hydrochlorothiazide (HCT) 26(11.5%), amlodipine 20(8,8%), and enalapril 19(8.4%). However, commonly prescribed two drug combinations were amlodipine + enalapril (45%) and HCT + nifedipine (44%). Among the respondents, 208 (91.6 %) were classified as having good adherence to prescribed medications.

The mean systolic and diastolic BP readings were 144.75 mm Hg (±10.40SD) and 86.59 mm Hg (±8.18 SD) respectively. One hundred

twenty-two (53.7%) of the participants had uncontrolled systolic, and 84 (37%) of the study participants had uncontrolled diastolic blood pressure. The overall magnitude of uncontrolled hypertension was 57.3% (Table 2).

Table 2 The type of antihypertensive drugs taken by study participants (n = 227)

Types of drug/s	Controlled BP	Uncontrolled BP	Ch-square *p*-value	Total (%)
HCT	14	12	.409	26 (11.5)
Amlodipine	11	9	.411	20 (8.8)
Enalapril	11	8	.288	19 (8.4)
Nifedipine	4	3	.557	7 (3.1)
Amlodipine + enalapril	21	24	.951	45 (19.8)
HCT + enalapril	20	24	.951	44 (19.4)
HCT+ nifedipine	7	5	.389	12 (5.3)
HCT + amlodipine	6	3	.210	9 (4)
Nifedipine + Lasix	6	4	.373	10 (4.4)
HCT + atenolol	3	5	.613	8 (3.5)
HCT + amlodipine + enalapril	6	8	.792	14 (6.2)
enalapril + metoprolol	8	5	.389	13 (5.7)
One drug	40	32	.077	72 (31.7)
Two drugs	71	65	.028	141 (62.1)
Three or more	6	8	.792	14 (6.6)
Total	117	110		227 (100)

Health Profile and Related Factors

The majority, 134 (59%) and 40 (19%) of participants ate cereal products and vegetables on most days of the week respectively. One hundred forty-one (62.1%) of participants added salt after preparing food. Nine (4%) of participants were current smokers and 13 (5.7%) reported that they drank alcohol daily. More than half of the participants (55.1%) were classified as having moderate levels of physical activity. One hundred ten (48.4%) of respondents had normal BMI and 87(38.4%) & 30(13.2%) were found overweight and obese respectively (Table 3).

Comorbidities and Family History of Hypertension

Of all respondents 58 (25.6%), 35 (15.4%), and 27 (11.9%) have diabetes mellitus, cardiovascular diseases, and chronic kidney diseases respectively. Forty-four (19.4%) of the respondents reported they had a family history of hypertension (Table 3).

Table 3 Behavioral and lifestyle characteristics of adult hypertensive patients attending at medical referral clinic of HUCSH, Hawassa, Ethiopia 2021 (n = 227)

Variables	Category	Controlled BP	Uncontrolled BP	Ch-square *p*-value	Total
Current smoking status	No	95	123	.082	218
	Yes	2	7		9
Current alcohol consumption	No	94	120	.040	214
	Yes	3	10		13
Use of added salt	No	54	32	.002	86
	Yes	43	98		141
Physical activity	Inactive	30	72	.001	102
	Active	67	58		128
BMI	18.5–24.9	73	36	.042	109
	25–29.9	18	69		87
	≥ 30	5	25		30
Presence of comorbid conditions	No	53	78	.213	131
	Yes	44	52		96
No of anti-HTN medications	One	41	32	.076	73
	Two	54	79		133
	≥Three	2	19		21
Adherence	Adherent	94	114	.003	208
	Non adherent	3	16		19

Determinants of Uncontrolled Blood Pressure

Out of fifteen variables analyzed in the bivariate analysis, only five variables (use of added salt, physical activity, BMI, adherence to medication, and health education) were statistically significant predictors of uncontrolled hypertension at *p*-value <0.05 in the multivariable logistic regression model (Table 4).

Hypertensive patients who used top-added salt on a plate were 2.6 times more likely to have uncontrolled BP than patients who didn't consume added salt (AOR = 2.6, 95% CI: 1.019, 6.707). Non-adherence to physical activity had 2.619 more risks of uncontrolled hypertension (AOR =2.619, 95% CI: 1.089, 6.300) than those with physically active hypertensive respondents.

Overweight patients were 7.526 more likely to have uncontrolled hypertension than those with normal weight (AOR = 7.526, 95% CI: 2.932, 19.317) and obese patients were 19.707 more likely to have uncontrolled hypertension than those with normal weight (AOR =19.707, 95% CI: 4.518, 85.967)

Hypertensive patients who were non-adherent to anti-hypertensive medication had 5.588 more likely to have uncontrolled hypertension than those with good adherence (AOR = 5.588, 95% CI: 1.160, 26.918). Hypertensive patients who did not have health education were 3.3 more likely to have uncontrolled hypertension than those who received health education (AOR =3.3, 95% CI: 0.137, 8.03) (Table 4).

Table 4 Determinants of uncontrolled blood pressure among adult hypertensive patients attending at medical referral clinic of HUCSH, Hawassa, Ethiopia 2021 (n = 227)

Variables	Category	Blood pressure control		Crude OR (95% CI)	Adjusted OR (95% CI)	*P*-value
		Controlled BP	Uncontrolled BP			
Residence	Urban	48 (49.5%)	80 (61.5%)	1	1	
	Rural	49(50.5%)	50 (38.5%)	0.612(0.360,1.042)	0.919(.302,2.799)	0.882
Current smoking	No	95(97.9%)	123(94.6%)	1	1	
	Yes	2 (22.2%)	7 (77.8%)	2.703(0.549,13.311)	0.989(.021, 47.550)	0.996
Current alcohol consumption	No	94(96.9%)	120 (92.3%)	1	1	
	Yes	3(3.1%)	10(7.7%)	2.611(0.699,9.576)	0.371(0.045, 3.035)	0.355
Use of added salt	No	54 (62.8%)	32 (37.2%)	1	1	
	Yes	43 (30.5%)	98 (69.5%)	3.846(2.185,6.770)	2.614(1.019, 6.707)	0.046
Physical activity	Inactive	30(29.4%)	72 (70.6%)	1	1	
	Active	67(69.1%)	58 (44.6%)	2.772(1.596, 4.816)	2.619(1.089, 6.300)	0.032
BMI	18. 25–29.9	73(75.3%)	36 (33%)	1	1	
	25–24.9	18 (18.6%)	69 (53.1%)	7.880(4.097,15,154)	7.526(2.932, 19.317)	0.001
	≥ 30	5 (5.2%)	25 (19.2%)	10.278(3.635,29.064)	19.707(4.518, 85.967)	
Adherence	Adherent	94 (96.9%)	114(87.7%)	1	1	
	Non-adherent	3 (3.1%)	16 (12.3%)	4.398(1.244,15.550)	5.588 (1.160, 26.918)	0.032
Health education	No	36(27.1%)	78(60%)	1	1	
	Yes	61(62.9%)	52(40%)	0.393(0.229,0.676)	0.332(0.137, 0.803)	0.014
Family history of hypertension	No	82 (84.5%)	101(77.7%)	1	1	
	Yes	15 (15.5%)	29 (22.3%)	1.570(0.789,3.123)	3.898(1.172,12.964)	0.126
Number of anti-HTN medications	One	41 (42.3%)	32(24.6%)	1	1	
	Two	54 (55.7%)	79 (60.8%)	1.874(1.052,3.339)	0.283(0.013, 6.326)	0.426
	≥Three	2 (2.1%)	19 (14.6%)	12.172(2.639,56.134)	0.413(.012, 13.702)	0.620

Discussion

Controlling blood pressure in people with hypertension to reduce cardiovascular morbidity and mortality is a major challenging public health problem in many developing countries like Ethiopia. This study revealed that 57.3% of hypertensive patients had uncontrolled BP despite being on follow-up at the referral hospital. This finding was in line with studies done in Ghana (57.7%) [34], South Asia (58.0%) [35], South Africa (58.1%) [36], Ayder comprehensive specialized hospital; Ethiopia (56.1%) and Jimma university hospital, Ethiopia (52.7%) [25,37].

However, this is higher than the findings reported from Israel (35.9%), Sudanese adults (64%), and Gondar university hospital, Ethiopia (37%) [38-40]. This could be explained by the lower rates of medication adherence, use of added salt, the proportion of overweight and obesity, and lower health education in our study compared to the study done in Israel. In addition, this might be due to socio-cultural and behavioral differences in the population and healthcare services differences in the study settings.

On the contrary, the magnitude of uncontrolled hypertension in this study is lower than the study done in Panama (66.7%) [41], Morocco 82.8% [42], the Democratic Republic of the Congo (77.5%) [43], South Africa (75.5%) [44] and Zewditu Memorial Hospital, Ethiopia (69.9%) [16]. This inconsistency could be due to the difference in the magnitude of co-morbidity, operational definition of uncontrolled hypertension, adherence to alcohol abstinence, smoking, and age of study participants.

Compared to the other studies, this study revealed a lower rate of co-morbidity among hypertensive patients. Most of the studies had a high proportion of co-morbidities or were exclusively done among hypertensive patients with chronic co-morbidities [42]. Many chronic diseases are

secondary causes of HTN, and controlling HTN among hypertensive patients with other chronic co-morbidities like diabetes mellitus and chronic kidney disease might be challenging [13,44]. The study done in the Democratic Republic of Congo has operationally defined uncontrolled hypertension as BP of ≥130/80 for hypertensive patients with chronic co-morbidities [43]. As a result, this lower cut point could contribute to the increased prevalence of uncontrolled hypertension

Compared to our study, the studies done in China, Morocco, the Democratic Republic of Congo, South Africa, and Zimbabwe had a higher proportion of older adults, despite the study in China was being done exclusively among older adults [36,43,44]. Even though our study did not show a significant association of age with uncontrolled hypertension, many previous studies revealed advanced age is an independent predictor of uncontrolled hypertension [37,42]. Additionally, higher adherence to alcohol abstinence in this study could have contributed to the lower prevalence of uncontrolled hypertension in this study compared to other studies done in Ethiopia [45].

The majority of the findings of this study are consistent with other similar works in different countries, but some variables have not yet shown a significant association in this study. Performing adequate physical activity, being overweight, using top-added salt on the plate after meal preparation, and non-adherence to anti-hypertensive medications are consistent with the findings of other similar studies. However, age, comorbidities, smoking, and educational level did not show a significant association in this study.

Performing adequate physical activity has a strong and independent role in reducing blood pressure. This study is consistent with the previous report from other sub-Saharan countries and southern China [46,47]. It revealed that patients who were physically active and did a moderate level of physical activity were more likely to have optimal BP control than patients who did not do any physical activity. Epidemiological studies have evidenced that physical activity results in significant BP and weight reduction. Sedentary life, which is a known predictor of obesity, is one of the major risk factors for high blood pressure and thus non-adherence to physical exercise makes it difficult to control hypertension [5].

Similarly, this study also revealed poor BP control in overweight patients. The result is similar with studies done in China [36]. Higher BMI (overweight and obesity) is one major contributing factor to hypertension. Many health studies have consistently identified that BMI and blood pressure have a direct and apparent dose-response relationship [46]. Obesity causes hypertension by activating the sympathetic nervous system, the amount of intra-abdominal and intra-vascular fat, sodium retention leading to an increase in renal reabsorption, and the renin-angiotensin system are considered to have important roles in the pathogenesis of obesity-related hypertension [47].

Using top-added salt on the plate after meal preparation was significantly associated with uncontrolled blood pressure in this study. This result is similar to studies done in Southern China [36], and may be due to high salt intake causing fluid retention that increases cardiac burden resulting in high blood pressure.

Non-adherence to anti-hypertensive medication was an independent predictor of uncontrolled hypertension. This result is in line with studies done in Ghana, and the University of Gondar hospital, Ethiopia, that showed poor adherence or non-adherence to anti-hypertensive medication was found statistically associated with uncontrolled hypertension [34,40].

Limitations of the Study

This study has the following limitations: Some key confounding variables such as coffee drinking, khat chewing, and biochemical measurements were not included in the study. The study was facility-based and conducted with a relatively small sample size.

Conclusion

The magnitude of uncontrolled hypertension was found high. Non-adherence to antihypertensive medications, overweight and obesity, non-adherence to physical exercise, use of top-added salt, and lack of health education were the independent predictors of uncontrolled hypertension. So, health care professionals and other stakeholders should promote overweight hypertensive patients to reduce their weight and maximize patients' adherence to antihypertensive therapy, physical exercise, salt reduction and health education.

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Ethics Approval

Formal letters were prepared and presented to the hospital administration. Ethical approval was obtained from the Institutional Review Board (IRB) of Hawassa University comprehensive specialized Hospital. Informed verbal consent was obtained from every participant. All the information retrieved was kept in a way that could not disclose personal confidentiality. The data and information collected or analyzed were held confidential. We confirm that our study complies with the Declaration of Helsinki.

Availability of Data and Materials

Authors of this manuscript had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis. All the data included in the manuscript can be accessed from the corresponding author upon request.

Competing Interests

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