Uncontrolled hypertension and associated factors among adult hypertensive patients on follow-up at public hospitals, Eastern Ethiopia: A multicenter study

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Abstract

Objective: The aim of this study was to assess the magnitude of uncontrolled hypertension and associated factors among adult hypertensive patients on follow-up at public hospitals in Eastern Ethiopia.

Methods: A hospital-based cross-sectional study was conducted among 415 hypertensive patients in Eastern Ethiopia from June 15 to July 15, 2021. A systematic random sampling technique was used to select the study participants. Data were collected through face-to-face interviews and reviewing patients’ charts. Bivariable and multivariable logistic regression analyses were performed to identify factors associated with uncontrolled hypertension.

Results: This study revealed that magnitude of uncontrolled hypertension was 48% (95% confidence interval = 43.1%–52.8%). Being male (adjusted odds ratio = 2.05, 95% confidence interval = 1.29–3.26), age ≥55 years (adjusted odds ratio = 3.16, 95% confidence interval = 1.96–5.08), non-adherence to medication (adjusted odds ratio = 1.83, 95% confidence interval = 1.14–2.94), low diet quality (adjusted odds ratio = 4.04, 95% confidence interval = 2.44–8.44), physically inactive (adjusted odds ratio = 3.20, 95% confidence interval = 1.84–5.56), and having comorbidity (adjusted odds ratio = 3.04, 95% confidence interval = 1.90–4.85) were significantly associated with uncontrolled hypertension.

Conclusions: In our sample of hypertensive patients on follow-up at public hospitals in Eastern Ethiopia, half had uncontrolled hypertension. Older age, male sex, non-adherence to antihypertensive medication, low diet quality, physically inactive, and having comorbidity were found to be predictors of uncontrolled hypertension. Therefore, sustained health education on self-care practices with special emphasis on older, males, and patients with comorbid conditions.

Keywords
Uncontrolled hypertension, Blood pressure, Associated Factors, Eastern Ethiopia

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Introduction

Despite the availability of therapeutic options, most of the hypertensive patients were living with uncontrolled hypertension.¹,² More than 1 billion people live with hypertension. Out of these, 82% of them lived in low-income and middle-income countries.³ Uncontrolled hypertension is higher in Sub-Saharan Africa (SSA) than in Western countries over the past few decades,⁴ while more than three-fourths of hypertensive patients are living with uncontrolled hypertension.⁵ According to the result of the meta-analysis report, the pooled prevalence of uncontrolled hypertension in Ethiopia was 48%.⁶

Despite the increasing availability of low-cost drugs and increasing treatment options,⑦ hypertension is associated with a significant burden of morbidity and mortality.⁸,⁹,¹⁰,¹¹,¹² Hyper­tensive patients who were treated with inadequate control of blood pressure were at increased risk of developing complications such as cardiovascular disease, end-stage renal disease, congestive heart failure, and stroke.¹³,¹⁴,¹⁵

Based on the above information, the current study aimed to assess the magnitude of uncontrolled hypertension and associated factors among adult hypertensive patients on follow-up at public hospitals in Eastern Ethiopia.
with high rates of morbidity, disability, and premature death. The increase of systolic blood pressure (SBP) by 20 mm Hg and diastolic blood pressure (DBP) by 10 mm Hg above normal ranges could double the risk of cardiovascular diseases (CVDs), strokes, and kidney diseases. In the Ethiopian context, the annual death-related non-communicable diseases (NCDs) including hypertension are still high despite all efforts. To manage and control high blood pressure (BP), identifying factors that affect BP control status is important.

There were several factors associated with uncontrolled hypertension in previous studies being males, advanced age, rural residence, low educational level, family history of hypertension, smoking, khat chewing, alcohol consumption, excessive salt consumption, lack of physical activity, poor weight control, and diabetes. Most of these studies were conducted in a single hospital. Multiple comorbid conditions such as anxiety, depression, and the role of social support in uncontrolled hypertension were not properly explored. In addition, those identified factors were inconstantly reported across all studies. Therefore, this study aimed to determine uncontrolled hypertension and associated factors among adult hypertensive patients on follow-up at public hospitals, in Eastern Ethiopia.

Materials and methods

Study setting and design

A hospital-based cross-sectional study was conducted from 15 June to 15 July 2021, in four public hospitals: namely, Hiwot Fana Compressive Specialized University Hospital and Jugal Hospitals were found in Harar, whereas Dilchora Referral Hospital and Sabian General Hospital were selected from the Dire Dawa Administration. Harar is the capital city of the Harari region which is found at a 526 km distance to the southeast of Addis Ababa. Based on the 2007 Central Statistical Agency population census, the total population of the town was projected to be 259,260, of those 130,097 are females in 2021. Dire Dawa Administration is found in the Eastern part of Ethiopia at a distance of 515 km away from Addis Ababa. According to the 2007 Central Statistical Agency population census, the total population of Dire Dawa Administration was projected to be 599,651, of those 301,496 are females in 2021. Harar and Dire Dawa Administration are 48 km apart and share similar socio-cultural characteristics.

Population and sampling procedure

All adult hypertensive patients who had been taking antihypertensive medications ≥6 months and were willing to participate in the study were included. Those patients who missed at least two previous visits’ BP measurements and patients who had a cognitive impairment were excluded. A single population formula was used to calculate the sample size. The assumptions considered during the calculation of the sample size were 95% confidence level, 5% margin of error, and 52.5% of prevalence of uncontrolled hypertension from the study carried out in Mekelle, Ethiopia. By adding a 10% non-response rate, the final sample size became 421. There were a total of 2934 hypertensive patients on follow-up in all hospitals: Dilchora hospital (353), Hiwot Fana Compressive Specialized University Hospital (672), Sabian General Hospital (618), and Jugal hospital (585). After reviewing the monthly patient flow of each hospital from the registration books, the average number of patients who came for follow-up per month was calculated, and then 421 were allocated to each respective hospital. Finally, 152, 96, 89, and 84 hypertensive patients were selected from Dilchora Referral Hospital, Hiwot Fana Compressive Specialized University Hospital, Sabian General Hospital, and Jugal Hospitals, respectively. A systematic random sampling technique was used to select the study participants and the first cases were selected by lottery method, and the rest were enrolled every two patients.

Data collection and measurements

A pretested questionnaire was used for data collection. The questionnaire contains socio-demographic information (age, sex, educational level, residence, occupation, monthly income, and family history of hypertension). The level of self-care activity was assessed using Hypertension Self-Care Activity Level Effects (H-SCALE). The Cronbach’s alpha of medication adherence, low salt, physical activity adherence, weight management, and alcohol use was 0.94, 0.74, 0.81, 0.93, and 0.92, respectively. Hypertension knowledge was assessed by Hypertension Knowledge-Level Scale (HK-LS). The Cronbach’s alpha is 0.81, indicating an acceptable level of internal consistency. The clinical characteristics include duration diagnosis, comorbidity, body mass index (BMI), BP check-up, frequency of follow-up, source medication, number of medications, and comorbidity. The internal consistency of the Generalized Anxiety Disorder 7-item (GAD-7) scale was 0.90 whereas the internal consistency of the Patient Health Questionnaire-9 (PHQ-9) was 0.95 and social support was assessed by Oslo Social Support Scale (OSSS-3), and its internal consistency was 0.86. The patient charts were also reviewed for medical information and physical measurement.
**Hypertension control status**

The last two consecutive measurements of BP recordings were taken to determine the level of hypertension from the patients’ records. Based on the mean of BP measurements, the level of hypertension was further dichotomized into controlled and uncontrolled BP as per the Eighth Joint National Committee (JNC-8) recommendations. Patients were classified as having uncontrolled hypertension if BP ≥150/90 mm Hg in hypertensive patients age 60 years or ≥140/90 mm Hg for patients aged less than 60 years and all hypertensive patients with diabetes mellitus (DM) or chronic kidney disease (CKD) based on the average of three measurements unless considered as controlled hypertension.14,24,25

**Operational Definitions**

The H-SCALE scale contains six domains (subscale) of self-care practice activities (medication adherence, weight management, physical activity, smoking, alcohol intake, and low-salt diet). Medication adherence was measured by three items containing the number of days in the last 7 days. Responses were summed (range from 0–21). Patients who scored 21 out of 21 were considered as adherent to medication.19

Dietary Approaches to Stop Hypertension (DASH-Q) was assessed by 11 items. These items assess the intake of healthy foods associated with the nutritional composition of the DASH diet. Item seven (“Eat pickles, olives, or other vegetables in brine?”) were reverse coded. Responses for all items are then summed and range from 0–77. Scores of 32 and below are considered as low diet quality; scores between 33 and 51 are medium diet quality, and scores of 52 or greater should be considered adherent.19 Weight management was measured by 10 items rated from 1 (strongly disagree) to 5 (strongly agree). The responses summed (10–50). Patients’ score ≥40 was considered as adherent to weight management.19 Past 7 days of physical activity of patients were assessed by two items. Responses were scored (range=0–14). The patients who scored ≥8 were considered as adherent to physical activity.19 Patients who had not smoked in the last 7 days were considered non-smokers.19 Alcohol intake was assessed by three items participants who reported not drinking any alcohol in the last 7 days, or who indicated that they usually did not drink at all, were considered adherent.19

Hypertension knowledge was measured by HK-LS which contains 22 item questions. Nine of these items on the questionnaire were negatively phrased. Before the analysis, these were reverse coded. The total sum of the scores of the knowledge items gives a score ranging from 0 to 22. The mean value was calculated. Respondents who scored equal to the mean and above on the HK-LS were considered as good knowledge and respondents who scored below the mean were considered as poor knowledge about hypertension.

Anxiety was assessed by the GAD-7 scale, which are scored from 0 (not at all) to 3 (nearly every day), which gives a score ranging from 0 to 21. In this study, patients with a score ≥10 had anxiety.26

Depression was screened using the PHQ-9, which are scored from 0 (not at all) to 3 (nearly every day), with a score ranging from 0 to 27. In this study, patients who scored ≥10 were had depression.21

Social support was measured using Oslo Social Support Scale (OSSS-3) which contains three items. The first item is rated on a 4-point Likert-type scale ranging from 1 to 4. The second and the third items are rated on a 5-point Likert-type scale ranging from 1 to 5. The sum score ranges from 3 to 14. The ranges from 12 to 14 in OSSS-3 were considered as strong social support, 9 to 11 were considered as moderate social support, and 3 to 8 were poor social support.27

**Data quality control**

A pretest was conducted among 21 (5%) of the sample size at Haramaya General Hospital which is outside of the study area. Data collectors and supervisors were trained for 2 days on the data collection approach of the study. Data were collected using the local language (Amharic, Afaan Oromo, and Af Somali), according to patients’ preferences. Continuous follow-up and supervision were done.

**Statistical analysis**

The data were entered into EpiData version 3.1 and then exported to SPSS version 20 for analysis. Simple frequency, percentage, mean values, median, standard deviations, and interquartile range were generated as descriptive statistical analyses. Variables with a P-value of less than 0.25 in the bivariate binary logistic regression analysis were considered for the multivariable regression model. The multi co-linearity test was carried out to see the correlation between independent variables using variance inflation factor (VIF) and tolerance test; no variables were observed with tolerance test <0.1 and VIF of >10. The model fitness was checked using Hosmer–Lemeshow (p=0.33). Crude and adjusted odds ratios with a 95% confidence interval (CI) were estimated, and variables with P-value less than 0.05 in the multivariable regression analysis were taken as significant predictors of uncontrolled hypertension.

**Results**

**Socio-demographic characteristics**

In this study, 415 hypertensive patients participated giving a response rate of 98.6%. The mean age (±SD) of the patients was 50 (±19) years and 220 (53%) were males. Two hundred fifty-seven (61.9%) of the participants were married and regarding the religion of respondents, 174 (41.9%) were Muslim religion followers, and almost half, 200 (48.2%), of
the respondents, attended college and above. Two hundred sixty-five (36.1%) of the participants had a family history of hypertension (Table 1).

**Hypertension knowledge and hypertension self-care practice**

The mean knowledge score of the respondents was 13.02 ± 3.72. More than half, 241 (58.1%), scored above the mean value that indicated good knowledge about hypertension. Almost half, 204 (49.2%), were adherent to medication. One hundred thirty-four (32.3%) of study participants were adherent to a DASH-Q and only near to one-fourth, 118 (28.4%), practiced physical activity. The majority, 355 (85.5%), of the participants were non-smokers and 301 (72.5%) of them were alcohol abstainers. Almost half, 205 (49.4%), of them, were engaged to weight management protocol (Table 2).

**Clinical-related characteristics**

Almost half, 215 (51.8%), of the patients had a disease duration of less than 5 years. The majority of the participants, 255 (61.4%), had normal BMI (18.5–24.9), and nearly half,
181 (43.6%), had BP measurement more than two times per month at home, health institution, or elsewhere. Almost half, 208 (50.1%), had ever missed follow-ups. About 182 (43.9%) of the patients had comorbidity, and 111 (61%) of them had DM comorbidity (Table 3).

**Psychosocial-related characteristics**

Among the respondents, 92 (22.2%) had anxiety and 80 (19.28%) had depression. One hundred sixty (38.6%) of the patients had strong social support, while 117 (28.2%) of respondents had moderate social support and 138 (33.3%) of them had poor social support.

**The magnitude of uncontrolled hypertension**

Based on the average of three consecutive blood pressure (Bps) measurements, the magnitude of uncontrolled hypertension was 48% (95% CI=43.1%–52.8%). The mean of SBPs was 145.01 ± 15.13 mmHg and the mean DBPs was 88.25 ± 9.53 mmHg.

**Bivariate analysis for factors associated with uncontrolled hypertension**

The following variables were analyzed to see the association with outcome variables: sex, age, educational level, residence, family income, family history of hypertension, medication adherence, diet, smoking, physical activity, alcohol intake, weight management, BMI, duration of diagnosis, frequency of appointment, BP check-up, source medication coverage, number medication used, follow-up miss, comorbidity, anxiety, depression, and level of social support. However, only sex, age, medication adherence, low-salt diet, smoking, physical inactive, alcohol intake, weight management, follow-up miss, comorbidity, and depression were significantly associated with uncontrolled hypertension. In multivariable logistic regression analysis, sex, age, medication adherence, low-salt diet, physical exercise, and comorbidity were significantly associated with uncontrolled hypertension at P-value < 0.25 (Table 4).

**Factors associated with uncontrolled hypertension**

In multivariable logistic regression analysis, sex, age, medication adherence, low-salt diet, physical exercise, and comorbidity were significantly associated with uncontrolled hypertension. Male patients were two times greater odds of uncontrolled hypertension as compared to female patients (adjusted odds ratio (AOR) = 2.05, 95% CI = 1.29–3.26). Patients aged ≥50 years was three times greater odds of uncontrolled hypertension than patients aged <50 years (AOR = 3.16, 95% CI = 1.96–5.08). Patients poor adhered to medication was 1.87 times greater odds of uncontrolled hypertension than their counterparts (AOR = 1.83, 95% CI = 1.14–2.94). The odds of having uncontrolled hypertension were four times higher among patients with low diet quality than those adherent to a quality diet (AOR = 4.01,
Physically inactive was found to have 2.86 times greater odds of uncontrolled hypertension than physically active (AOR = 3.20, 95% CI = 1.84–5.56). The odds of having uncontrolled hypertension were 3.04 higher among patients who had confirmed comorbidity than their counterparts (AOR = 3.04, 95% CI = 1.90–4.85) (Table 5).

**Discussion**

The results of this study revealed that 48% of the patients on follow-up had uncontrolled hypertension. This finding was in line with studies conducted in Jimma Southwest Ethiopia (52.7%), Mekelle Northern Ethiopia (48.6%), and Congo (52.7%); however, the results of this study are higher than the studies conducted in Nekemte West Ethiopia (36.4%), Gondar Northern Ethiopia (37%), Sudan (36%), and Chile (36.9%). This inconsistency might be due to the proportion of non-adherence to medication, delivery services, proportion of comorbidity, and socio-demographic characteristics.

But, this finding is lower than other studies done in Addis Ababa central Ethiopia (69.9%), Debre Tabor Northern Ethiopia (57.1%), Kenya (64.7%), and Nigeria (60.8%). This discrepancy might be differences in the way of outcome variable categorized, study population, lifestyle

### Table 3. Clinical characteristics of adult hypertensive patients on follow-up at public hospitals, Eastern Ethiopia, 2021 (n=415).

| Variable                          | Frequency (n=415) | Percent (%) |
|----------------------------------|------------------|-------------|
| Body mass index (kg/m²)          |                  |             |
| 18.5–24.9                        | 255              | 61.4        |
| 25–29.9                          | 73               | 17.6        |
| ⩾30                              | 24               | 5.8         |
| <18.5                            | 63               | 15.2        |
| Duration of hypertension (years) |                  |             |
| <5                               | 215              | 51.8        |
| 5–10                             | 128              | 30.8        |
| >10                              | 72               | 17.3        |
| Frequency of appointment (months)|                  |             |
| 1 month                          | 125              | 30.2        |
| 2 months                         | 74               | 17.8        |
| 3 months                         | 216              | 52.0        |
| Blood pressure check-up (months) |                  |             |
| ⩾2 times                         | 181              | 43.6        |
| ⩽2 times                         | 234              | 56.4        |
| Source medication coverage       |                  |             |
| Health insurance                 | 243              | 58.5        |
| Self-sponsored                   | 136              | 32.8        |
| Free charge                      | 36               | 8.7         |
| Number medication used           |                  |             |
| Monotherapy                      | 162              | 39.0        |
| Dual therapy                     | 220              | 53.0        |
| ⩾Triple therapy                  | 33               | 8.0         |
| Follow-up missed                 |                  |             |
| Yes                              | 208              | 50.1        |
| No                               | 207              | 49.9        |
| Comorbidity                      |                  |             |
| Yes                              | 182              | 43.9        |
| No                               | 233              | 56.1        |
| Types of comorbidities (n = 182) |                  |             |
| Diabetes mellitus                | 111              | 61.1        |
| Chronic kidney disease           | 23               | 12.6        |
| Myocardial infarction            | 33               | 18.1        |
| Stroke                           | 26               | 14.3        |
| Others*                          | 29               | 15.9        |

*Others: heart failure, hyperlipidemia, and ischemic heart disease.
Table 4. Bivariate analysis for factors associated with uncontrolled hypertension among adult hypertensive patients in Eastern Ethiopia, 2021 (n = 415).

| Variable                                | Hypertension |          |          |          |
|-----------------------------------------|--------------|----------|----------|----------|
|                                         | Uncontrolled (%) | Controlled (%) | COR (95% CI) | P-value |
| **Sex**                                 |              |          |          |          |
| Male                                    | 127 (57.7)  | 93 (42.3) | 2.33 (1.57–3.46) | 0.00**  |
| Female                                  | 72 (36.9)   | 123 (63.1) | 1         |          |
| **Age (years)**                         |              |          |          |          |
| ⩾50                                     | 128 (60.7)  | 83 (39.3) | 2.88 (1.93–4.30) | 0.00**  |
| <50                                     | 71 (34.8)   | 133 (65.2) | 1         |          |
| **Educational level**                   |              |          |          |          |
| No formal education                     | 26           | 25       | 1.15 (0.64–2.06) | 0.645   |
| Formal education                        | 173          | 191      | 1         |          |
| **Residence**                           |              |          |          |          |
| Rural                                   | 63           | 68       | 1.00 (1.67–1.53) | 0.974   |
| Urban                                   | 136          | 148      | 1         |          |
| **Family income**                       |              |          |          |          |
| ⩽500                                    | 25           | 25       | 1.11 (0.6–2.03) | 0.733   |
| 500–2000                                | 48           | 51       | 1.04 (0.66–1.66) | 0.852   |
| >2000                                   | 126          | 140      | 1         |          |
| **Family history of hypertension**      |              |          |          |          |
| Yes                                     | 75           | 75       | 1.14      | 0.530   |
| No                                      | 124          | 141      | 1         |          |
| **Medication adherence**                |              |          |          |          |
| No-adherent                             | 118 (55.9)  | 93 (44.1) | 1.92 (1.3–2.84) | 0.001*  |
| Adherent                                | 81 (39.7)   | 123 (60.3) | 1         |          |
| **Diet**                                |              |          |          |          |
| Low diet quality                        | 98           | 36       | 6.22 (2.4–12.09) | 0.005*  |
| Medium diet quality                     | 45           | 52       | 1.98 (1.13–4.21) |          |
| Adherent diet quality                   | 56           | 128      | 1         |          |
| **Non-smoking**                         |              |          |          |          |
| No-adherent                             | 79 (58.5)   | 56 (41.5) | 1.88 (1.24–2.85) | 0.003*  |
| Adherent                                | 120 (42.9)  | 160 (57.1) | 1         |          |
| **Physical activity**                   |              |          |          |          |
| Physically inactive                     | 166 (55.9)  | 131 (44.1) | 3.26 (2.05–5.18) | 0.00**  |
| Physically active                       | 33 (28.0)   | 85 (72.0) | 1         |          |
| **Alcohol abstinence**                  |              |          |          |          |
| No-adherent                             | 64 (56.1)   | 50 (43.9) | 1.57 (1.02–2.42) | 0.041*  |
| Adherent                                | 135 (44.9)  | 166 (55.1) | 1         |          |
| **Weight management**                   |              |          |          |          |
| No-adherent                             | 113 (53.8)  | 97 (46.2) | 1.61 (1.09–2.37) | 0.016*  |
| Adherent                                | 86 (42.0)   | 119 (58.0) | 1         |          |
| **Body mass index (kg/m²)**             |              |          |          |          |
| 18.5–24.9                               | 106          | 149      | 1         |          |
| 25–29.9                                 | 40           | 33       | 1.7 (0.76–2.33) | 0.261   |
| ⩾30                                     | 14           | 10       | 1.97 (0.98–2.45) | 0.451   |
| <18.5                                   | 29           | 34       | 1.2 (0.64–1.97) | 0.672   |
| **Duration of diagnosis (years)**       |              |          |          |          |
| <5                                      | 93           | 122      | 1         |          |
| 5–10                                    | 68           | 60       | 0.67 (0.22–1.23) | 0.885   |
| >10                                     | 38           | 35       | 0.70 (0.45–1.12) | 0.918   |
| **Frequency of appointment (months)**   |              |          |          |          |
| 1 month                                 | 125          | 30.2     | 1.6 (1.03–2.5) | 0.37    |
| 2 months                                | 74           | 17.8     | 0.72 (0.42–1.24) | 0.43    |
| 3 months                                | 216          | 52       | 1         |          |

(Continued)
behaviors, and environmental factors. For instance, one BP value was used in a study done in Kenya, but in this study, an average of three BP results was used and this might increase the proportion of uncontrolled hypertension.

In this study, uncontrolled hypertension was higher among male than female patients. The possible justification might be due to females are more adherent to most components of the hypertension lifestyle modifications. Another possible justification might be men are burdened by outdoor activities which make them busy and make them forget their medications. Alcohol consumption, a common practice by males, could also be a barrier to their treatment adherence. This is in line with other studies conducted in Nekemte West Ethiopia, Morocco, Congo, Iran, and Vietnam.

In this study, the odds of having uncontrolled hypertension are also higher among patients aged ≥50 years. This is consistent with studies done in Jimma Southwest Ethiopia, Mekelle Northern Ethiopia, Uganda, Angola, India, and Lebanon. This could be due to the biological effect of increased SBP with age, mainly due to the reduction in elasticity (increased stiffness) of large duct arteries which in turn leads to arterial stiffening, peripheral vascular resistance which leads to raised BP. Another possible reason might be older age is unfavorable with most hypertension self-care practices whereas hypertension self-care practices are important for control of BP.

Non-adherence to antihypertensive medication was also positively associated with uncontrolled hypertension. This finding is consistent with other studies conducted in Mekelle, Gondar Northern Ethiopia, Sudan, Cameroon, and Congo. This might be due to antihypertensive medications controlling high BP by vasodilatation, increasing urination to remove excess salt and fluid from the body which leads to decreasing of BP. In addition, one-third of the patients’ monthly income was very lower than two thousand Ethiopian Birr, which indicates they cannot afford the price of the medicines this might affect medication adherence.

This study revealed that hypertensive patients with low diet quality were more likely associated with uncontrolled hypertension than those who adhered to a quality diet. This is supported by studies conducted in Mekelle, Debre Tabor,

| Variable                        | Hypertension               | COR (95% CI) | P-value |
|---------------------------------|----------------------------|--------------|---------|
|                                 | Uncontrolled (%) | Controlled (%) |          |
| Blood pressure check-up (months) |                         |              |         |
| ≤2 times                        | 138                       | 96           | 1.77 (0.98–2.89) | 0.340 |
| ≥2 times                        | 81                        | 100          | 1       |        |
| Source medication coverage      | Health insurance          | 108          | 135     | 1       |        |
|                                 | Self-sponsored            | 71           | 65      | 1.37 (0.89–2.08) | 0.32 |
|                                 | Free charge               | 20           | 16      | 1.56 (0.77–3.16) | 0.411 |
| Number medication used          | Monotherapy               | 88           | 74      | 1.61 (0.78–2.25) | 0.345 |
|                                 | Dual therapy              | 115          | 105     | 1.48 (0.64–2.54) | 0.561 |
|                                 | ≥Triple therapy           | 14           | 19      | 1       |        |
| Follow-up miss                  | Yes                       | 112 (53.8)   | 96 (46.2)| 1.60 (1.09–2.37) | 0.016* |
|                                 | No                        | 87 (42.0)    | 120 (58.0)| 1       |        |
| Comorbidity                     | Yes                       | 117 (64.3)   | 65 (35.7)| 3.31 (2.21–4.97) | 0.000*** |
|                                 | No                        | 82 (35.2)    | 151 (64.8)| 1       |        |
| Anxiety                         | Yes                       | 52           | 40      | 1.21 (0.46–3.45) | 0.761 |
|                                 | No                        | 167          | 156     | 1       |        |
| Depression                      | Yes                       | 40 (58.0)    | 29 (42.0)| 1.62 (0.96–2.73) | 0.07  |
|                                 | No                        | 159 (46.0)   | 187 (54.0)| 1       |        |
| Level of social support         | Poor social support       | 72           | 66      | 1.37 (0.87–2.16) | 0.179 |
|                                 | Moderate social support   | 56           | 61      | 1.15 (0.71–1.86) | 0.565 |
|                                 | Strong social support     | 71           | 89      | 1       |        |

CI: confidence interval; COR: crude odds ratio.

*P < 0.05; **P < 0.001.
and Gondar Northern Ethiopia, China, and French. 25,28,34,53,54

This is due to the effect of high-salt diets on the activation of the renin–angiotensin–aldosterone system (RAAS) disrupts the natural sodium balance in the body and causes fluid retention that increases the pressure exerted by the blood against blood vessel walls. 55

Another possible justification is that one-third of the study participants had poor social support since the existence of the family or relative support increased adherence to medication, a low-salt diet, and reminding follow-up time. The World Health Organization (WHO) 56 self-care practices (SCP) guideline supports the presence of good social support for coping with chronic diseases like hypertension.

This study shows that physically inactive patients were more likely associated with uncontrolled hypertension than their counterparts. This is similar to studies done in Mekelle and Debre Tabor Northern Ethiopia, South Africa, China, and the United States. 28,34,57–59

The reason could be physical activity controls high BP through enhancement of heart function, renal function, and preventing weight gain. 60,61

Another possible reason is that physical activity also increases endothelial function and decreases psychosocial stress. 61

Patients with other medically confirmed comorbidities were more likely to have uncontrolled hypertension than those patients without other comorbidities. This is in line with studies conducted in Gondar and AyderNorthern

| Variable                  | Hypertension |       | COR (95% CI) | AOR (95% CI) |
|---------------------------|--------------|-------|--------------|--------------|
|                           | Uncontrolled (%) | Controlled (%) |               |              |
| **Sex**                   |              |       |              |              |
| Male                       | 127 (57.7)  | 93 (42.3) | 2.33 (1.57–3.46)** | 2.05 (1.29–3.26)* |
| Female                     | 72 (36.9)   | 123 (63.1) | I             | I            |
| **Age (years)**            |              |       |              |              |
| ⩾50                        | 128 (60.7)  | 83 (39.3) | 2.88 (1.93–4.30)** | 3.16 (1.96–5.08)** |
| <50                        | 71 (34.8)   | 133 (65.2) | I            | I           |
| **Medication adherence**   |              |       |              |              |
| No-adherent                | 118 (55.9)  | 93 (44.1) | 1.92 (1.3–2.84)* | 1.83 (1.14–2.94)* |
| Adherent                   | 81 (39.7)   | 123 (60.3) | I             | I            |
| **Diet**                   |              |       |              |              |
| Low diet quality           | 98           | 36     | 6.22 (2.4–12.09)** | 4.01 (2.44–8.44)* |
| Medium diet quality        | 45           | 52     | 1.98 (1.13–4.21) | 1.32 (0.6–3.45) |
| Adherent diet quality      | 56           | 128    | I             | I            |
| **Non-smoking**            |              |       |              |              |
| No-adherent                | 79 (58.5)   | 56 (41.5) | 1.88 (1.24–2.85)* | 1.54 (0.88–2.69) |
| Adherent                   | 120 (42.9)  | 160 (57.1) | I             | I            |
| **Physical activity**      |              |       |              |              |
| Physically inactive        | 166 (55.9)  | 131 (44.1) | 3.26 (2.05–5.18)** | 3.20 (1.84–5.56)** |
| Physically active          | 33 (28.0)   | 85 (72.0) | I             | I            |
| **Alcohol abstinence**     |              |       |              |              |
| No-adherent                | 64 (56.1)   | 50 (43.9) | 1.57 (1.02–2.42)* | 1.55 (0.90–2.68) |
| Adherent                   | 135 (44.9)  | 166 (55.1) | I             | I            |
| **Weight management**      |              |       |              |              |
| No-adherent                | 113 (53.8)  | 97 (46.2) | 1.61 (1.09–2.37)* | 1.53 (0.92–2.54) |
| Adherent                   | 86 (42.0)   | 119 (58.0) | I             | I            |
| **Follow-up miss**         |              |       |              |              |
| Yes                        | 112 (53.8)  | 96 (46.2) | 1.60 (1.09–2.37)* | 1.27 (0.79–2.03) |
| No                         | 87 (42.0)   | 120 (58.0) | I             | I            |
| **Comorbidity**            |              |       |              |              |
| Yes                        | 117 (64.3)  | 65 (35.7) | 3.31 (2.21–4.97)** | 3.04 (1.90–4.85)** |
| No                         | 82 (35.2)   | 151 (64.8) | I             | I            |
| **Depression**             |              |       |              |              |
| Yes                        | 40 (58.0)   | 29 (42.0) | 1.62 (0.96–2.73) | 1.86 (0.98–3.53) |
| No                         | 159 (46.0)  | 187 (54.0) | I             | I            |

CI: confidence interval; COR: crude odd ratio; AOR: adjusted odd ratio.

*P < 0.05; **P < 0.001.
Ethiopia, South Asia, Thailand, and Malaysia. This might be due to many chronic diseases affecting endothelial cells which disturb the dilation of blood vessels or might be due to insulin resistance.

Strength and limitations of the study

This study was a multicenter study that would have a better representation of the study participants and the generalizability of the result. This study would not be free from the limitations. Since it was a cross-sectional study, it did not show a temporal relationship. In addition, the tools (questionnaires) were validated in different contexts and some items may not have been relevant in the study context. Finally, in this study, factors associated with dropping out of care or not attending a clinic visit were not assessed.

Conclusions

The magnitude of uncontrolled hypertension was higher in this study. Male sex, age ≥50 years, non-adherence to antihypertensive medication, low diet quality, being physically inactive, and having comorbidity were significantly associated with uncontrolled hypertension. So, healthcare professionals and other stakeholders need to design interventions that enhance lifestyle modifications including healthy dietary practice, physical activity, and medication-taking behaviors.

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Author contributions

L.A., S.L., N.A., and S.G. participated in the conception of the idea, development, amendment of the proposal, data collection, analysis, and write-up of the results. M.L., E.Y., T.B., A.H., and Y.G. have participated in data collection, analysis, and manuscript write-up.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

Ethical clearance was obtained from the Institutional Health Research Ethics Review Committee (IHRERC) of Haramaya University, College of Health and Medical Sciences on 10 June with reference number N0.IHRERC/079/2021. A formal letter of permission and support was provided to all hospitals in which the study was conducted from Haramaya University.

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Informed consent

Written informed consent was obtained from all subjects who were ≥18 years old before the study after explanations about the aims, objectives, benefits, and harms of the study was provided. During data collection, the COVID-19 prevention protocol was kept.

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Data availability

Data can be made available on request to the corresponding authors.

Supplemental material

Supplemental material for this article is available online.

References

1. Whelton PK, Carey RM, Aronow WS, et al. 2017 ACC/AHA/ACP/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: a report of the American College of Cardiology/American Heart Association task force on clinical practice guidelines. J Am Coll Cardiol 2018; 71(19): e127–e248.
2. Kingue S, Ngec CN, Menanga AP, et al. Prevalence and risk factors of hypertension in urban areas of Cameroon: a nationwide population-based cross-sectional study. J Clin Hypertens 2015; 17(10): 819–824.
3. Ezzat M. 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. Lancet 2021; 398: 957–980.
4. Van de Vijver S, Akinyi H, Oti S, et al. Status report on hypertension in Africa—consultative review for the 6th session of the African union conference of ministers of health on NCD’s. Pan Afr Med J 2013; 16(1): 38.
5. Ataklte F, Erqou S, Kaptoge S, et al. Burden of undiagnosed hypertension in sub-Saharan Africa: a systematic review and meta-analysis. Hypertension 2015; 65(2): 291–298.
6. Amare F, Hagos B, Sisay M, et al. Uncontrolled hypertension in Ethiopia: a systematic review and meta-analysis of institution-based observational studies. BMC Cardiovasc Disord 2020; 20(1): 129.
7. Ostchega Y, Fryar CD, Nwankwo T, et al. Hypertension prevalence among adults aged 18 and over: United States, 2017–2018. NCHS Data Brief 2020; 364: 1–8.
8. World Health Organization. Hypertension. Geneva: World Health Organization, 2021.
9. Michael A, Schiffrin EL, White WB, et al. Clinical practice guidelines for the management of hypertension in the community. A statement by the American Society of Hypertension and the International Society of Hypertension. New York: American Society of Hypertension, 2013.

10. Briasoulis A, Agarwal V, Tousoulis D, et al. Effects of antihypertensive treatment in patients over 65 years of age: a meta-analysis of randomised controlled studies. Heart 2014; 100(4): 317–323.

11. World Health Organization. Noncommunicable diseases (NCD) country profiles. Risk of premature death due to NCDs in Ethiopia. Geneva: World Health Organization, 2018.

12. Dagnaw WW. Assessment of priority non-communicable diseases and injuries (NCDD) interventions and human resourceing at selected health facilities in four regions of Ethiopia. Boston, MA: Harvard Medical School, 2021.

13. Tesfaye B, Haile D, Lake B, et al. Uncontrolled hypertension and associated factors among adult hypertensive patients on follow-up at Jimma University Teaching and Specialized Hospital: cross-sectional study. Res Rep Clin Cardiol 2017; 8: 21–29.

14. Fekadu G, Adamu A, Gebre M, et al. Magnitude and determinants of uncontrolled blood pressure among adult hypertensive patients on follow-up at Nekemte Referral Hospital, Western Ethiopia. Integr Blood Press Control 2020; 13: 49–61.

15. 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 Cardiovasc Disord 2019; 19(1): 121.

16. Ho AK, Thorpe CT, Pandhi N, et al. Association of anxiety and depression with hypertension control: a US multidisciplinary group practice observational study. J Hypertens 2015; 33(11): 2215–2222.

17. Wang L, Li N, Heizhati M, et al. Association of depression with uncontrolled hypertension in primary care setting: a cross-sectional study in less-developed Northwest China. Int J Hypertens 2021; 2021: 6652228.

18. Ojo OS, Malomo SO and Sogunle PT. Blood pressure (BP) control and perceived family support in patients with essential hypertension seen at a primary care clinic in Western Nigeria. J Family Med Prim Care 2016; 5(3): 569–575.

19. Warren-Findlow J, Basalik DW, Dulin M, et al. Preliminary validation of the hypertension self-care activity level effects (H-scale) and clinical blood pressure among patients with hypertension. J Clin Hypertens 2013; 15(9): 637–643.

20. Erkoc SB, Isikli B, Metintas S, et al. Hypertension Knowledge-Level Scale (HK-LS): a study on development, validity and reliability. Int J Environ Res Public Health 2012; 9(3): 1018–1029.

21. Spitzer RL, Kroenke K, Williams JB, et al. A brief measure for assessing generalized anxiety disorder: the GAD-7. Arch Intern Med 2006; 166(10): 1092–1097.

22. Gelaye B, Williams MA, Lemma S, et al. Validity of the patient health questionnaire-9 for depression screening and diagnosis in East Africa. Psychiatr Res 2013; 210(2): 653–661.

23. Dalgard OS, Dowrick C, Lehtinen V, et al. Negative life events, social support and gender difference in depression. Soc Psychiatry Psychiatr Epidemiol 2006; 41(6): 444–451.

24. James PA, Oparil S, Carter BL, et al. 2014 evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8). JAMA 2014; 311(5): 507–520.

25. Animit Y, Assefa AT and Lemma DG. Blood pressure control status and associated factors among adult hypertensive patients on outpatient follow-up at University of Gondar Referral Hospital, Northwest Ethiopia: a retrospective follow-up study. Integ Blood Press Control 2018; 11: 37–46.

26. Kroenke K and Spitzer RL. The PHQ-9: a new depression diagnostic and severity measure. Thorofare, NJ: SLACK Incorporated, 2002.

27. Kocalevent RD, Berg L, Beutel ME, et al. Social support in the general population: standardization of the Oslo social support scale (OSSS-3). BMC Psychol 2018; 6: 31.

28. Aberhe W, Mariye T, Bahrey D, et al. Prevalence and factors associated with uncontrolled hypertension among adult hypertensive patients on follow-up at Northern Ethiopia, 2019: cross-sectional study. Pan Afr Med J 2020; 36: 187.

29. Ikama MS, Nsitou BM, Makani J, et al. Arterial hypertension and control in Brazaville (Congo): role of ambulatory blood pressure monitoring (ABPM). Ann Cardiol Angeiol 2015; 64(2): 76–80.

30. Abdu O, Diri E, Balcha A, et al. Blood pressure control among hypertensive patients in University of Gondar Hospital, Northwest Ethiopia: a cross sectional study. Clin Med Res 2017; 6: 99–105.

31. Babiker FA, Elkalifa LA and Moukhlyer ME. Awareness of hypertension and factors associated with uncontrolled hypertension in Sudanese adults. Cardiovasc J Afr 2013; 24(6): 208–212.

32. Sandoval D, Nazzal C and Romero T. Clinical, socioeconomics, and psychosocial factors associated with blood pressure control and adherence: results from a multidisciplinary cardiovascular national program providing universal coverage in a developing country. Int J Hypertens 2018; 2018; 5634352.

33. Yazie D, Shibeshi W, Alebachew M, et al. Assessment of blood pressure control among hypertensive patients in Zewditu Memorial Hospital, Addis Ababa, Ethiopia: a cross-sectional study. J Bioanal Biomed 2018; 10(3): 80–87.

34. Teshome DF, Demissie AF and Zeleke BM. Determinants of blood pressure control amongst hypertensive patients in Northwest Ethiopia. PLoS ONE 2018; 13(5): e0196535.

35. Kubo MN, Kayima JK, Were AJ, et al. Factors associated with uncontrolled hypertension among renal transplant recipients attending nephrology clinics in Nairobi, Kenya. J Transplant 2015; 2015: 746563.

36. Azeez IA, Ige OM, Ilori T, et al. Prevalence of uncontrolled hypertension at a secondary health care center in South-Western Nigeria. Afr J Biomed Res 2020; 23: 207–211.

37. Gebremichael GB, Berhe KK, Beyene BG, et al. Self-care practices and associated factors among adult hypertensive patients in Ayder Comprehensive Specialized Hospital, Tigray, Ethiopia, 2018. BMC Res Notes 2019; 12(1): 489.

38. Agedom SW, Atey TM and Desse TA. Antihypertensive medication adherence and associated factors among adult hypertensive patients at Jimma University Specialized Hospital, Southwest Ethiopia. BMC Res Notes 2018; 11(1): 27.
39. Essayagh T, Essayagh M, El Rhaeffoulia A, et al. Prevalence of uncontrolled blood pressure in Meknes, Morocco, and its associated risk factors in 2017. PLoS ONE 2019;14(8): e0220710.

40. Arabzadeh S, Sadeghi M, Rabiei K, et al. Determinants of uncontrolled hypertension in an Iranian population. ARA Atheroscler 2014;10(1):25–31.

41. Nguyen HT, Phuong NHT, Nguyen NT, et al. Characterizing patients with uncontrolled blood pressure at an urban hospital in Hanoi, Vietnam. Int J Hypertens 2020; 2020: 5710281.

42. Musinguzi G, Van Geertruyden JP, Bastiaens H, et al. Uncontrolled hypertension in Uganda: a comparative cross-sectional study. J Clin Hypertens 2015;17(1):63–69.

43. Pires JE, Sebastião YV, Langa AJ, et al. Patterns and predictors of undiagnosed and uncontrolled hypertension: observations from a poor-resource setting. J Hum Hypertens 2017;31(1):56–65.

44. Kanungo S, Mahapatra T, Bhowmik K, et al. Patterns and predictors of undiagnosed and uncontrolled hypertension: a cross-sectional study. J Clin Hypertens 2015; 17(1): 63–69.

45. Ke L, Ho J, Feng J, et al. Prevalence, awareness, treatment and control of hypertension in Macau: results from a cross-sectional epidemiological study in Macau, China. Am J Hypertens 2015;28(2):159–165.

46. World Health Organization. World Health Organization website. Available at: https://www.who.int. Accessed [insert date].

47. World Health Organization. WHO consolidated guideline on self-care interventions for health: sexual and reproductive health and rights: web supplement: GRADE tables. Geneva: World Health Organization, 2019.

48. Masilela C, Pearce B, Ongole JJ, et al. Cross-sectional study of prevalence and determinants of uncontrolled hypertension among South African adult residents of Mkhondo municipality. BMC Public Health 2020;20(1):1069.

49. Yang L, Xu X, Yan J, et al. Analysis on associated factors of uncontrolled hypertension among elderly hypertensive patients in Southern China: a community-based, cross-sectional survey. BMC Public Health 2014;14(1):903.

50. Egan BM. Physical activity and hypertension: knowing is not enough; we must apply. Willing is not enough; we must do. Parvus von Goethe. Hypertension 2017; 69(3): 404–406.

51. Lee DC, Sui X, Church TS, et al. Changes in fitness and fatness on the development of cardiovascular disease risk factors hypertension, metabolic syndrome, and hypercholesterolemia. J Am Coll Cardiol 2017; 69(3): 404–406.

52. Lee DC, Sui X, Church TS, et al. Changes in fitness and fatness on the development of cardiovascular disease risk factors hypertension, metabolic syndrome, and hypercholesterolemia. J Am Coll Cardiol 2017; 69(3): 404–406.

53. Jafar TH, Gandhi M, Jehan I, et al. Determinants of uncontrolled hypertension in rural communities in South Asia: Bangladesh, Pakistan, and Sri Lanka. Am J Hypertens 2018; 31(11): 1205–1214.

54. Sakboonyarat B, Rangsin R, Kantiwong A, et al. Prevalence and associated factors of uncontrolled hypertension among hypertensive patients: a nation-wide survey in Thailand. BMC Res Notes 2019;12(1):380.

55. Ghazali R, Lukman KA, Naing DKS, et al. Factors associated with uncontrolled hypertension among hypertensive patients reported from different primary health clinics in Tuaran, Sabah, Malaysia: a cross sectional study. Turk Klin J Med Sci 2020; 40(1): 52–58.

56. Pugh D, Gallagher PJ and Dhaun N. Management of hypertension in chronic kidney disease. Drugs 2019; 79(4): 365–379.