ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCE

SCHOOL OF MEDICINE

DEPARTMENT OF NEUROLOGY

RESEARCH THESIS

THE MAGNITUDE OF ANTIHYPERTENSIVE MEDICATIONS ADHERENCE, BLOOD PRESSURE CONTROL AND ASSOCIATED FACTORS AMONG HYPERTENSIVE PATIENTS AT SELECTED HEALTH CENTERS, A.A, ETHIOPIA.

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A thesis to be submitted to Tikur Anbessa Specialized Hospital, Neurology Department in partial fulfillment of the requirement for specialization certificate in neurology.

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Addis Ababa University, College of Health Science, School of Medicine and Department of Neurology

The magnitude of antihypertensive medications adherence, blood pressure control and associated factor among hypertensive patients at selected health center, A.A, Ethiopia.

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Table of Contents

LIST OF TABLES & FIGURES

LIST OF FIGURES

LIST OF TABLES

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Acronyms

AAU - Addis Abeba University

ACC/AHA-American College of Cardiology and the American Heart Association

ACEI - Angiotensin-converting enzyme inhibitors

ADCQ -Antidepressant Compliance Questionnaire

ARBs- Angiotensin receptor blockers

AOR- Adjusted odd ratio

ASCVD- Atherosclerosis cardiovascular disease

BP - Blood pressure

CHD - Cardiovascular heart disease

CHS - College of health science

DM - Diabetes Mellitus

EDHS - Ethiopian Demographic and Health Survey

FDA - Food and Drug Administration

ICH- Intracranial hemorrhage

HTN - Hypertension

MMAS-8 - Morisky Medication Adherence Scale-8

RPC -Research and Publication Committee

TASH - Tikur Anbessa specialized hospital

UOG - University of Gonder

USA- United state of America

WHO - World health organization

Abstract

Background: Hypertension is a major risk factor for stroke, contributing to high mortality and morbidity, particularly in low-income countries like Ethiopia. Studies indicate a rising incidence of stroke in developing nations, with intracerebral hemorrhage disproportionately affecting low-income populations. Assessing blood pressure control, medication adherence, and associated factors is essential for identifying key contributors to the increasing stroke burden and guiding targeted interventions. While most existing data come from hospital-based studies, this research focuses on primary healthcare facilities, where a significant proportion of hypertensive patients receive follow-up care. Future studies can explore additional contributing factors to the growing burden of stroke in developing countries.

Methods: A cross-sectional study was conducted using multi-stage sampling at selected health centers from October to December 2024. Data were collected via structured questionnaires and analyzed using SPSS version 25. Multiple logistic regression model was employed to determine factors associated with BP control and medication adherence.

Results: Of 348 patients, only *27.3%* achieving the target Blood pressure of <130/80 mmHg, while *35.1%* fell into the category of 130/80-139/89 mmHg and *35.9%* had high BP (>139/89 mmHg), indicating poor control. High medication adherence was observed in *43.1%* of participants, *32.2%* moderate adherence, but *24.7%* had low adherence. Factors significantly associated with BP control included adherence levels, frequency of BP monitoring, appointment frequency, education, income, and age. Medication adherence was influenced by income, appointment frequency, blood pressure monitoring frequency, fruit consumption, and salt intake. Lifestyle modifications such as exercise and dietary habits showed concerning trends but were not significant predictors in the regression model. Significant proportion of the patients are on monotherapy.

Conclusion: Poor blood pressure control and suboptimal medication adherence underscore the urgent need for targeted interventions to reduce the burden of stroke and other hypertension-related complications in Ethiopia. Key strategies include enhancing patient education, improving access to healthcare and strengthening healthcare systems through regular follow-up appointments and promoting home blood pressure monitoring. Additionally, promoting healthy lifestyle choices, addressing financial barriers, and optimization in treatment regimens to prevent therapeutic inertia are essential to improving hypertension management. These efforts can help mitigate the burden of stroke and other cardiovascular diseases. Further research, including longitudinal and qualitative studies, is recommended to explore underlying barriers, identify effective intervention strategies, and investigate other contributing factors beyond hypertension-related issues.

1.Introduction

1.1 Background

Hypertension affects over 30% of adults globally—more than a billion people—and is a leading cause of cardiovascular diseases like heart attack, stroke, kidney disease, and dementia, contributing to around 9.4 million deaths annually.[1] [2]

In 2015, the National WHO STEPS survey estimated that the prevalence of hypertension in Ethiopia is 16%. [3]

From an epidemiologic view, there's no clear blood pressure threshold that defines hypertension. Cardiovascular, stroke, and kidney disease risks increase steadily with rising blood pressure, starting as low as 115/75 mmHg. Large studies like MRFIT and meta-analyses show that for every 20 mmHg rise in systolic or 10 mmHg in diastolic pressure, cardiovascular risk doubles. In older adults, systolic and pulse pressures are stronger predictors of risk than diastolic pressure. [2]

Despite the benefits of antihypertensive therapy, many patients remain untreated or poorly managed—especially in Ethiopia and other low- and middle-income countries. There's a gap between guidelines and practice, with few patients reaching target levels, while some face overtreatment due to non-evidence-based protocols. [2] [3]

1.2 Statement of problem

Hypertension is the most common and most important risk factor for stroke[42] [5], including isolated systolic hypertension. [43] [44] An overview of 14 hypertension treatment trials concluded that a long-term (mean five years) 5 to 6 mmHg decrease in the usual diastolic blood pressure was associated with a 35 to 40 percent reduction in stroke. [42]

While the incidence of stroke is decreasing in high-income countries, including the United States [45] [46], the incidence is increasing in low-income countries. [47] A reduction in systolic blood pressure has been identified as a key factor in the decline of stroke incidence in developed countries. [46]

It was being estimated that by 2020, 19 of 25 million annual stroke deaths to be in developing countries.[39] Two-thirds of strokes occur in low-income and middle-income countries where the average age of patients with stroke is 15 years below that in high-income countries.[40] Despite the enormous and growing burden of stroke, especially in people of working age, the disease does not receive the attention it deserves (and requires) for prevention and management.[40] [41]

In one study done in Ethiopia the pooled burden of hemorrhagic and ischemic stroke was

46.42% and 51.40% respectively. [4] Similar studies show the same result suggesting relatively high burden of ICH compared to the western. In united states ICH accounts for ~10% of all strokes, and ~35–45% of patients die within the first month. [2 6] Globally it accounts 9-27%. [48] This likely indicates suboptimal hypertension management in developing countries. The clinical impact of ICH appears disproportionately high among lower-resource populations both in the United States and internationally. [6]

This study examines the factors contributing to an increase in stroke incidence. Various factors can explain the significant disparity in stroke burden between developing and developed countries. These factors include challenges in managing hypertension (HTN), where a reduction in systolic blood pressure is cited as a reason for decreased stroke incidence in developed countries, according to a previous study. Other contributing factors are issues with diabetes management (DM), increased life expectancy, and advancements in diagnostic imaging, among others.

This study aims to evaluate issues related to hypertension management, such as the degree of blood pressure control and medication adherence as well as associated factors, as potential reasons for the significant difference in stroke burden between developing and developed countries. Since HTN is the most common and independent risk factor for stroke, as previously mentioned, addressing these issues is critical. Other potential factors contributing to the disparity in stroke burden can be explored in future studies.

1.3 Significant of the study

The results of this study allow us to identify areas for intervention that could help reduce the increasing stroke burden. While previous studies have primarily been hospital-based, this study focuses on lower health facilities, where a significant number of patients receive follow-up care. This study pinpoints one of the potential causes for the rising prevalence of stroke in low-income countries like Ethiopia, opening the door for possible interventions and significant reductions in stroke-related mortality and morbidity.

One of the significances of the study is to determine the magnitude of antihypertensive medication adherence, BP control and associated factor at selected health center and disseminate the results to different stakeholders. Stakeholders include health center stuff, hospital staffs, the scientific community and policy makers even to the community. Additionally, it will be an input for the scientific community and it will be a source of inquiry for further research based on the gaps that will be identified. Furthermore, it will guide policy makers and government bodies planning and providing services for patients with poorly controlled HTN with poor adherence.

2. Literature review

There are a number of studies done that assess adherence of antihypertensive medication with associated factor but little study was done on blood pressure control and most of the study were done at hospital level.

2.1 Adherence to medication

In general, the study done in Ethiopia show that the proportion of patient adherent to their medication range from 46.6%-75% and most of the study done at hospital level.

An institutional cross-sectional study at UOG with 384 patients found only 64.6% were adherent to treatment. Adherence was influenced by sex, distance from the hospital, number of comorbidities, and knowledge about hypertension and its treatment. Early management, counseling, and patient education were recommended to improve adherence. [7]

In a prospective cohort study done at Jimma university ambulatory cardiac clinic involving 416 patients the adherence rate was 46.6%. Patients with merchant occupation, physical inactivity, and diabetes mellitus co-morbidity were significantly associated with a higher rate of medication non-adherence. [8]

A cross-sectional study in selected public hospitals in Addis Ababa with 404 patients found a 66.8% adherence rate. Adherence was higher among females, those with comorbidities, and patients knowledgeable about hypertension, but lower among young adults. [9]

A cross-sectional study in Northwest Ethiopia involving 409 patients reported a 67.2% adherence rate, considered good. Key factors for improving adherence included preventing comorbidities, ensuring access to medical services, and maintaining strong client-provider relationships. [10]

A cross-sectional study at Tikur Anbessa Hospital's renal unit with 286 patients found a 69.2% adherence rate. Adherence was significantly associated with marital status, employment, healthcare access, and duration of hypertension and treatment. Overall, adherence was still considered low among participants. [11]

A cross-sectional study at Debre Tabor General Hospital with 346 patients reported a 75.1% medication adherence rate. Urban residence, taking fewer than two drugs daily, and good knowledge of hypertension were positively linked to adherence, while age over 60 was negatively associated.[12]

A Systematic review and meta-analysis done in Ethiopia involving around 14 studies Which include 4938 patients showed adherence rate of 65.41%. [19]

An Institutional based cross-sectional study done in Nigeria involving 150 patients. Adherence rate was 44.3%. Another study also done Nigeria found out 54% adherence with forgetfulness the most common reason for medication non-adherence. [22] [23]

A study in Egypt with 2,420 patients found a 46% adherence rate. Key factors for non-adherence included being over 65, illiterate, low income, having comorbidities, using three or more antihypertensive drugs, and living in rural areas. Behavioral factors like missing doses and not following dietary guidelines were also significant. A similar study in Pakistan reported a 77% adherence rate, with increased age, better awareness, and more prescribed pills improving adherence.[24] [25]

Study assessing adherence in USA show adherence rate with 44.7%, 35.9%, and 35.8% of patient's adherent at 3, 6, and 12 months, respectively in patient who were on concomitant antihypertensive and lipid-lowering therapy. [30]

A study in Italy involving 18,806 patients found 8.1% had high, 40.5% had intermediate, and 51.4% had low adherence to antihypertensive treatment. High adherence was significantly associated with multiple drug treatments, dyslipidemia, diabetes, obesity, and antihypertensive combination therapy. [31]

2.2 Blood pressure control and Guideline adherence

A cohort study at Jimma University Medical Center involving 416 patients found a 42.8% blood pressure control rate. Key factors were age, poor adherence to medication (46.6%), and low clinician adherence to guidelines (44.2%). Combination therapy was used in 66.1% of cases, with ACE inhibitors prescribed most frequently (63.7%).[13]

A retrospective study at Gondar University Hospital involving 561 patients found monotherapy was the most common antihypertensive regimen (~50%). Twice-daily dosing and monthly follow-ups were linked to better blood pressure control.[14]

A cross-sectional study at Ayder Hospital in Tigray involving 320 patients found 52.5% had uncontrolled hypertension. Key predictors included being overweight, having co-morbidities, and poor adherence to medication, physical activity, and alcohol abstinence. [15]

An observational study at Gondar University Hospital with 578 patients found 11.4% had uncontrolled blood pressure, with high salt intake increasing the risk sixfold. Older adults had lower risk, while comorbidities showed no significant link. Other studies reported uncontrolled BP rates of 59.9% at Black Lion Hospital and 69.9% at Zewditu Hospital. [16] [17] [18]

A cross-sectional study at Hiwot Fana Specialized University Hospital with 400 patients found diuretics, especially hydrochlorothiazide (55%), were the most commonly prescribed antihypertensives, followed by enalapril (22.3%), methyldopa (11.2%), atenolol (6.9%), and nifedipine (4.6%), both as monotherapy and in combination. [20]

A cross-sectional study of 392 hypertensive patients in a district hospital in Northwest Ethiopia found 77.3% were adherent to medication, and 42.9% had controlled blood pressure. Better control was linked to being female, age over 60, regular vegetable intake, physical activity, and using fewer than three drugs daily. Poor adherence, asthma, and adding salt to food were linked to poor control.[21]

A study done in Cameroon show control rate of 36.8% from 440 patients with good adherence to anti-hypertensive medications and dietary lifestyle changes were associated with good control. [26] A study done In Nigeria also show a control rate of 32.9%. Only 23.4% knew the consequences of poor blood pressure control and 64% were expecting a cure from treatment even when the cause of hypertension was not known. Furthermore, 68.7% showed low adherence to medication, the reported reasons for which included forgetfulness (61.2%), financial constraints (56.6%), high pill burden (22.5%), side effects of medication (17.3%), and low measured blood pressure (12.1%). Finally, knowledge and practice of the lifestyle modifications necessary for blood pressure control was inadequate among the participants. [27] Similar study done in Nigeria also show a rate of BP controlled of 35%. [28]

A U.S. retrospective review of 820 patients found common monotherapies included ACE inhibitors (27%), calcium channel blockers (22%), beta-blockers (20%), and diuretics (11%). Among 840 patients, 74.8% had high medication adherence, with 43% achieving BP control, compared to 34% and 33% in medium and low adherence groups. High adherence increased the likelihood of BP control by 45% after adjusting for age, gender, and comorbidities. [29]

Another study done USA among adults taking antihypertensive medication, the age-adjusted estimated proportion with controlled BP increased from 53.4% (95% CI, 49.0%-57.9%) in 1999-2000 to 68.3% (95% CI, 65.9%-70.8%) in 2007-2008, remained stable and was 72.2% (95% CI, 68.6%-75.8%) in 2013-2014, and then declined to 64.8% (95% CI, 61.3%-68.3%) in 2017-2018. [32]

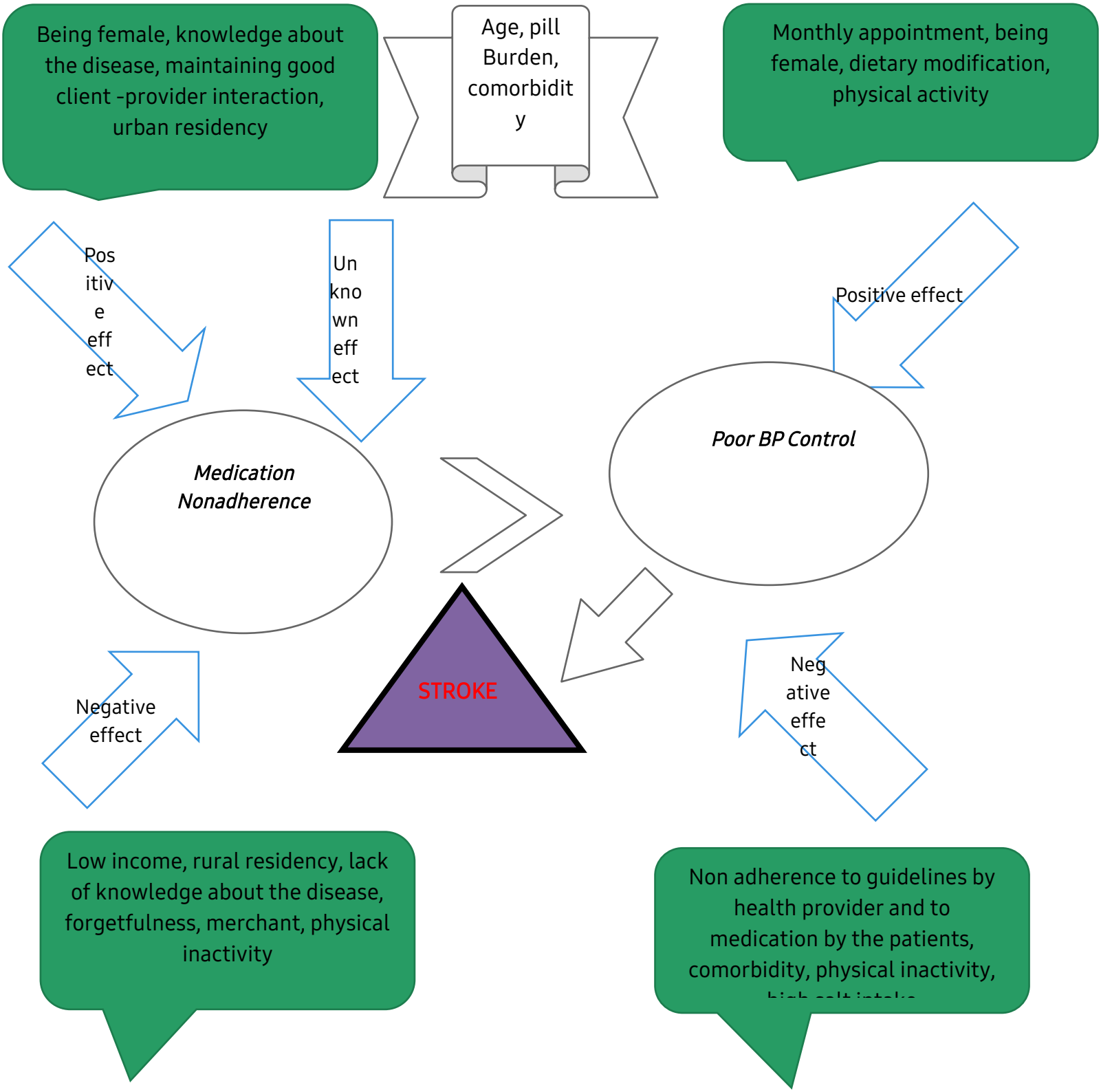
From these studies, adherence rates and blood pressure control are found to be significantly suboptimal, surprisingly even at the hospital level. There is also a notable difference in BP control between Africa (as low as 30%) and the Western world (as high as 72.2%). [18] [32] This disparity likely contributes to the high burden of stroke in African countries, including Ethiopia. The studies identify various associated factors that affect adherence and BP control.

Being female, knowledge about the disease, maintaining good client -provider interaction, urban residency are factor associated with good medication adherence. In contrary low income, rural residency, lack of knowledge about the disease, forgetfulness, merchant, physical inactivity are factor associated with poor adherence. Factors like age, pill burden, co morbidity showed mixed results. Fig 1

Monthly appointment, being female, dietary modification, physical activity, low pill burden associated with good BP control. In contrary non adherence to guidelines by health provider and to medication by the patients, comorbidity, physical inactivity, high salt intake are associated with poor control of blood pressure. Fig 1

Since none of the previous studies have been conducted at lower health facilities like health centers, where many hypertensive patients receive follow-up care, this study aims to fill that gap. It seeks to identify potential associated factors, including those that have shown mixed results in earlier research.

Figure 1. Conceptual framework


Being female, knowledge about the disease, maintaining good client -provider interaction, urban residency
Age, pill Burden, comorbidity
Monthly appointment, being female, dietary modification, physical activity
Positive effect
Unknown effect
Positive effect
Medication Nonadherence
Poor BP Control
STROKE
Negative effect
Negative effect
Low income, rural residency, lack of knowledge about the disease, forgetfulness, merchant, physical inactivity
Non adherence to guidelines by health provider and to medication by the patients, comorbidity, physical inactivity,

3. Objective

3.1 General objective

To assess the magnitude of antihypertensive medications adherence, blood pressure control and associated factor among hypertensive patients on follow up at selected health center, A.A, Ethiopia.

3.2 Specific objectives

To assess the magnitude of antihypertensive medications adherence.

To assess the magnitude of blood pressure control.

To assess the associated factors in antihypertensive medications adherence and blood pressure control.

4. Method and Material

4.1 Study area and period

The study was conducted at a selected health center in Addis Ababa, Ethiopia, which has an estimated population of 3,686,068 (1,389,817 male, 1,527,478 female) according to 2012 (EFY) data from the Central Statistical Agency (CSA). The city covers 526.99 square kilometers, with a population density of 5,535.8 people per square kilometer. As of 2023, the metro population is 5,461,000, reflecting a 4.46% increase from 2022. Addis Ababa has 97 health centers.[33–35] The study involved a total of 10 health centers across six sub-cities, including three health centers from Nifas Silk Lafto, three from Kality, and one each from Arada, Yeka, Bole, and Lideta.

The study period was from April 2024 - December 2024 GC. This period was utilized to finalize the research proposal, collect data, analyze and produce the last research draft.

4.2 Study design

The study method is a cross-sectional study employed at selected health center, A.A, Ethiopia.

4.3 Selection of study population

4.3.1 Target population

All adult patients with hypertension on follow up and antihypertensive medication at health center in Ethiopia

4.3.2 Study population

All adult population on follow up in health center with Hypertension and Antihypertensive medication in Addis Ababa.

4.3.3 Sample

Adult patients with hypertension who are on antihypertensive medication and under follow-up care at selected health centers in Addis Ababa were sampled using a multi-stage sampling method.

4.4 Eligibility Criteria

4.4.1 Inclusion Criteria

All adult patient with the diagnosis of HTN on antihypertensive medication and following up at local health center.

4.4.2 Exclusion criteria

Patient with confirmed secondary Hypertension.

4.5 Sample Size Determination

The sample was calculated by assuming a Confidence interval of 95%.

A single population proportion formula

$$S = (Z)^2 p (1-p) / M2$$, will be used to estimate the sample size.

S - sample size

Z- Z score Which is 1.96 using confidence interval of 95%

P- population proportion (assumed to be 50%=0.5)

M- margin of error which is 0.05

$$S = (1.96)^2 (0.5) (1-0.5)/ (0.05)2 = 384$$

The sample size considering 10% non-respondents' rate was 422.

Adjusted sample size = S/1 + [(S-1)/Population], Where S is 422.

Study done in 2021 GC show prevalence of hypertension in Addis Ababa is 29%. [37] And taking the estimated current population of Addis Abeba as 5,462,000[35], the patient with

hypertension would be 1,583,690.

Adjusted sample size=422/1 + [(422-1)/1,583,690] =422.

Multi-stage sampling technique was used to select the participants.

4.6 Data Collection Procedure

4.6.1 Data collection tools

Data was collected using a google form questionnaire which was adapted from previously published studies with some modification to ensure applicability to our current study, validity and reliability. The google form questionnaire consists questions on socio-demographic factors, Blood pressure control, medication adherence using medication adherence self-efficacy scale and the associated factors. In addition to collecting data directly from the patients, data was also gathered from their charts.

4.6.2 Data collection Method

Data was collected by trained data collectors under the supervision of the investigator and was collected by trained general practitioners, nurses and health officers who agreed to collect data from 35 patients each. Data collectors had one-day training on how to extract the required information from patients and patients' charts and complete the google form questionnaire. The time in target range (TTR) was used from multiple records over the past several months(3-6 months) to determine where the patient's blood pressure lie in the given catagories. [50] The MMSA-8 was used to check medication adherence. The 8-item Morisky Medication Adherence Scale (MMAS-8) was originally designed for use in hypertensive populations and demonstrates superior psychometric properties compared to the original MMAS. Due to its simplicity, cost-effectiveness, and reliability, it has become a widely utilized tool for assessing medication adherence among patients with chronic diseases.[38] A pilot study was done to evaluate feasibility, duration, cost, and improve upon the study design.

4.7 Study Variables

4.7.1 Dependent Variables

- BP control
- Medication adherence

4.7.2 Independent variable

- Socio-demographic factors (Age, Sex, Income, income, marital status, education)
- Duration of HTN
- BP measurement frequency

- Frequency of appointment
- Physical activity
- Diet including salt consumption
- Alcohol consumption
- Smoking
- Insurance
- Knowledge about BP target
- Medication adherence

4.8 Operational Definitions

4.8.1. BP target

Guidelines establishing blood pressure targets for hypertension control continue to evolve. According to 2017 guidelines developed by the ACC/AHA, the recommended goal of blood pressure control for the primary and secondary prevention of cardiovascular disease is a blood pressure <130/80 mmHg, including patients with diabetes mellitus and chronic kidney diseases. However, in hypertensive patients without elevated ASCVD risk, the clinical trial evidence is strongest for a target blood pressure of 140/90 mmHg but some expert as well as recent guideline still recommend BP target of <130/80 as long as well tolerated. [2] [49] (Table 1)

Recent clinical trials exploring optimal blood pressure (BP) targets include SPRINT, ACCORD, and SPS-3. These trials investigated different BP goals: SPRINT and ACCORD compared more intensive targets (SBP <120 mm Hg) with standard targets (SBP <140 mm Hg), while SPS-3 aimed for a more intensive target of <130/80 mm Hg. The results of these trials were mixed in terms of achieving their primary endpoints.

SPRINT was halted early after a median follow-up of 3.26 years, as the more intensive BP treatment significantly reduced the primary composite cardiovascular disease (CVD) outcome and all-cause mortality. In contrast, ACCORD did not show a significant reduction in its primary CVD composite outcome with more intensive BP treatment. However, it did demonstrate a significant reduction in stroke incidence, which was a component of the primary outcome. Notably, the standard glycemia subgroup in ACCORD showed significant benefits. A meta-analysis of SPRINT and ACCORD, revealed a significant reduction in CVD events.

On the other hand, SPS-3 did not achieve its primary endpoint of reducing recurrent

stroke (P=0.08), but it did find a significant reduction in a subgroup of patients with hemorrhagic stroke. Overall, these trials highlight the complexity of determining optimal BP targets and suggest that benefits may vary depending on patient subgroups and specific outcomes. [50] [51] [52] The more recent ESPRIT and BPROAD Trial provide robust evidence that intensive blood pressure control (targeting SBP <120 mm Hg) significantly reduces cardiovascular events in high-risk populations, including those with diabetes or elevated CV risk, with manageable increases in adverse events. These findings underscore the importance of stricter blood pressure management in improving cardiovascular outcomes. [53] [54]

Table 1. ACC/AHA Guidelines for Hypertension Management
Indications for Use of Blood Pressure–Lowering Medications
Secondary prevention of recurrent CVD events in patients with clinical CVD (defined as CHD, CHF, stroke) and SBP ≥130 mmHg or DBP ≥80 mmHg Primary prevention in patients with an estimated 10-year ASCVD risk ≥10% and SBP ≥130 mmHg or DBP ≥80 mmHg Primary prevention of CVD and low CVD risk in patients with SBP ≥140 mmHg or DBP ≥90 mmHg
Blood Pressure Goal for Patients with Hypertension
For adults with confirmed hypertension and known CVD or 10-year ASCVD event risk ≥10%, a BP target <130/80 mmHg
Possible Exceptions to Therapeutic Target of <130/80 mmHg
Patients >80 years of age Patients previously untreated for hypertension who experience an ischemic stroke or TIA and have blood pressure <140/90 mmHg Acute therapy of most hypertensive urgencies and emergencies Low risk patients (No CVD, ASCVD <10%, no Diabetes mellitus, no chronic kidney disease): < 140/90 (some experts would set a more aggressive blood pressure goal of <130/<80 mmHg)

4.8.2 Guideline adherence

Adherence to guidelines denotes the degree of conformity between the knowledge, cognition and/or action of an agent with the recommendations of a guideline. [36]

For patients with systolic pressure 10-20 mmHg above the goal and/or diastolic pressure 10 mmHg above the goal, antihypertensive therapy should begin with low to moderate doses of two drugs with complementary mechanisms. In stage 1 hypertension (systolic 130-139 mmHg, diastolic 80-89 mmHg), one drug is typically sufficient. The key to effective blood pressure control is avoiding therapeutic inertia, which occurs when treatment is not adjusted despite uncontrolled hypertension. A survey found that treatment was intensified with a new drug in only 17% of cases when blood pressure was above 140/90 mmHg. Therapeutic inertia is a bigger barrier to control than patient nonadherence. For monotherapy, common classes include ACE inhibitors, ARBs, thiazide diuretics, and dihydropyridine calcium channel blockers (e.g., amlodipine, felodipine). When two drugs are used, they should come from different classes, with ACE inhibitors (or ARBs), calcium channel blockers, and thiazide diuretics as the preferred combinations, based on the ACCOMPLISH trial findings. [5] Table 1

4.8.3 Medication Adherence

The U.S. Food and Drug Administration (FDA) states,

"Medication adherence, or taking medications correctly, is generally defined as the extent to which patients take medication as prescribed by their doctors. This involves factors such as getting prescriptions filled, remembering to take medication on time, and understanding the directions."

The American Medical Association says,

"A patient is considered adherent if they take 80% of their prescribed medicine(s). If patients take less than 80% of their prescribed medication(s), they are considered nonadherent."[36]

Commonly used tools to assess medication adherence include the Morisky Medication Adherence Scale (MMAS), introduced in 1986 for hypertensive patients; the Medication Adherence Rating Scale (MARS), developed in 2000; and the Antidepressant Compliance Questionnaire (ADCQ). The 8-item MMAS (MMAS-8), designed specifically for hypertension, has improved psychometric properties and is widely used due to its simplicity, cost-effectiveness, and reliability in evaluating adherence in chronic disease patients. [38] So in this study MMAS -8 was used.

4.9 Data Processing and Analysis

The data was entered onto and analyzed using SPSS version 25. Data cleaning was conducted exclusively by the Investigator. Descriptive summary of the data was presented in Tables and Figures. Frequency distributions was used to organize the data and present the responses obtained. Multiple logistic regression was used to identify variables that are associated with BP control, and drug adherence. Adjusted odds ratios with 95% confidence interval was used to determine the strength of association between dependent and independent variables. Variables having P-value < 0.05 will be considered as significant.

4.10 Data Quality Control

The Investigator examined the appropriateness of the methodologies followed. The questionnaire was reviewed for completeness and pre-testing was undertaken. The questionnaire was pre-tested on 5% of sample in similar setting, which are not be part of the study. Filled questionnaires was checked for completeness and consistency of information by the Investigator every 2 weeks during data collection.

4.11 Ethical Consideration

Ethical clearance to conduct the study was obtained before the beginning of data collection from the Research and Publication Committee (RPC) of the Department of Neurology, TASH. The participant's rights were protected by explaining the purpose and significance of the study. Participants was reassured that their responses would remain anonymous, and no remarks was made that could identify patients. The clients were informed that their participation in the study would remain anonymous and that their privacy was respected. They were provided with a comprehensive explanation that their involvement in the study is voluntary and that they can withdraw at any time without it affecting the care they receive or any other statutory rights.

4.12 Dissemination of results

The study results will be disseminated to key stakeholders, including CHS, AAU, TASH, DPCH, Department of Neurology, and other appropriate institutions of higher education. The results will further be disseminated to wider scientific community through abstract presentation at a conference and through publication in a peer-reviewed scholarly journal.

5. Result

5.1 Socio-demographic characteristics

A total of 348 patients included in the study. Female account the majority of the patients (60.5%). The majority of participants (54.9%) were in the 46–65-year age group.

The 18-45 years age group is the smallest, accounting for only 14.9% of the sample. The largest group is elementary education, making up 35.3% of the total. A significant portion of the population is uneducated (22.7%). 48% of the population has low income (<5000 birr). (Baseline demographic characteristics are depicted on table 2 below.)

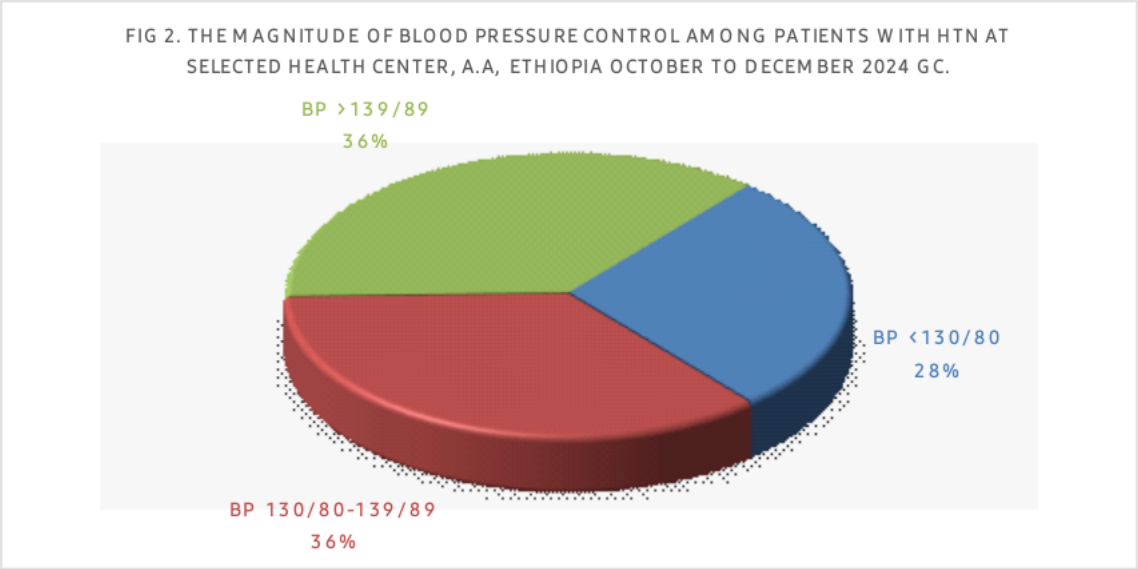
Table 2. Socio-demographic characteristics among patient with HTN on follow up at selected health center, A.A, Ethiopia October to December 2024 GC

		N	Marginal Percentage
AGE	18-45 year	52	15.4%
	46-65 year	186	55.0%
	>65 year	100	29.6%
SEX	Male	134	39.5%
	Female	204	60.5%
MARITAL	Married	214	63.3%
	Unmarried	23	6.8%
	Widowed	74	21.9%
	Divorced	27	8.0%
INCOME	<1000 birr	39	11.5%
	1000-5000 birr	123	36.4%
	5000 birr - 10,000 birr	82	24.3%
	>10,000 birr	35	10.4%
	I don't Know	59	17.5%
EDUCATION	Elementary	119	35.2%
	High school	66	19.5%
	College/University	75	22.2%
	Uneducated	78	23.1%
Valid		338	100.0%
Missing		10	
Total		348	

5.2. Magnitude of blood pressure control and associated factors

Approximately 35.1% (CI (0.301,0.401)) of the individuals fall into the blood pressure category of 130/80-139/89. Around 35.9% (CI (0.309,0.409) of the individuals have high

blood pressure, which indicate poor BP control (>139/89). About 27.3% (CI (0.226,0.320)) of the individuals have blood pressure within the target range of less than 130/80 mmHg. A significant portion of the population (71%) has blood pressure at or above 130/80 mmHg. Only about 27.3% of the individuals have blood pressure within the desired range.



The result of a multinomial logistic regression analysis showed that individuals with elementary education are more likely to have BP between 130/80-139/89 compared to individuals with BP<130/80 (AOR = 2.618, p = 0.042). Individuals whose BP measured monthly are less likely to have BP between 130/80-139/89 compared to individuals with BP<130/80 (AOR = 0.227, p = 0.007). Individuals with monthly appointments are more likely to have BP between 130/80-139/89 compared to individuals with BP<130/80 (AOR = 5.277, p < 0.001). The other counterintuitive result is smokers are less likely to have BP between 130/80-139/89 compared to individuals with BP<130/80 (AOR = 0.104, p = 0.020) possible reason of which explained under discussion part. Age, marital status, income, and other lifestyle factors (e.g., exercise, fruit consumption, salt intake) did not show significant associations with having BP between 130/80-139/89.

Younger individuals (18-45 years) are less likely to have BP >139/89 compared to individuals with BP<130/80 (AOR = 0.159, p = 0.004). Individuals with the lowest income (<1000 birr) are less likely have BP >139/89 compared to individuals with BP<130/80 (AOR = 0.130, p = 0.003). Individuals with monthly appointments are more likely to have BP >139/89 compared to individuals with BP<130/80 (AOR = 4.921, p < 0.001). Individuals with high adherence are less likely to have high BP (>139/89) compared to those with BP <130/80 (AOR = 0.256, p = 0.001). Marital status, education, frequency of healthcare visits, fruit consumption, exercise, salt intake, alcohol consumption, and smoking did not

show significant associations with having BP >139/89.(Table 3 and 4)

Although no association found in this study 40.6% of the population does not exercise, 26.8% exercise only 1-2 times/week for 30 minutes; while only 10.0% meet recommended levels (5 times a week, 30 min per session) and 40.3% have low fruit consumption. 25.5% consume salt more than recommended. (See table 3 for more information.)

The most common comorbidity identified was diabetes mellitus (27%), followed by dyslipidemia (16%). Stroke and cardiac disease each accounted for 3%. The majority of patients (55%) did not have any comorbidities. Hydrochlorothiazide was the most commonly used medication (37%), followed by enalapril (34%) and amlodipine (33%). Monotherapy was being used in 45% of the patients.

Table 3. Parameter Estimates of magnitude of blood pressure control and associated factor among patient with HTN at selected health center, A.A, Ethiopia, October to December, 2024 GC.

BP controlª	P value	AOR	95% CI	
Education: elementary	0.42	2.62	1.037	6.61
Frequency of BP measurement: monthly	0.007	0.227	0.077	0.671
Appointment: every 1 months	<0.001	5.277	2.087	13.361
Smoking: yes	0.02	0.104	0.015	0.701

ª Blood Pressure (BP) Category: 130/80-139/89 in reference to BP < 130/90

Table 4. Parameter Estimates of magnitude of blood pressure control and associated factor among patient with HTN at selected health center, A.A, Ethiopia, October to December, 2024 GC.

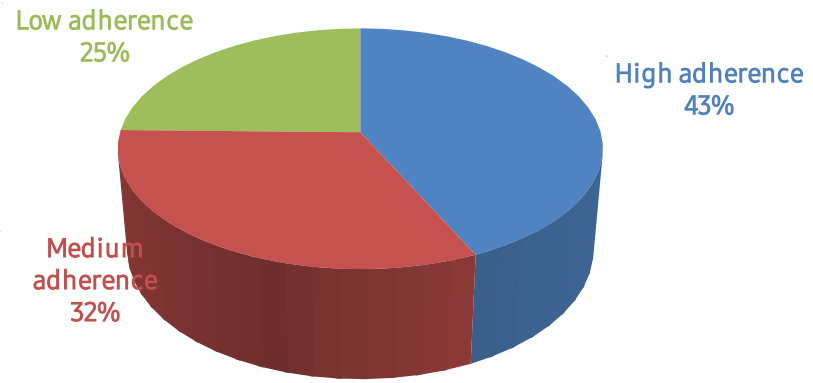
BP controlª	P value	AOR	95% CI	
Appointment: every 1 month	<0.001	4.921	1.976	12.258
Income: <1000 birr	0.003	0.13	0.034	0.506
Age: 18-45 year	0.004	0.159	0.045	0.558
Adherence: high adherence	0.001	0.256	0.111	0.586

ª Blood Pressure (BP) Category: BP > 139/89 in reference to BP < 130/90

5.3. The magnitude of antihypertensive medications adherence and associated factors

The largest group (43.1%) (CI (37.9% to 48.3%)) exhibits high adherence. A considerable portion (32.2%) (CI (27.3% to 37.1%)) falls into moderate adherence. Low adherence accounts for nearly a quarter (24.7%) (CI (20.2% to 29.2%)) of the population.

FIG 3. THE MAGNITUDE OF ANTIHYPERTENSIVE MEDICATIONS ADHERENCE AMONG PATIENT WITH HTN AT SELECTED HEALTH CENTER, A.A, ETHIOPIA, OCTOBER TO DECEMBER, 2024 GC.



The result of a multinomial logistic regression analysis showed that individuals with the lowest income (<1000 birr) are less likely to have moderate adherence compared to high adherence (AOR = 0.140, p = 0.001). Individuals with income 1000-5000 birr are also less likely to have moderate adherence compared to high adherence (AOR = 0.273, p = 0.007).

Individuals with appointments every 2 months are less likely to have moderate adherence compared to high adherence (AOR = 0.409, p = 0.037). Age, sex, marital status, education, frequency of BP measurement, fruit consumption, exercise, salt intake, alcohol consumption, smoking, insurance, and knowledge about BP target did not show significant associations with moderate adherence.

Individuals with the lowest income (<1000 birr) are less likely to have low adherence compared to individuals with high adherence (AOR = 0.204, p = 0.022). Individuals whose BP measured weekly are less likely to have low adherence compared to individuals with high adherence (AOR = 0.229, p = 0.026). Individuals whose BP measured every 2 weeks are less likely to have low adherence compared to individuals with high adherence (AOR = 0.177, p = 0.008). Individuals whose BP measured monthly are less likely to have low adherence compared to high adherence (AOR = 0.284, p = 0.018).

Individuals who consume fruit 3-5 times/week are less likely to have low adherence compared to high adherence (AOR = 0.101, p = 0.035). Individuals with low salt intake (<1 unit) are less likely to have low adherence compared to high adherence (AOR = 0.464, p = 0.047). Individuals with appointments every 2 months are less likely to have low adherence compared to high adherence (AOR = 0.344, p = 0.034). (Table 5 and 6)

Age, sex, marital status, education, exercise, alcohol consumption, smoking, insurance, and knowledge about blood pressure target did not show significant associations with low adherence. The study also identifies that 18% of individuals are unaware of their target blood pressure. (For more information see Table 4)

Table 5. Parameter Estimates of the magnitude of antihypertensive medications adherence and associated factors among patient with HTN at selected health center, A.A, Ethiopia, October to December, 2024 GC.

Adherence ª	P value	AOR	95% CI	
Income: < 1000 birr	0.001	0.14	0.042	0.465
Income: 1000 - 5000 birr	0.007	0.273	0.107	0.696
Appointment: every 2 months	0.037	0.409	0.177	0.946

ª Adherence catagories: Moderate adherence in reference to high adherence

Table 6. Parameter Estimates of the magnitude of antihypertensive medications adherence and associated factors among patient with HTN at selected health center, A.A, Ethiopia, October to December, 2024 GC.

Adherence[a]	P value	AOR	95% CI	
Income: <1000 birr	0.022	0.204	0.52	0.798
Frequency of BP measurement: weekly	0.026	0229	0.063	0.835
Frequency of BP measurement: every 2 weeks	0.008	0.177	0.05	0.637
Appointment: every 2 months	0.034	0.344	0.128	0.923
Fruit consumption: 3-5x/ week	0.035	0.101	0.012	0.847

[a] Adherence catagories: Low adherence in reference to high adherence

6. Discussion

6.1 Magnitude of blood pressure control and associated factors

This study aimed to assess the magnitude of blood pressure (BP) control, antihypertensive drug adherence, and associated factors among patients with HTN at selected health center, A.A, Ethiopia. The findings reveal critical insights into BP control, adherence levels and the factors influencing them, which are essential for designing targeted interventions to improve hypertension management so that potentially deceasing the burden of stroke as well as other cardiovascular disease in developing country like Ethiopia. Below is a detailed discussion of the results, their implications, and their alignment with existing literature.

This study provides critical insights into the magnitude of blood pressure (BP) control and the factors associated with different BP categories. The findings reveal that a significant portion of the population has suboptimal BP control, with only 27.3% (CI: 22.6% to 32.0%) of individuals achieving the target BP of <130/80 mmHg. Meanwhile, 35.1% (CI: 30.1% to 40.1%) fall into 130/80-139/89 mmHg category and 35.9% (CI: 30.9% to 40.9%) have high BP (>139/89 mmHg), indicating poor BP control. These results underscore the urgent need for targeted interventions to improve BP control and reduce the burden of hypertension-related complications including stroke. All studies reviewed in the literature were conducted at the hospital level, whereas our study, conducted in local health centers, found BP control to be at the lower end of the spectrum when using a target of <130/80 mmHg, with control rates ranging from 30% to 68% in previous studies [13 15 17 18 21]. Similar findings have been reported in other African countries such as Nigeria and Cameroon [26 27 28]. In contrast, a study conducted in the USA demonstrated a significantly higher BP control rate of 72% [32]

The recent studies and guidelines [2 49–54] recommend for lower BP target and our study highlights the challenges in managing hypertension effectively and suggests that current interventions may be insufficient.

In contrary to other study[14] individuals with monthly appointments were more likely to have BP in the range of 130/80-139/89 compared to those with BP <130/80 mmHg (AOR = 5.277, p < 0.001). This counterintuitive finding may indicate that individuals with higher BP are more likely to seek regular care, or that current care is insufficient to achieve optimal BP control.

In this study there are many other factors identified which are not mention in the literature reviews. Individuals with elementary education were more likely to have BP in the range of 130/80-139/89 compared to those with BP <130/80 mmHg (AOR = 2.618, p = 0.042). This suggests that lower education levels may be associated with poorer BP control, possibly due to limited health literacy or access to resources.

Individuals who measured their BP monthly were less likely to have BP in the range of 130/80-139/89 compared to those with BP <130/80 mmHg (AOR = 0.227, p = 0.007). This highlights the importance of regular BP monitoring in maintaining control. Another unexpected result is smokers were less likely to have 130/80-139/89 compared to those with BP <130/80 mmHg (AOR = 0.104, p = 0.020). This unexpected result may reflect a combination of survivor bias, confounding factors, small sample size, and potential data quality issues. It is unlikely that smoking itself has a protective effect on blood pressure, given the well-established risks associated with smoking.

The analysis also identified factors associated with BP > 139/89 compared to individual with BP < 130/80. In agreement with other study [13], our study found that Individuals with high adherence are less likely to have high BP (>139/89) compared to those with BP <130/80 (AOR = 0.256, p = 0.001) suggesting high adherence is associated with a lower likelihood of high BP (>139/89), emphasizing the importance of medication adherence in achieving BP control.

The appointment frequency showed similar result like above but the subsequent variable was not found to be associated with BP control in our literature review. Younger individuals (18-45 years) were less likely to have high BP compared to those with BP <130/80 mmHg (AOR = 0.159, p = 0.004). This aligns with the natural progression of hypertension, which is more common in older adults. Individuals with the lowest income (<1000 birr) were less likely to have high BP compared to those with BP <130/80 mmHg (AOR = 0.130, p = 0.003). This may reflect underdiagnosis or lack of healthcare access among low-income groups and another possibility could be dietary factor. Marital status, education, frequency of healthcare visits, fruit consumption, exercise, salt intake, alcohol consumption, and smoking did not show significant associations with having BP >139/89. This contrasts with some studies that have identified some of these factors as predictors of good BP control like sex, exercise, dietary modification, high salt intake. The lack of significance in this study may reflect the unique characteristics of the study population or the influence of other unmeasured variables.

Although lifestyle factors such as exercise, fruit consumption, and salt intake did not show significant associations with BP categories in the regression analysis, the descriptive data reveal concerning patterns. Only 10.0% of the population meets the recommended exercise levels (5 times/week, 30 minutes per session), while 40.6% do not exercise at all. This lack of physical activity is a significant risk factor for hypertension and stroke. 40.3% of the population has low fruit consumption, which may contribute to poor dietary habits and increased BP. 25.5% of the population consumes more salt than recommended, which is a well-established risk factor for hypertension. These findings highlight the need for lifestyle interventions to address these modifiable risk factors, even though they were not significant predictors in the regression model. Finally significant proportion of patients (45%) are on monotherapy despite guideline recommendation of dual therapy for most patient [46] and high prevalence of therapeutic inertia [5]. Randomized controlled trials have demonstrated that treatment with 1 antihypertensive medication is effective for reaching the blood pressure goal in only ≈30% of participants and that the majority of participants achieved the goal with 2 or 3 medications. Therefore, ≥2 antihypertensive medications are recommended for primary stroke prevention in most patients who require pharmacological treatment of hypertension. [55]

6.2 The magnitude of antihypertensive medications adherence and associated factors

The study also found that 43.1% (CI: 37.9% to 48.3%) of the population exhibited high adherence to antihypertensive medication, while 32.2% (CI: 27.3% to 37.1%) had moderate adherence, and 24.7% (CI: 20.2% to 29.2%) had low adherence. These results indicate that while a significant proportion of the population adheres well to their medication, nearly a quarter of individuals have low adherence, which is concerning given the critical role of adherence in achieving BP control and preventing complications like stroke.

This finding is more or less similar with other studies done in Ethiopia (46.6%-75% of adherence rate) especially when combing the high adherence with medium adherence. [7–9 11 12 19]

It is also comparable with study done in other country like Nigeria, Egypt, Pakistan, USA, and Italy (35%-77% adherence rate). [22–25 30]. But all of these studies were done at Hospital level.

Individuals with the lowest income (<1000 birr) were significantly less likely to have moderate adherence to medication compared to high adherence (AOR = 0.140, p = 0.001). Similarly, those earning between 1000-5000 birr also had lower odds of moderate adherence (AOR = 0.273, p = 0.007). Study done in Egypt found the opposite[24] so this finding appears counterintuitive because financial barriers are typically associated with lower adherence, not necessarily shifting adherence from moderate to high. One possible explanation is that individuals in the lowest income groups may experience severe healthcare access limitations, meaning they are less likely to seek medical care, receive prescriptions, or be diagnosed in the first place. As a result, they might not even be in a position to demonstrate moderate adherence because they are not consistently engaged in treatment or follow-up care.

Individuals with appointments every 2 months were less likely to have moderate adherence compared to high adherence (AOR = 0.409, p = 0.037). This suggests that less frequent follow-ups may contribute to lower adherence, as regular appointments provide opportunities for patient education, monitoring, and reinforcement of adherence behaviors. This finding was also not mention in most of other studies.

The analysis also identified factors associated with low adherence compared to individual with high adherence. Most of these factors are not mention on our literature reviews. Individuals who measured their BP weekly, every 2 weeks, or monthly were less likely to have low adherence compared to high adherence (AOR = 0.229, p = 0.026; AOR = 0.177, p = 0.008; AOR = 0.284, p = 0.018, respectively). This highlights the importance of regular BP monitoring in promoting adherence, as it reinforces the

connection between medication use and BP control. Individuals who consumed fruit 3-5 times per week were less likely to have low adherence compared to individual with high adherence (AOR = 0.101, p = 0.035). This suggests that healthier dietary habits may be associated with better adherence, possibly due to overall healthier lifestyles or greater health consciousness. Individuals with low salt intake (<1 table salt) were less likely to have low adherence compared to individual with high adherence (AOR = 0.464, p = 0.047). This aligns with the known benefits of reduced salt intake in BP control and underscores the role of lifestyle modifications in supporting adherence. Income and frequency of appointment have similar effect like that of moderate adherence.

Several factors, including age, sex, marital status, education, exercise, alcohol consumption, smoking, insurance, and knowledge about BP targets, did not show significant associations with moderate or low adherence. This contrasts with some studies that have identified some of these factors as predictors of adherence like sex, exercise, knowledge about BP targets. The lack of significance in this study may reflect the unique characteristics of the study population or the influence of other unmeasured variables. The study also identifies that 18% of individuals are unaware of their target blood pressure (BP).

7. Conclusion and recommendation

This part concludes the study by summarizing the key research findings in relation to research aims and research questions as well as the value and the contribution of thereof. It will also review the limitation and strength of the study and propose opportunity for future research.

This study aimed to assess the magnitude of blood pressure control, antihypertensive drug adherence, and associated factors among patients with HTN at selected health center, A.A, Ethiopia. The result showed that only 27.3% of individuals achieved the target BP of <130/80 mmHg, while 35.1% fell into the category of 130/80-139/89 mmHg and 35.9% had high BP (>139/89 mmHg), indicating poor control.
Similarly, 43.1% exhibited high adherence to medication and 32.2% moderate adherence, but 24.7% had low adherence, which is concerning given the critical role of adherence in preventing HTN-related complications like stroke. Key factors influencing BP control include education level, frequency of BP measurement, frequency of appointment, medication adherence, age and income. Key factors influencing medication adherence include income, frequency of appointment and BP measurement, fruit consumption and salt intake. The study also showed poor adherence to healthy lifestyle modifications. Significant proportion of the patients are on monotherapy even though guideline recommend dual medication for most patients and the high prevalence of therapeutic inertia. [5] [49]

These findings suggest that poor blood pressure control may be a key factor contributing to the rising burden of stroke, including hemorrhagic stroke, in developing countries compared to Western nations. This study focuses on a healthcare facility where this issue has not been previously explored and aims to identify potential areas for intervention to curb the growing stroke burden. While medication adherence rates in this study are comparable to those observed in other studies, including those conducted in Western countries, adherence remains a crucial target for intervention to improve BP control and reduce stroke incidence. The study also identified key factors that warrant further intervention to improve health outcomes. In addition, with a significant portion of patients (45%) using a single medication, there may be room for optimization in treatment regimens and mitigate therapeutic inertia.

7.1 Recommendation

7.1.1 Blood pressure control and associated factors

Based on the findings of this study, the following recommendations are proposed to improve BP control:

1. Improve Access to Healthcare:
    - Address financial barriers for low-income individuals by providing subsidized medications and free healthcare services.
    - Expand community-based programs to reach underserved populations.
2. Enhance Patient Education:
    - Develop educational materials to improve health literacy, particularly among individuals with lower education levels.
3. Strengthen Healthcare Systems:
    - Encourage more frequent follow-up appointments to provide ongoing patient education and monitoring.
    - Promote the use of home BP monitoring devices to empower patients and reinforce adherence.
4. Promote Healthy Lifestyle Choices:
    - Implement dietary interventions to increase fruit consumption and reduce salt intake.
    - Encourage regular physical activity to support overall cardiovascular health.
5. Addressing Medication Adherence and optimize treatment regimens:
    - Ensuring patients adhere to their medication schedules and receive the most appropriate treatment could improve outcomes
    - With a significant portion of patients (45%) using a single medication, there may be room for optimization in treatment regimens and

mitigate therapeutic inertia.

6. **Conduct Further Research**:
    - **Longitudinal Studies**: Conduct longitudinal studies to establish causal relationships between BP control and its predictors.
    - **Qualitative Research**: Use qualitative methods to explore the cultural, social, and psychological factors influencing BP control, particularly among patients with low-income
    - **Intervention Studies**: Evaluate the effectiveness of targeted interventions, such as financial support programs, culturally sensitive education, and lifestyle modification programs, in improving BP control.

7.1.2 Antihypertensive medications adherence and associated factors

Based on the findings of this study, the following recommendations are proposed to improve antihypertensive medication adherence:

1. Targeted Interventions for Low-Income Individuals

- **Address Financial Barriers**: Provide financial assistance, subsidized medications, or free healthcare services to low-income individuals to improve access to treatment and follow-up care.
- **Community-Based Programs**: Implement community health programs to reach individuals who may not have regular access to healthcare facilities..

2. Strengthen Healthcare Systems

- **Regular Follow-Up Appointments**: Encourage more frequent follow-up appointments (e.g., monthly) to provide ongoing patient education, monitoring, and reinforcement of adherence behaviors.
- **Home BP Monitoring**: Promote the use of home BP monitoring devices to empower patients to track their BP and understand the connection between medication use and BP control.

3.Promote Healthy Lifestyle Choices:

- Implement dietary interventions to increase fruit consumption and reduce salt intake.

4. Further Research

- **Longitudinal Studies**: Conduct longitudinal studies to establish causal relationships between adherence and its predictors, as well as to explore the impact of adherence on long-term health outcomes.
- **Qualitative Research**: Use qualitative methods to explore the cultural, social, and psychological factors influencing adherence, particularly among patients with low-income.
- **Intervention Studies**: Evaluate the effectiveness of targeted interventions, such as financial support programs, culturally sensitive education, and lifestyle modification programs, in improving adherence.

By addressing these factors, healthcare providers and policymakers can improve BP control, enhance medication adherence, and reduce the burden of hypertension-related complications like stroke in low-income country including Ethiopia. *Finally, more research also needed to assess other factors contributing to the rising burden of stroke in developing country other than Hypertension-related factors*.

7.2 Strength and limitation of the study

7.2.1 Strength

This is the first study conducted at lower-level health facilities in Ethiopia, addressing a notable knowledge gap as most previous studies were hospital-based. It revealed unique factors not identified in earlier literature, offering valuable insights for targeted recommendations. The study also provided important numerical data, highlighting significant gaps in blood pressure control and medication adherence compared to Western countries. Multinomial logistic regression enabled a deeper understanding of the factors influencing varying levels of BP control and adherence.

7.2.2 Limitation

The study faced limitations including financial constraints affecting data quality control and BP measurement, and sampling bias due to underrepresentation of some sub-cities from the multi-stage sampling. Its cross-sectional design restricts causal inference, while reliance on self-reported data may introduce reporting bias. Small sample sizes in certain subgroups, like smokers and low-income individuals, may affect result reliability. Additionally, lack of detailed clinical data—such as medication type, comorbidities, side effects, or ASCVD risk—limits deeper analysis of factors influencing BP control and adherence.

Despite its limitations, this study provides valuable insights into the magnitude of BP control, medication adherence, and associated factors in a lower health facility setting. The findings highlight the need for targeted interventions to address modifiable factors such as income disparities, healthcare access, and lifestyle habits. Future research should address the limitations by incorporating longitudinal designs, larger and more diverse samples, and a broader range of clinical and behavioral factors to further refine strategies for improving hypertension management and reducing the burden of stroke and other cardiovascular diseases.

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Annex

Questionnaire Consent Form

I, _____(participant's name), understand that I am being asked to participate in survey/questionnaire activity that forms part of _____ (Researcher's name) required course work in Addis Abeba University, College of health science, School of Medicine, Department of neurology. It is my understanding that this survey/questionnaire has been designed to gather information about the magnitude of antihypertensive medications adherence, blood pressure control and associated factor at selected health center, A.A, Ethiopia.

I have been given some general information about this project and the types of questions I can expect to answer. I understand that the survey/questionnaire will be conducted in person and that it will take approximately 10 minutes of my time to complete.

I understand that my participation in this project is completely voluntary and that I am free to decline to participate, without consequence, at any time prior to or at any point during the activity. I understand that any information I provide will be kept confidential, used only for the purposes of completing this assignment, and will not be used in any way that can identify me. All survey/questionnaire responses, notes, and records will be kept in a secured environment. . If I decline it, it will be destroyed by the researcher.

I also understand that there are no risks involved in participating in this activity, beyond those risks experienced in everyday life.

.

I have read the information above. By signing below and returning this form, I am consenting to participate in this survey/questionnaire project.

Participant name: _____

Signature: _____

Questionnaire

PART 1: Socio-demographic characteristics

Variable	Response
Study number	
Date	
Age	A.18-45 B.46-65 C.>65
Sex	A. M B. F
Income per month	A.<1000 B.1000-5000 C.5000-10000 D.>10000
Marital status	A. Married B. Unmarried C. Divorced D. Widowed E. Other…….
Education level	A. Elementary B. High school C. College /University E. other…….

PART 2: BP control

Variable	Response
For how long have you been hypertensive?	A. <5 years B. 5-10 years C. >10 years
Range of blood pressure in the past 3 months	A. <130/80 B. 130/80-139/89 C. >139/89
Frequency BP measurement	A. Daily B. Weekly C. Monthly D. More than monthly
Frequency of appointment	A. Every 1 month B. Every 2 months C. Every 3 months D. other .....
How frequently do include fruit and vegetables in your meal?	A. Daily B.3 times /week C.1 times /week D. Other.....
How Frequent and for how long do you do	A. 5 times and 30 minutes /week

physical activity?	B. 3-4 times and 30 minutes /week C 1-2 times and 30 minutes /week D Other .....
Any comorbidity?	A. Diabetes mellitus B. Dyslipidemia C. Cardiac illness D. stroke F. Other.....
How many tea spoons of salt do you add during food preparation?	A.1 or more B.<1
Do you smoke cigarette	A. Yes B. No
How much alcohol do you consume per week?	A.3 or more per day B.<3/Day
What medication are you using for your hypertension (including the dose)? (More than one answer is possible.)	A. Amlodipine B. Extended release nifedipine C. Enalapril D. Lisinopril E. Hydrochlorothiazide F. Other.....
Do you have health insurance?	A. Yes B. No

PART 3: Medication Adherence

3.1 Assessing medication adherence: Modified 8-item Morisky Medication Adherence Scale (score ›2 - low adherence ;1 or 2 - moderate adherence; 0 - high adherence)

Questions	Patient answer (Yes or No	Score Yes=1(except question number 5) No=0
Do you sometimes forget to take your pills?		
Have you ever cut back or stopped using your medication without telling your doctor, because you felt worse when you took it?		
People sometimes miss taking their medications for reasons other than forgetting. Thinking over the past two weeks, were there any days when you did not take your medicine?		
When you travel or leave home, do you sometimes forget to bring along your medication?		
Did you take your medicine yesterday?		
When you feel like your BP is under control, do you sometimes stop taking		

your medicine?		
Taking medication every day is a real inconvenience for some people. Do you ever feel hassled about sticking to your treatment plan?		
How often do you have difficulty remembering to take all your medications? A. Never/Rarely, B. Once in a while, C. Sometimes, D. Usually E. All the time		A=0 B-E=1

3.2 Assessing associated factors

What is the target Blood pressure?	A. Right (<130/80) B. Wrong (other than A)