RESEARCH

Open Access

Determinants of uncontrolled blood pressure among adult hypertensive patients on follow-up at Negelle and Adola General Hospital, Guji Zone, Southern Ethiopia: facility-based case control study

Azmach Habtegiorgis[1,2]*, Alo Edin[2], Kebebew Lemma[2], Takala Utura[2], Dereje Girma[2,4], Dawit Getachew[3] and Teshome Bekele[5,6]

Abstract

Background Uncontrolled blood pressure is a significant public health problem associated with a high rate of mortality and morbidity worldwide. In Ethiopia, 48% of hypertensive patients have Uncontrolled blood pressure. Therefore, this study aimed to identify the determinants of uncontrolled blood pressure among adult hypertensive patients on follow-up at the Negele and Adola General Hospitals in the Guji Zone, Oromia, Ethiopia.

Methods A facility-based, unmatched case–control study was conducted in Negelle and Adola General Hospitals, Guji Zone, from January-01–30, 2023, on 384 samples. Study participants were selected consecutively as they came for treatment until the required sample size was obtained. The data were collected using an interview-administered structured questionnaire and medical chart review. The data were entered into Epi-data version 3.1 and exported to SPSS version 25 for analysis. Binary logistic regression analysis was used to model the association between the dependent and independent variables. The candidate variables with $p < 0.25$ in the bivariate analysis were entered into the multivariable logistic regression. An Adjusted Odds ratio (AOR) and 95% CI were used to measure the strength of the association. Finally, at $p < 0.05$, statistical significance was declared.

Results A sample of 384 respondents (128 cases and 256 controls) were included, for a response rate of 100%. No adherence to medication (AOR = 2.01, 95% CI = 1.16–3.44), no adherence to smoking abstinence (AOR = 1.84, 95% CI = 1.05–3.22), no adherence to weight management (AOR = 2.02, 95% CI = 1.04–3.92), poor hypertension knowledge (AOR = 2.18, 95% CI = 1.26–3.76), use of traditional medicine (AOR = 9.13, 95% CI = 5.31–15.69), and overweight (AOR = 3.35, 95% CI = 1.79–6.26) were significantly associated with uncontrolled blood pressure.

Conclusion This study revealed that no adherence to medication, smoking, weight management, poor hypertension knowledge, traditional medicine use, and being overweight were determinants of uncontrolled blood pressure. Since these are modifiable and preventable factors, there is a need to implement interventions that will enhance self-care practices in this population to improve treatment outcomes.

Keywords Uncontrolled blood pressure, Determinant, Case–control, Guji, Ethiopia

*Correspondence:
Azmach Habtegiorgis
azmachhabte2022@gmail.com
Full list of author information is available at the end of the article

Habtegiorgis *et al. BMC Public Health*   (2024) 24:2971

Page 2 of 12

Background

Hypertension is defined as a state of sustained elevated systolic blood pressure (SBP) of 140 mm Hg or greater and/or diastolic blood pressure (DBP) of 90 mm Hg or greater based on the average of at least two accurate blood pressure measurements taken at two visits [1–3]. It is one of the major but preventable risk factors for coronary artery disease, hemorrhagic and ischemic stroke, heart failure, and chronic kidney disease if uncontrolled [4–6]. According to the Report of the Joint National Committee on Prevention, Detection, and Evaluation of High Blood Pressure JNC-8, Uncontrolled is defined as blood pressure (BP) ≥ 150/90 mmHg in hypertensive patients aged 60 or older, or BP ≥ 140/90 mmHg in hypertensive patients aged less than 60 years and all ages of hypertensive patients with diabetes mellitus or chronic kidney disease [2], based on an average of two or more measurements at two or more follow-up visits [7].

Uncontrolled blood pressure is a major public health challenge among hypertensive patients in both high- and low-income countries, including sub-Saharan Africa (SSA) [4, 7], where the prevalence of uncontrolled hypertension is very high [8]. In sub-Saharan Africa (SSA) including Ethiopia, the adult hypertensive population is predicted to be 150 million by 2025 [9]. According to the World Health Organization (WHO), 2023 reports worldwide, 1.28 billion people have hypertension, two-thirds live in low- and middle-income countries (LMICs), and one in five adults (21%) of hypertensive patients has UBP [9]. Africa is one of the regions in the world with the highest prevalence of UBP [10]; 93% of the pooled prevalence of UBP was reported by systematic review and meta-analysis in SSA [8]. In particular, in Ethiopia, a systematic review and meta-analysis of 13 studies revealed a 48% pooled incidence [11]. However, individual studies have shown various reports ranging from 11.4% in Gondar University Hospital to 52.7% in Jima University Teaching and Specialized Hospital and 69.9% in Zewditu Memorial Hospital [4, 7, 12]. These findings indicated that almost half of the hypertensive patients who were following their treatment in health institutions in Ethiopia did not achieve their target blood pressure (BP). However, it could be possible to achieve adequate blood pressure targets in approximately 70–80% of patients by improving adherence to lifestyle modifications and/or intensifying pharmacologic therapy [13, 14].

Despite the increase in the availability of affordable treatment options, UBP is associated with high rates of morbidity, disability, and premature death [15]. According to a World Health Organization (WHO) report, UBP is estimated to cause 7.5 million deaths worldwide. This figure accounts for 57 million disability-adjusted life years (DALYS) or 3.7% of the total DALYS [16]. UBP is responsible for at least 45% of deaths due to heart disease and 51% of deaths due to stroke [17]. A systematic review performed in Ethiopia revealed that the leading cause of death was CVD (24%), the proportions of which were 12% and 11%, respectively, for UBP and stroke [18]. Furthermore, uncontrolled blood pressure also has societal and economic consequences in addition to the direct costs associated with healthcare utilization for the management of complications by causing significant productivity losses from disability and premature death [19]. Premature deaths from NCDs in Ethiopia were mainly due to CVD, which was primarily attributable to UBP [3]. Thus, attaining the target of a one-third relative reduction in premature death from CVD set by the Ethiopia National Health Strategy for Prevention and Control of Non-communicable Diseases 2030 and SDG 3 will be difficult.

There is a variety of contributing factors to the condition of patients with hypertension who have UBP. Concerning socio-demographic factors, the associations between marital status, sex, ethnicity, and uncontrolled blood pressure, according to previous studies are inconsistent [5, 7, 14, 15, 20]. Sex [14, 21], age [4, 5, 7, 14, 15, 22], residence [23], and education level [14, 21] were associated with uncontrolled blood pressure. In terms of self-care practices for adherence to lifestyle modifications, non-adherence to medication [5, 14, 15, 24, 25], a low-salt diet [5], physical exercise [5, 14, 24], smoking abstinence [7, 15], weight management [5], alcohol abstinence [7, 24], and khat chewing [7] were associated with UBP**.** However, the factors that determine UBP vary from place to place even though proper lifestyle modification should work in combination with or in place of medical therapy for blood pressure control, as suggested by different studies [3, 4, 7]. Thus, these might not be the only interventions to be applied to control blood pressure. Improving the management and control of hypertension will require an understanding of the determinants that affect blood pressure control.

Most of the previous studies conducted on UBP were cross-sectional studies; to the best of our knowledge, there are no case–control studies on the determining factors of UBP in Ethiopia. Furthermore, little is known about the role of depression, social support, and anxiety in UBP [24–26]. In addition, studies have shown that traditional medicine use is widespread in SSA, including Ethiopia, as a treatment option for a wide range of diseases with or without modern medicine [27]. However, its association with UBP has not been fully elucidated, and its role has been insufficiently studied. Inadequate information regarding the determining factors of UBP affects the management of hypertension and the care of hypertensive patients in the country. This problem is worse in

Habtegiorgis *et al. BMC Public Health*   (2024) 24:2971

Page 3 of 12

Ethiopia, where patients undergo low-level screening and follow-up. Hence, this study identified determinants of uncontrolled blood pressure among adult hypertensive patients on follow-up at the Negelle and Adola hospitals in the Guji zone in Oromia, Ethiopia.

Methods and materials

Study area, study design and study period

A facility-based, unmatched case–control study was conducted at Negelle and Adola General Hospital in the Guji zone, Oromia, southern Ethiopia, from January 1st to 30th, 2023. These Hospitals are located 595 km and 470 km away from Addis Ababa, respectively. There are two general hospitals within the zone, and both were selected for inclusion in the study due to their high patient flow. These general hospitals are meant to serve a catchment population of more than 1.5 million. Each of these hospitals provides chronic illness follow-up care at their chronic care outpatient department (OPD). The service is given routinely on working days. The chronic care OPD is composed of hypertension, DM, and other chronic cases. Each chronic care unit included two trained nurses and one trained physician.

Population

The source population of this study was all adult hypertensive patients who were followed up at the chronic care follow-up outpatient visits of the Negelle and Adola General Hospitals. The study population included adult hypertensive patients with uncontrolled blood pressure and controlled blood pressure at the time of treatment at the chronic care follow-up (OPD) of Negelle and Adola General Hospital. The study population included sample participants aged 18 years and older for at least 6 months with a mean BP ≥ 150/90 mmHg in hypertensive patients aged 60 or older, or BP ≥ 140/90 mmHg in hypertensive patients aged less than 60 years and all ages of hypertensive patients with diabetes mellitus or chronic kidney disease based on the average of two or more properly measured, seated BP readings at two or more office visits [2]; a control participant aged 18 years or older for hypertension for at least 6 months following first enrollment before data collection with a mean BP < 150/90 mmHg in hypertensive patients aged 60 or older, or BP < 140/90 mmHg in hypertensive patients aged less than 60 years and all ages of hypertensive patients with diabetes mellitus or chronic kidney disease, based on the average of two or more properly measured, seated, BP readings at two or more office visits [2]. The inclusion criteria for patients and controls were eligible if they were ≥ 18 years old, were receiving pharmacologic therapy, and had been followed up in the hospital for at least six months. Pregnant women were excluded because of the physiological effect of pregnancy on blood pressure.

Sample size determination and sampling technique

The sample size was calculated using EPI Info STAT-CALC software version 7.2.2.6 for two population proportions for the stated objective using the unmatched case–control formula from Fleiss with continuity correction statistical method with the assumption of the following parameters: significance = 95%; and 1 to 2 cases to controls ratio was recruited to achieve 80% power. The variable comorbidity (yes) from a study conducted in Bale Zone Hospitals, Southeast Ethiopia, in 2021 [28] yielded a maximum sample size of 348, which was the optimum sample size for this study. Assuming a nonresponse rate of 10%, the sample sizes for cases and controls were 128 and 256, respectively, which yielded a total sample size of 384. The study participants of cases and controls fulfilling the inclusion criteria were included from Negelle and Adola General Hospital hypertensive patients visiting the chronic care outpatient facility for follow-up during the working time of the data collection period. The total sample size was distributed proportionally for both cases and controls to Adola and Negelle general hospitals based on the patient load. Accordingly, the total monthly numbers of hypertensive patients at the Negelle and Adola General Hospitals were 416 and 408, respectively. Therefore, the total sample size for Negelle Hospital was 195 (patients 65 and controls 130), and the total sample size for Adola Hospital was 189 (patients 63 and controls 126). A consecutive sampling method was employed until the required sample size of the patients and the controls were achieved. Since cases were rare, all identified cases available during the study period were taken until the total sample size was reached. On the other hand, for each selected case, two consecutive controls were selected on the same day for each case from the same chronic care OPD.

Data collection procedure and instrument

The data collection tools used were developed by reviewing different relevant literature on the determinants of uncontrolled hypertension [7, 14, 15, 18, 20, 21]. The data were collected by interviewing hypertensive patients and through a review of their medical records. Hypertension self-care practice was assessed according to the hypertension self-care activities scale effect (H-Scale). This tool was studied and validated in hypertensive patients in Ethiopia at Jimma University Teaching and Specialized Hospital. The H-SCALE has six domains: medication adherence (3 items), low-salt diet (12 items), physical activity (2 items), smoking (1 item), weight management (10 items), and alcohol (1 item). All self-care domains

had acceptable reliability in previous studies in Ethiopia [7, 15, 29]. The Cronbach's alpha values for medication adherence, low salt intake, physical activity adherence, weight management, and alcohol use were 0.94, 0.74, 0.81, 0.93, and 0.92, respectively [20].

Hypertension knowledge-related factors were adopted from the Hypertension Knowledge Level Scale (HK-LS) [30]. The HK-LS had acceptable reliability, with an alpha coefficient of 0.81 in a previous study [20].

Psychosocial factors include three domains: anxiety, depression, and social support. Anxiety was assessed by the Generalized Anxiety Disorder 7-item (GAD-7) scale, which was developed by Robert L. Spitzer [31]. The GAD-7 has acceptable reliability, with an alpha coefficient of 0.90 in a previous study [20]. Depression was assessed by Patient Health Questionnaire-9 (PHQ-9), which was originally designed by Spitzer [31]. The PHQ-9 score was based on the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV). The PHQ-9 has acceptable reliability, with an alpha coefficient of 0.83 in a previous study in Ethiopia [7]. Social support was measured with the Oslo Social Support Scale (OSSS-3), which contains three items [32]. The OSSS-3 has acceptable reliability, with an alpha coefficient of 0.86 in a previous study in Ethiopia [20].

The patients' medical charts were reviewed to retrieve clinical information (comorbidity status) and physical information (weight and height). This information was subsequently documented on the questionnaires after the interviews.

Before the recruitment of cases and controls, the mean documented blood pressure readings from the last three clinic visits, including the data collection day, were reviewed to determine the BP status [15, 33] and to identify cases and controls. Cases and controls were recorded by medical record number. Following the segregation of cases and controls, data were collected by interviewing the study participants and from a review of their medical charts. The data were collected by two BSc. Nurses and supervised by two MPH holders.

Study variables

The dependent variable in this study was uncontrolled blood pressure. The independent variables were as follows: socio-demographic characteristics: sex, education level, marital status, occupation, residence, religion, and income level. Hypertension self-care practice: Medication adherence, smoking status, alcohol consumption status, physical activity, salt content in food, Khat chewing, weight management. Knowledge of hypertension. Clinical-related characteristics included family history of hypertension, frequency of follow-up, lack of follow-up, frequency of BP measurement, and source of medication

coverage (Community-based health insurance (CBHI is a scheme in which community members prepay for health service & free of charge where clients cost nothing for the service), body mass index, and comorbid conditions/use of traditional medicine. Psychosocial factors: Depression, anxiety, and social support.

Measurements (Annex-2)

Medication adherence was assessed by three items the number of days in the last week that an individual: (1) takes blood pressure medication, (2) takes it at the same time every day, and (3) takes the recommended dosage. Responses were summed (range, 0–21), and participants reporting that they followed these 3 recommendations on 7 out of 7 days were considered adherent (score = 21) unless they were considered non-adherent to medication.

Weight management:—was assessed by 10 items activities undertaken to manage weight through dietary practices such as reducing portion size and making food substitutions as well as exercising to lose weight. Items assessed agreement with weight management activities during the past 30 days. Response categories ranged from strongly disagree (1) to strongly agree (5). Responses were summed creating a range of scores from 10 to 50. Participants who reported that they agreed or strongly agreed with all 10 items (score ≥ 40) were considered adherent to weight management and a score ≤ 39 was considered non-adherent.

Physical activity was assessed by 2 items of days in the last seven days of last week. Then, the responses were added up (range, 0–14). Participants who scored ≥ 8 were coded as adhering to the physical activity recommendations.

A low-salt diet:—was assessed by ten items. Six items were negatively phrased; these items were reverse-coded. A mean score was calculated. Scores of 5 or better (indicating that participants followed low-salt diet practices on 6 out of 7 days) were considered adherent to a low-salt diet.

Hypertension Knowledge:—was measured by HK-LS which includes 22 item questions. Nine of these items on the questionnaire were negatively phrased. Before the analysis, these were reverse-scored. The total sum of the scores of the knowledge items gives a score ranging from 1 to 22. The mean score was used to measure the knowledge level. This way, those who scored the mean and above were regarded as having good knowledge of HK-LS, while those who scored below the mean score were regarded as having poor knowledge of HK-LS.

Psychosocial factors contain six domains which are anxiety, depression, and social support. The seven items were used to assess Generalized Anxiety Disorder. Scores for each item were 0 "not at all" 1 "several days" 2 "more than half days" to 3 "nearly every day" with a total score

Habtegiorgis *et al. BMC Public Health*   (2024) 24:2971

Page 5 of 12

ranging from 0 to 21. The respondents who scored above or equal to ten were considered to have anxiety.

The depression screening and diagnostic questionnaire for major depressive disorder (MDD) was used PHQ-9. Scores for each item are 0 "not at all" 1 "several days" 2 "more than half days" to 3 "nearly every day" with a total score ranging from 0 to 27. The respondent who scored above or equal to ten was considered as having depression.

Social support was assessed by the OSSS-3 which contains three items. The first item is rated on a four-point Likert scale ranging from 1 to 4. The second and the third items are rated on a five-point Likert scale ranging from 1 to 5. The sum score ranges from 3 to 14. The ranges from 12–14 to OSSS-3 were strong social support, 9–11 were considered moderate social support, and 3–8 were poor social support.

Operational definitions

Uncontrolled blood pressure was defined as blood pressure (BP) $\geq$ 150/90 mmHg in hypertensive patients aged 60 or older, or BP $\geq$ 140/90 mmHg in hypertensive patients aged less than 60 years and all ages of hypertensive patients with diabetes mellitus or chronic kidney disease [2].

Abstinence from alcohol drinking: Participants who had not consumed any type or amount of alcohol in the last 7 days according to the H-SCALE [20, 34, 35].

Adherence to a low-salt diet: Respondents who scored equal to the mean and above the low-salt diet of the H-SCALE cohort [20, 34, 35].

Adherence to physical activity: Participants were considered adherent to physical exercise when the mean score was above 8 out of 14 physical activities of H-SCALE [20, 34, 35].

Adherence to weight management: measured by 10 Likert-type scale items rated from 1 (strongly disagree) to 5 (strongly agree). The responses were summed [10–27, 36–58]. Patients with a score $\geq$ 40 were considered adherent to weight management [20, 34, 35].

Medication adherence: Patients who scored 21 out of 21 were considered adherent to medication [20, 34, 35].

Adherence to smoking abstinence: Respondents who reported not smoking in the last seven days on the H-SCALE [20, 34, 35].

Current khat chewing: Patients have chewed khat, even just a single stick, in the last 7 days [7].

Good hypertension knowledge: A total of 22 respondents had a score ranging from 0 to 22 points on the Hypertension Knowledge-Level Scale [20].

Poor hypertension knowledge: From a score ranging from 0 to 22, respondents scored below the mean on the Hypertension Knowledge-Level Scale (HK-LS) [20].

Major depressive disorder: The total score ranged from 0 to 27, and a respondent who scored above or equal to ten points on the PHQ was included [20].

Generalized Anxiety Disorder: Patients with a score ranging from 0 to 21 were considered to have a score above or equal to 10 on the GAD-7 [20].

Poor social support: Respondents' score ranges from 3 to 8 according to the OSSS-3 [20].

Moderate social support: Respondents' scores ranged from 9 to 11 according to the OSSS-3 [20].

Strong social support: Respondents' score ranges from 12 to 14 according to the OSSS-3 [20].

BMI categorized: underweight < 18.50 kg/m2; normal 18.5- 24.99; overweight 25.0–29.99 and obese > 30 [15].

Data quality control

To ensure the quality of the data, all the data collectors were given two days of training on the data collection approach of the study before the data collection. All the questionnaires were prepared in the English language, translated to Afan Oromo, and retranslated back to English to check for any inconsistencies. Pretests were performed on 19 (i.e., 5%) randomly selected patients at Bore Hospital, which is outside of the study area, and all corrections and modifications were maintained. Supervision and verification were provided by the assigned supervisors and principal investigator to ensure the completeness and consistency of the collected data. All the collected data were examined for completeness and consistency during data management, storage, and analysis.

Data processing and analysis

The data were entered into Epi Data 3.1, and analyses were performed with SPSS version 25. Descriptive statistics (simple frequency, percentage, mean, and standard deviation) were computed to describe the study objectives in terms of appropriate variables.

A bivariable and multivariable binary logistic regression analysis was performed to identify independent determinants of uncontrolled blood pressure. In the bivariable analysis, those variables with a p-value $\leq$ 0.25 were further entered into the multivariable binary logistic regression model to assess the association between dependent and independent variables and to control for the potential effects of confounders. A multivariate logistic regression model with a backward likelihood ratio method was used to identify predictors of UBP. Crude and adjusted odds ratios with 95% CIs were used to determine the strength of the association between the response variable and predictor variables. A *p*-value < 0.05 was considered to indicate statistical significance. The Hosmer–Lemeshow goodness-of-fit statistic was used to check model fitness, and the model had a *p*-value = 0.277 (> 0.05). A

Habtegiorgis *et al. BMC Public Health*   (2024) 24:2971

Page 6 of 12

multicollinearity test was carried out to determine the correlation between independent variables using the variance inflation factor (VIF), and no variables were observed with a VIF > 10. (Annex-1) The results were then presented using frequency tables, figures, and text.

Results

Socio-demographic characteristics of the respondents

In this study, a total of 384 respondents (128 cases and 256 controls) participated, for a response rate of 100%. Among the respondents, 61 (47.66%) were male, and 131 (51.17%) were male. The mean ages of the respondents were 53.64 years (SD = 14.9) and 54.5 years (SD = 15.4) for the controls and cases, respectively. In terms of educational status, 53.13% of patients (cases) and 45.70% of controls did not attend formal education. Government employers made up 87 (33.98%) of the controls and 22 (17.19%) of the cases. Ninety-three (72.66%) of the patients and one hundred ninety (74.22%) of the controls were urban residents (Table 1).

Clinical characteristics

In this study, among all the respondents, 57 (44.5%) and 94 (36.7%) had a family history of hypertension. Regarding the duration of diagnosis of HTN, 62 (44.8%) patients and 145 (56.6%) controls were diagnosed within the last five years, and the majority of the patients (92.97%) and controls (90.63%) had a monthly follow-up at the hospitals. A comparable number of the patients (39.06%) and the controls (39.06%) had missed follow-ups. Regarding the source of medication, 92 (71.88%) patients and 182 (71.09%) controls used community-based health insurance (CBHI). Furthermore, 93 (72.66%) of the patients and 50 (19.53%) of the controls used traditional medicine in combination with or in place of modern antihypertensive drugs. Among the patients, 49 (38.28%) and 50 (19.53%) were overweight. More than a quarter of the patients (59 [46.09%]). Among the controls, 117 (45.70%) had a medically confirmed comorbidity (Table 2).

Hypertensive knowledge, hypertension self-care practices and behavioral factors

In this study, 51 (39.84%) of the patients and 141 (55.07%) of the controls scored above the mean knowledge score, which indicated good knowledge of HTN. Regarding hypertension self-care practices, less than a quarter of the patients 46 (35.94%); most of the controls (165 [64.45%] were adherent to their antihypertensive medication). Concerning the low-salt diet, more than half of the patients (57.81%) and the controls (51.95%) were adherent to the low-salt diet. Likewise, a few of the patients 9(7.03%) and one of the controls 29(11.33%) were adherent to the recommended physical

Table 1 Socio-demographic Characteristics of Adult Hypertensive Patients on Follow-Up at Negelle and Adola General Hospitals Guji Zone, Oromia, Ethiopia, January 1–30, 2023

Characteristics		Cases Number (%)	Controls Number (%)
Sex	Male	61(47.66)	131(51.17)
	Female	67(52.34)	125(48.83)
Age	18–35 years	11(8.59)	24(9.38)
	36–49 Years	39(30.47)	91(35.55)
	≥ 50 years	78(60.94)	141(55.08)
Marital status	Single	2(1.56)	9(3.52)
	Married	83(64.84)	176(68.75)
	Divorced	14(10.94)	19(7.42)
	widowed	29(22.66)	52(20.31)
Religion	Orthodox	56(43.75)	116(45.31)
	Muslim	43(33.59)	98(38.28)
	Protestant	24(18.75)	24(9.38)
	Catholic	2(1.56)	11(4.30)
	Others	3(2.34)	7(2.73)
Educational level	No formal education	68(53.13)	117(45.70)
	Primary education	18(14.06)	51(19.92)
	Secondary education	16(12.50)	22(8.59)
	Collage/university	26(20.31)	66(25.78)
Occupational level	Housewife	40(31.25)	65(25.39)
	Government employer	22(17.19)	87(33.98)
	Unemployed	5(3.91)	3(1.17)
	Retired	29(22.66)	41(16.02)
	Merchant	27(21.09)	47(18.36)
	Farmer	2(1.56)	4(1.56)
Income level	Less than 2000birr	19(14.84)	31(12.11)
	2000 and above	109(85.16)	225(87.89)
Residence	Urban	93(72.66)	190(74.22)
	Rural	35(27.34)	66(25.78)

activity. Approximately half of the 66 patients (51.56%) and nearly three-fourths of the controls 186 (72.66%) were adherent to smoking abstinence. Moreover, 68 (53.13%) of the patients and 116 (45.31%) of the controls were nonadherent to alcohol abstinence. Approximately 109 (85.16%) of the patients and 117 (69.14%) of the controls were nonadherent to weight management. A comparable magnitude of the cases (47.66%) and the controls (46.48%) were khat chewers (Table 3).

Psychosocial factors

In this study, 31 (24.22%) of the patients and 62 (24.22%) of the controls had anxiety on the Generalized Anxiety Disorders 7-item (GAD-7) scale. Similarly, 24 (18.75%) of the patients and 50 (19.53%) of the controls had

Table 2 Clinical Characteristics of Adult Hypertensive Patients on Follow-Up at Negelle and Adola General Hospitals Guji Zone, Oromia Region, Oromia, Ethiopia, January 1–30, 2023

Characteristics		Cases	Controls
		Number (%)	Number (%)
Family history of HTN	Yes	57(44.53)	94(36.72)
	No	71(55.47)	162(63.28)
Duration of diagnosis	< 5 years	62(48.44)	145(56.64)
	5–10 years	47(36.72)	74(28.91)
	> 10 years	19(14.84)	37(14.45)
Frequency of visit	Every two weeks	6(4.69)	15(5.86)
	Monthly	119(92.97)	232(90.63)
	Every six month	3(2.34)	9(3.52)
Missed Appointments	Yes	50(39.06)	100(39.06)
	No	78(60.94)	156(60.94)
Source of Medication	CBHI	92(71.88)	182(71.09)
	Free of charge	4(3.13)	6(2.34)
	Self-sponsored	32(25.00)	68(26.56)
Frequency of BP measurement	Every 2 weeks	27(21.09)	75(29.30)
	Monthly	81(63.28)	144(56.25)
	Every 2 months	3(2.34)	2(0.78)
	Every 3 months	17(13.28)	35(13.67)
Traditional medicine use	Yes	93(72.66)	50(19.53)
	No	35(27.34)	206(80.47)
BMI	Normal weight	53(41.41)	175(68.36)
	Overweight	49(38.28)	50(19.53)
	Obese	26(20.31)	31(12.11)
Comorbidity	Yes	59(46.09)	117(45.70)
	No	69(53.91)	139(54.30)

Table 3 Hypertension self-care practices and behavioral factors among adult hypertensive patients receiving care at Negelle and Adola General Hospitals, Guji Zone, Oromia, Ethiopia, 2023

Characteristics		Cases	Controls
		Number (%)	Number (%)
Hypertensive knowledge	Good Knowledge	51(39.84)	141(55.07)
	Poor Knowledge	77(60.16)	115(44.93)
Medication Adherence	Adherent	46(35.94)	165(64.45)
	Non-Adherent	82(64.06)	91(35.55)
Low salt diet	Adherent	74(57.81)	133(51.95)
	Non-Adherent	54(42.19)	123(48.05)
Physical activity	Adherent	9(7.03)	29(11.33)
	Non-Adherent	119(92.97)	227(88.67)
Non-Smoking	Adherent	66(51.56)	186(72.66)
	Non-Adherent	62(48.44)	70(27.34)
Alcohol Abstinence	Adherent	60(46.88)	140(54.69)
	Non-Adherent	68(53.13)	116(45.31)
Weight Management	Adherent	19(14.84)	79(30.86)
	Non-Adherent	109(85.16)	177(69.14)
Current Khat chewing	Yes	61(47.66)	119(46.48)
	No	67(52.34)	137(53.52)

Table 4 Psychosocial factors of adult hypertensive patients at the Negelle and Adola General Hospitals in the Guji Zone, Oromia, Ethiopia, January 1-30, 2023

Characteristics		Cases	Controls
		Numbers (%)	Numbers (%)
Anxiety	**Yes**	31(24.22)	62(24.22)
	No	97(75.78)	194(75.78)
Depression	**Yes**	24(18.75)	50(19.53)
	No	104(81.25)	206(80.47)
Socialsupport	**Poorsocial support**	48(37.50)	127(49.61)
	Moderatesocialsupport	64(50.00)	106(41.41)
	Strongsocialsupport	16(12.50)	23(8.98)

depression according to the Patient Health Questionnaire-9 (PHQ-9) scale. Approximately 48 (37.50%) of the patients and 127 (49.61%) of the controls had poor social support according to the Oslo Social Support Scale (OSSS-3) (Table 4).

Determinants of uncontrolled blood pressure

According to our bivariate analysis, the independent variables that were associated with the outcome variable were education status, medication adherence, adherence to smoking abstinence, adherence to physical activity, adherence to alcohol abstinence, adherence to weight management, family history of HTN, use of traditional medicine, knowledge of hypertension, BMI, and social support. All the predictor variables with a p-value < 0.25 according to the bivariable logistic regression were collectively entered into the multivariable logistic regression to control for confounding variables. Finally, the

multivariable analysis revealed that nonadherence to antihypertensive medication, nonadherence to smoking abstinence, nonadherence to weight management, poor knowledge of hypertension, use of traditional medicine, and being overweight were found to be significant predictors of uncontrolled blood pressure.

In this study, the odds of nonadherence to antihypertensive medication in hypertensive patients with UBP were 2 times greater than those in their counterparts (AOR = 2.01, 95% CI = 1.16–3.44). The odds of nonadherence to smoking abstinence in hypertensive patients with UBP were 1.8 times greater than those in

Habtegiorgis *et al. BMC Public Health*   (2024) 24:2971

Page 8 of 12

Table 5 Determinants of uncontrolled blood pressure among adult hypertensive patients on follow-up at Negelle and Adola General Hospitals, Guji Zone, Oromia. Ethiopia, 2023

Characteristics		Cases N (%)	Controls N (%)	COR (95% CI)	AOR (95% CI)
Educational status	No formal education	68(53.13)	117(47.70)	1.47(0.85–2.54)	1.47(0.71–3.07)
	Primary education	18(14.06)	51(19.92)	0.89(0.44–1.81)	1.03(0.41–2.59)
	Secondary education	16(12.50)	22(8.59)	1.84(0.84–4.05)	3.22(1.09–9.50)
	Collage/university	26(20.31)	66(25.78)	1	1
Medication adherence	Non-adherence	82(64.06)	91(35.55)	3.23(2.07–5.03)	2.00(1.16–3.44) *
	Adherent	46(35.94)	165(64.45)	1	1
Smoking abstinence	Non-Adherent	62(48.44)	70(27.34)	2.49(1.60–3.88)	1.83(1.05–3.22) *
	Adherent	66(51.56)	186(72.66)	1	1
Physical activity	Nonadherent	119(92.97)	227(88.67)	1.68(0.77–3.68)	0.76(0.26–2.21)
	Adherent	60(46.88)	140(54.69)	1	1
Alcohol Abstinence	Nonadherent	68(53.13)	116(45.31)	1.37(0.89–2.09)	1.05(0.60–1.87)
	Adherent	60(46.88)	140(54.69)	1	1
Adherence to Weight Management	Nonadherent	109(85.16)	177(69.14)	2.56(1.47–4.46)	2.01(1.04–3.92) *
	Adherent	19(14.84)	79(30.86)	1	1
Knowledge for hypertension	Poor Knowledge	77(60.16)	115(44.92)	1.85(1.20–2.85)	2.18(1.26–3.76) **
	Good Knowledge	51(39.84)	141(55.08)	1	1
Family History of Hypertension	Yes	57(44.53)	94(36.72)	1.38(0.89–2.13)	1.24(0.71–2.19)
	No	71(55.47)	162(63.28)	1	1
Traditional Medicine use	Yes	93(72.66)	50(19.53)	10.94(6.66–17.98)	9.13(5.31–15.69) **
	No	35(27.34)	206(80.47)	1	1
BMI	Normal weight	53(41.41)	175(68.36)	1	1
	Overweight	49(38.28)	50(19.53)	3.24(1.96–5.33)	3.35(1.79–6.26) **
	Obese	26(20.31)	31(12.11)	2.77(1.51–5.07)	2.64(1.26–5.59) *
Social Support	Poor	48(37.50)	127(49.61)	0.54(0.26–1.12)	0.48(0.19–1.22)
	Moderate	64(50.00)	106(41.41)	0.86(0.43–1.76)	0.72(0.29–1.81)
	Strong	16(12.50)	23(8.98)	1	1

* Significant at *p*-value < 0.05**significant at a *P* value < 0.01

their counterparts (AOR = 1.84, 95% CI = 1.05–3.22). Likewise, the odds of nonadherence to weight management in hypertensive patients with uncontrolled blood pressure were 2 times greater than those in their counterparts (AOR = 2.02, 95% CI = 1.04–3.92). In this study, the odds of having poor knowledge of hypertension in patients with uncontrolled blood pressure were 2 times greater than those in their counterparts (AOR = 2.18, 95% CI = 1.26–3.76). Moreover, in this study, the odds of traditional medicine use in hypertensive patients with uncontrolled blood pressure were 9 times greater than those in their counterparts (AOR = 9.13, 95% CI = 5.31–15.69). Accordingly, the odds of being overweight in hypertensive patients with UBP were 3 times greater than those in normal-weight hypertensive patients (AOR = 3.35, 95% CI = 1.79–6.26) (Table 5).

Discussion

This case–control study investigated the determinants of uncontrolled blood pressure among adult hypertensive patients on follow-up at the Negelle and Adola General Hospitals in the Guji Zone, southern Ethiopia, 2023. In this study, nonadherence to antihypertensive medication, nonadherence to smoking abstinence, nonadherence to weight management, poor hypertension knowledge, use of traditional medicines, and being overweight were found to be significantly associated with uncontrolled blood pressure.

In this study, the odds of non-adherence to antihypertensive medication in those patients were 2 times greater than those of their counterparts. This study was in line with a cross-sectional study performed in different regional areas of study, including Ethiopia (Amhara, Tigray) and Brazil [5, 15, 21, 24, 52, 53]. This might be due to antihypertensive medications control high blood

pressure by increasing vasodilatation, increasing urination to remove excess salt and fluid from the body, and blocking the sympathetic activation of the heart to slow the heartbeat, and widening the blood vessels [39, 59].

In the present study, the odds of non-adherence to smoking abstinence in hypertensive patients with UBP were 1.8 times greater than those in their counterparts. These findings are in line with cross-sectional studies performed in the Bale zone and Jimma, Ethiopia [7, 15]. This might imply that smoking leads to the enhancement of sympathetic activity, which increases cardiac muscle oxygen demand through the escalation of BP, heart rate, and contraction of the myocardium [60]. Moreover, prolonged smoking and even after quitting, rigid and tough arteries can persist, which leads to sustained high BP [61].

Similarly, in this study, the odds of nonadherence to weight management in hypertensive patients with uncontrolled blood pressure (patients) were 2 times greater than those in their counterparts. These findings are consistent with those of a cross-sectional study performed in Mekelle, Northern Ethiopia, and a prospective cohort study performed in Italy [5, 50]. Weight reduction has been shown to decrease left ventricular mass and wall thickness reduces arterial stiffness and improves endothelial function, leading to a decrease in blood pressure [62].

In this study, the odds of having poor hypertension knowledge in hypertensive patients with uncontrolled blood pressure were 2 times greater than those in their counterparts. This finding is consistent with cross-sectional studies performed in Pakistan and China [55, 56]. This practice is useful because having good knowledge of HTN is a crucial factor that can enhance healthy lifestyle modifications and modify a person's perception of their risk, which are significant in controlling HTN and preventing its related complications.

According to this study, the odds of traditional medicine use in hypertensive patients with uncontrolled blood pressure were 9 times greater than those in their counterparts. This finding is in line with a cross-sectional study performed in 12 sub-Saharan African countries [27]. This might imply that patients who take traditional medicine but take conventional antihypertensive medicine irregularly have poor compliance with the pharmacologic management of HTN, leading to UBP. However, these findings are inconsistent with those of a study performed in Central America in Belize, where the use of traditional medicine was found to lower high blood pressure [63]. This discrepancy might be due to differences in international traditional medicine use policy, strategies, implementation, and study setting.

Similarly, in this study, the odds of uncontrolled blood pressure among overweight hypertensive patients were 3 times greater than those among individuals with a normal weight. These findings are consistent with those of a cross-sectional study conducted in Morocco, the Bale zone in Ethiopia, and Jimma in Ethiopia [7, 15, 64].

Limitations of the study
This study has the following limitations: Several self-reported variables, such as adherence to the recommended self-care practice for hypertension, might be affected by social desirability bias, and this bias was reduced through detailed clarification of the objective before the participants were interviewed. In addition, self-reported adherence to self-care activities was measured by the H-SCALE for the past seven days, and this may have caused recall bias. Furthermore, this was a facility-based study, and the sampling method employed was a nonprobability sampling technique; therefore, its generalizability to the general population is limited.

Conclusion
In adult hypertension patients who were followed up, this study identified factors that contributed to UBP. We concluded that poor hypertension knowledge, the use of traditional medications, nonadherence to antihypertensive medication, nonadherence to smoking abstinence, nonadherence to weight management, and overweight were significant predictors of UBP. The majority of the factors that have been linked to patients with uncontrolled blood pressure in the Guji zone, Oromia, Ethiopia, are modifiable and preventable. Therefore, patients' adherence to antihypertensive medication should be maximized. Moreover, to enhance patients' knowledge of hypertension, continuous health education on lifestyle practices and hypertension-related complications should be provided at each follow-up visit through nurses, physicians, and pharmacists to prevent this problem. Regarding weight management and high BMI (being Overweight/ Obese) a multiprofessional approach is relevant with a particular focus on nutritionists, health promotion officer and exercise experts. Furthermore, risk communication regarding traditional medicine use should be performed in addition to information about hypertension risk factors. Finally, we recommend further study to explore the mechanism through which traditional medicine use may influence blood pressure control and identify specific herbs or practices that may pose a risk to hypertensive patients. Thus, by addressing these factors, we can reduce the burden of UBP and improve overall health outcomes for patients in this population.

Habtegiorgis *et al. BMC Public Health*   (2024) 24:2971

Page 10 of 12

Abbreviations

AOR	Adjusted Odds Ratio
SBCC	Social Behavioral Change Communication
BMI	Body Mass Index
BP	Blood Pressure
CBHI	Community-Based Health Insurance
CI	Confidence Interval
CKD	Chronic Kidney Disease
CVD	Cardiovascular Disease
DALYS	Disability-adjusted life years
DBP	Diastolic blood pressure
DM	Diabetes Mellitus
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders, fourth edition
GAD-7	Generalized Anxiety Disorders-7 items
HK-LS	Hypertension Knowledge Likert Scale
H-SCALE	Hypertension-Self-Care Activity Level Effects
IEC	Information Education Communication
LMICs	Low- and middle-income countries
NCD	Non-communicable diseases
OPD	Outpatient Department
OSSS-3	Oslo Social Support Scale
PHQ-9	Patient Health Questionnaire-9 scales
SBP	Systolic blood pressure
SD	Standard Deviation
SDG	Sustainable Development Goal
SSA	Sub-Saharan Africa
UBP	Uncontrolled blood pressure
WHO	World Health Organization

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-024-20366-3.

> Supplementary Material 1: Annex-1. Result of the multicollinearity test
>
> Supplementary Material 2: Annex 2. The step for creating the variables
>
> Supplementary Material 3.

Declarations

Ethics approval and consent to participate

 Ethical clearance was obtained from the ethics review board of Bule Hora University, Institute of Health, and School of Public Health with reference number BHU/IOH/SPH/ 086/2015. A support letter was written from the zonal health department to each general hospital. Permission was obtained from each hospital medical director to access medical records and conduct the study. The benefits and risks of the study were explained to each participant included in the study, and written informed consent was obtained from each patient involved in the study. To ensure confidentiality, the names of the patients were not recorded on the data collection tools.

Consent for publication

 Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1]Directorate of Resource Mobilization, Monitoring of NGOs, East Borena Zonal Health Office, Negele Borena, Ethiopia. [2]Department of Public Health, Institute of Health, Bule Hora University, Bule Hora, Ethiopia. [3]Department of Public Health, School of Public Health, College of Medicine and Health Sciences, Mizan Tepi University, Southwest Ethiopia Regional State, Mizan Aman, Ethiopia. [4]Program Officer at the Oromia Health Bureau, Centers for Disease Control and Prevention (CDC), Shakiso Town, Ethiopia. [5]Clinical Nutrition, Centre for Food Science and Nutrition, Addis Ababa University, Addis Ababa, Ethiopia. [6]Food Science and Nutrition, Functional Foods and Food Fortification, Arsi University, Asela, Ethiopia.

References

1. WHO. Clinical guideline for the management of hypertension. 2005.
2. James PA, Oparil S, Carter BL, Cushman WC, Dennison-Himmelfarb C, Handler J, 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;311:507–20.
3. FMOH E. National Strategic Plan for The Prevention and Control of Major Non-Non-Communicable Diseases 2013–2017 EFY (2020/21–2024/25). 2020;2:16.
4. Abegaz TM. Magnitude and determinants of uncontrolled blood pressure among hypertensive patients in Ethiopia: hospital-based observational study. 2018;16(2):1–7.
5. Aberhe W, Mariye T, Bahrey D, Zereabruk K, Hailay A, Mebrahtom G. Prevalence and factors associated with uncontrolled hypertension among adult hypertensive patients on. 2020;36(187):1–14.
6. WHO. Global report on hypertension: The race against a silent killer. 2023.
7. Tesfaye B, Haile D, Belachew T, Tesfaye T, Abera H. Uncontrolled hypertension and associated factors among adult hypertensive patients on follow-up at Jimma University Teaching and Specialized Hospital. Clin Hypertens. 2014;20:1–9.
8. Ataklte F, Erqou SKS, et al. The burden of undiagnosed hypertension in sub-Saharan Africa: a systematic review and meta-analysis. Hypertension. 2015;65:291–8.
9. Opie LHSY. Hypertension in sub-Saharan African populations. Circulation. 2005;112(23):3562–8.
10. Solomon M, Negussie YM, Bekele NT, et al. Uncontrolled blood pressure and associated factors in adult hypertensive patients undergoing follow-up at public health facility ambulatory clinics in Bishoftu town, Ethiopia: a multi-center study. BMC Cardiovasc Disord 23, 258. Available from: https://doi.org/10.1186/s12872-023-03290-z.
11. WHO. Complication prevention for patients with hypertension a noncommunicable disease education manual for primary health care professionals and patients. 2017.
12. General A. Sustainable Development Goals (SDGs), transforming our world. The general assembly. 2015.

Habtegiorgis *et al. BMC Public Health*   (2024) 24:2971

Page 11 of 12

13. WHO. Global status report on noncommunicable disease. 2014.

14. Gebre M. Magnitude and Determinants of Uncontrolled Blood Pressure Among Adult Hypertensive Patients on Follow-Up at Nekemte Referral Hospital, Western Ethiopia. 2020;13:49–61.

15. Lemessa F, Lamessa M. Uncontrolled Hypertension and Associated Factors among Hypertensive Adults in Bale Zone Public Hospitals. Ethiopia Hypertens Manag. 2021;7(1):1–9.

16. WHO2019. Hypertension. Available from: https://www.who.int/news%0A-room/fact-sheets/detail/hypertension.

17. Zhou B, Carrillo-larco RM, danaei G,Rilaey LM, Paciorek CJ,Stevens GA, Gregg EW, Bennett JE, Solomon B, Singleton RK, Sophiea Mk 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. Lancet. 2021;398:957–980.

18. Amare F, Hagos B, Sisay M, Molla B. Uncontrolled hypertension in Ethiopia: a systematic review and meta-analysis of institution-based observational studies. 2020;3:1–9.

19. Yazie D, Shibeshi W, Alebachew M, Beyene Berha A. Assessment of Blood Pressure Control among Hypertensive Patients in Zewditu Memorial Hospital, Addis Ababa, Ethiopia: A Cross-Sectional Study. J Bioanal Biomed. 2018;10(03).

20. Abdisa L, Girma S, Lami M, Hiko A, Yadeta E, Geneti Y, et al. Uncontrolled hypertension and associated factors among adult hypertensive patients on follow-up at public hospitals, Eastern Ethiopia: A multicenter study. 2022;10:1–12.

21. Fentaw Z, Adamu K, Wedajo S. Blood pressure control status of patients with hypertension on treatment in Dessie City Northeast Ethiopia. BMC Public Health. 2022;1–7.

22. Kebede B, Chelkeba L. Rate of blood pressure control and its determinants among adult hypertensive patients at Jimma University Medical Center, Ethiopia: Prospective cohort study. 2021;

23. Rahimi BA. Determinants of Uncontrolled Hypertension Among Hypertensive Patients in Kandahar Determinants of Uncontrolled Hypertension Among Hypertensive Patients in Kandahar, 2021;(April 2020).

24. Gebremichael GB, Berhe KK, Zemichael TM. Uncontrolled hypertension and associated factors among adult hypertensive patients in Ayder comprehensive specialized. 2019;6:1–10.

25. Tan Hooi Shyuan1, 2, Ahmad Azuhairi Ariffin1, Nor Afiah Mohd Zulkefli1 FIM3. Predictors of Uncontrolled Hypertension among Patients Receiving Treatment from Public Primary Care Clinics in Pulau. 2020;16(3):234–43.

26. Wang L, Li N, Heizhati M, Li M, Yang Z, Wang Z, et al. Association of Depression with Uncontrolled Hypertension in Primary Care Setting: A Cross-Sectional Study in Less-Developed Northwest China. 2021;2021.

27. Lassale C, Gaye B, Diop IB, et al. Use of traditional medicine and control of hypertension in 12 African countries. BMJ Global Health 2022;7:e008138. https://doi.org/10.1136/bmjgh-2021-008138.

28. Anwar Tahir Buta1 ATM and GMD. Uncontrolled Hypertension and Its Associated Factors among Hypertensive Patients On Follow-Up in Bale Zone Hospitals, Southeast Ethiopia. Int J Epidemiology Public Heal Res. 2021;1.

29. Melaku T, Bayisa B, Fekeremaryam H, Feyissa A, Gutasa A. Self-care practice among adult hypertensive patients at the ambulatory clinic of tertiary teaching Hospital in Ethiopia : a cross-sectional study. 2022;3:1–11.

30. Erkoc SB, Isikli B, Metintas S, Kalyoncu C. Hypertension Knowledge-Level Scale (HK- LS): A Study on Development, Validity and Reliability. 2012;1018–29.

31. Spitzer RL, Kroenke K, Williams JB, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. Arch Intern Med. 2006;166:1092–7.

32. Dalgard OS, Dowrick C, Lehtinen V, Vazquez-Barquero JL, Casey P, Wilkinson GE, et al. Negative life events, social support and gender difference in depression. Soc Psychiatry Psychiatr Epidemiol. 2006;41:444–51.

33. Decoste M, Vanobberghen R, Borgermans L, Devroey D. Uncontrolled hypertension among black Africans in the city of Brussels: a case-control study. 2013;886–94.

34. Gelaw S, Yenit MK, Nigatu SG. Self-Care Practice and Associated Factors among Hypertensive Patients in Debre Tabor Referral Hospital. Northwest Ethiopia. 2020;2021:2021.

35. Warren-Findlow J, Basalik DW, Dulin M, et al. Preliminary validation of the hypertension self-care activity level effects (H-scale) and clinical blood

36. pressure among patients with hypertension. J Clin Hypertens Clin Hypertens. 2013;15(9):637–43.

36. Valpe m S c. Natural history of treated and untreated hypertension.Disorders of blood pressure regulation: phenotypes, mechanisms, therapeutic options. Springer. 2018;33–44.

37. Elliott WJ. What factors contribute to the inadequate control of elevated Blood pressure? J Clin Hypertens. 2008;10(10):2–6.

38. WHO 2022. The Global Health Observatory: Explore a world of health data.

39. World Health Organization. A global brief on hypertension: silent killer, global public health crisis. Geneva: World Health Organization; 2013. Available from: https://apps.who.int/iris/handle/10665/79059.

40. Legese N, Tadiwos Y. Epidemiology of hypertension in Ethiopia: A systematic review. Integr Blood Press Control. 2020;13:135–43.

41. Sorato MM, Davari M, Kebriaeezadeh A, Sarrafzadegan N, Shibru T. Societal economic burden of hypertension at selected hospitals in southern Ethiopia: a patient-level analysis. BMJ Open. 2022;12(4):1–13.

42. Ho AK, Thorpe CT, Pandhi N, Palta M, Smith MA, Johnson HM. Association of anxiety and depression with hypertension control: a US multidisciplinary group practice observational study. J Hypertens. 2015;33(22):15–22.

43. Ojo OS, Malomo SO, 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 Fam Med Prim Care. 2016;5:569–75.

44. Alawneh IS, Yasin A, Musmar S. The Prevalence of Uncontrolled Hypertension among Patients Taking Antihypertensive Medications and the Associated Risk Factors in North Palestine: A Cross-Sectional Study. 2022;2022.

45. Selçuk KT. Uncontrolled Blood Pressure in Patients with Hypertension and Associated Factors: The Role of Low Health Literacy. 2018;40(4):222–7.

46. Sciences A, Article O. Determinants of Uncontrolled Hypertension Among Hypertensive Patients in Kandahar. 2020;19(2):1–7.

47. Magara GM. Prevalence of Uncontrolled Hypertension and Associated Factors among Hypertensive Patients Attending Medical Outpatient Clinic, Thika Level 5 Hospital, Kiambu County, Kenya. 2022;

48. Sisay Y, Abera H, Biratu TD, Legesse TG. Uncontrolled Hypertension and Behavioral Risk Factors among Adult Hypertensive Patients at Saint Paul's Hospital, Millennium Medical College, Addis Ababa, Ethiopia. 2022;2022:1–7.

49. Addisu Worku (BSc) Addis Abeba University. Raised Blood Pressure Magnitude And Associated Factors Among Previously Undiagnosed Adult Outpatient Attendants In Tirunesh Beijing General Hospital, Addis Ababa, Ethiopia. 2021;(September). http://etd.aau.edu.et/handle/123456789/28491.

50. Gilardini L, Redaelli G, Croci M, Conti A, Pasqualinotto L, Invitti C. Effect of a modest weight loss in normalizing blood pressure in obese subjects on antihypertensive drugs. Obes Facts. 2016;9(4):251–8.

51. Nomazulu Mpande1, Camillio Fungai Chinamasa1, Portia Manangazira2, More Mungati1*, Lucia Takundwa1 D, Bangure1, Notion Tafara Gombe1 MT. Factors Associated with Uncontrolled High Blood Pressure amongst Patients with Hypertension at Harare Central Hospital in Zimbabwe. 2018;2(2329–9487):1–24.

52. Araújo TDP, Gabriel L, Borges S, Brandão AA, Kunz W, Barroso S, et al. Factors associated with uncontrolled blood pressure in hypertensive Brazilians. 2022;(February):814–24.

53. Araújo TDP, Gabriel L, Borges S, Brandão AA, Kunz W, Barroso S, et al. Factors associated with uncontrolled blood pressure in hypertensive Brazilians. 2022;24(7):814–24.

54. Asgedom SW, Gudina EK, Desse TA. Assessment of Blood Pressure Control among Hypertensive Patients in Southwest Ethiopia. 2016;1–12.

55. Almas A, Godil SS, Lalani S, Samani ZA, Khan AH. Good knowledge about hypertension is linked to better control of hypertension; A multicentre cross-sectional study in Karachi, Pakistan. BMC Res Notes. 2012;5:1–8.

56. Li S Shan, Zhou F, Lu Y Chao, Lyv P, Zhang H Feng. Hypertension related knowledge and behavior associated with awareness, treatment, and control of hypertension in a rural hypertensive population: a community-based, cross-sectional survey. 2016;7051.

57. Berhe DA, Yenit MK, Gebreegziabher A, Baraki. The Burden of Hypertension and Associated Factors Among Adults Visiting the Adult Outpatient Department at Yekatit 12 Hospital. Vasc Health Risk Manag. 2020;545–52.

58. Sarfo FS, Mobula LM, Burnham G, Ansong D, Plange-Rhule J, Sarfo-Kantanka O, et al. Factors associated with uncontrolled blood pressure

Habtegiorgis *et al. BMC Public Health*   (2024) 24:2971

Page 12 of 12

among Ghanaians: Evidence from a multicenter hospital-based study. PLoS ONE. 2018;13(3):e0193494. https://doi.org/10.1371/journal.pone.0193494.

59. Hernandez-Vila E. A review of the JNC 8 blood pressure guideline. Tex Heart Inst J. 2015;42:226–8.

60. Aurelio Leone. Smoking and Hypertension. J Cardiol Curr Res Smok. 2015;2(2).

61. Virdis A, Giannarelli C, Neves MF, Taddei S, Ghiadoni L. Cigarette smoking and hypertension. Curr Pharm Des. 2010;16(23):2518-25. https://doi.org/10.2174/138161210792062920.

62. Bacon SL, Sherwood A, Hinderliter A, et al. Effect of exercise, diet and weight loss on high blood pressure. Sport med [Internet]. 2004;34:307–16. Available from: https://doi.org/10.2165/00007256-200434050-00003.

63. Mphuthi DD, Husaini DC. Traditional medicinal plants used by hypertensive patients in Belize : a qualitative evaluation of beliefs and practices. Bull Natl Res Cent. 2022; Available from: https://doi.org/10.1186/s42269-022-0078

64. Mphuthi DD, Husaini DC. Traditional medicinal plants used by hypertensive patients in Belize: a qualitative evaluation of beliefs and practices. Bull Natl Res Cent. 2022;46:107. https://doi.org/10.1186/s42269-022-00789-x.

Publisher's Note