

Hypertension Management among Hypertensive Patients in Al-Thawra Hospital, Sana'a City, Yemen: A Cross-Sectional Analysis

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ABSTRACT

Background: Hypertension remains a leading cause of cardiovascular morbidity in low resource settings, yet data on real-world management practices in conflict-affected regions such as Yemen remain scarce. **Aim:** To evaluate demographic characteristics, adherence to non-pharmacologic therapy, and antihypertensive prescribing patterns among hypertensive patients attending AL-Thawra Hospital, Sana'a City, Yemen. **Materials and Methods:** A hospital-based, cross-sectional study was conducted among 120 adult patients with confirmed essential hypertension. Data on demographics, comorbidities, lifestyle adherence, and pharmacological regimens were collected via structured interviews and medical record review. Descriptive statistics and Chi-square tests were used for analysis. **Results:** Participants were predominantly female (58.3%) and aged 41-70 years (82.5%). Overall, 70% reported adherence to non-pharmacologic recommendations, with consistent rates across comorbidity subgroups. Angiotensin-Converting Enzyme inhibitors/Angiotensin Receptor Blockers (ACE/ARB) were the most prescribed drug class (61.7%), with significantly higher utilization among females (39.2% vs. 22.5%). ACE/ARB monotherapy was the predominant regimen (39.2%); however, combination therapy with ACE/ARB plus β -blocker was frequently prescribed to patients with heart failure/ischemic heart disease (10.0%), reflecting guideline-aligned practice. **Conclusion:** Hypertension management in this Yemeni tertiary setting demonstrates reasonable alignment with international guidelines regarding lifestyle counselling and renin angiotensin system inhibitor use. However, underutilization of thiazide diuretics and calcium channel blockers highlights opportunities for protocol optimization. Strengthening drug supply chains and prescriber education may enhance therapeutic outcomes in similar resource constrained environments.

Keywords: Adherence, Antihypertensive therapy, Cross-sectional study, Hypertension, Prescribing patterns, Yemen.

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INTRODUCTION

High Blood Pressure remains one of the most significant public health challenges for more than 40% of deaths globally, representing a leading modifiable risk factor for cardiovascular diseases, stroke, diabetes and kidney failure (Global Burden of Metabolic Risk Factors for Chronic Diseases Collaboration, 2014). The epidemiology of hypertension demonstrates considerable geographical variation, with the most concerning increases in prevalence observed in sub-Saharan Africa, Oceania, and South Asia (Satoh *et al.*, 2026). Compared with high income

regions, hypertension is a greater burden and impacts on millions of people in limited income countries and tends to display a faster rate than the increase in these countries (Mills *et al.*, 2016; Zhou *et al.*, 2021; NCD-RisC, 2021), and may return to low awareness, treatment, and control rates for hypertension (Mills *et al.*, 2016). Multiple modifiable and non-modifiable risk factors contribute to the development and progression of hypertension (Satoh *et al.*, 2026). Traditional lifestyle determinants include excess sodium intake, low potassium intake, obesity, and physical inactivity (Satoh *et al.*, 2026). Research has identified that physical inactivity affects 78.7% of populations, while overweight and obesity constitute 46.8% and 20.6% of prevalent risk factors, respectively (Alinaitwe *et al.*, 2024). Additional risk factors include smoking, alcohol consumption, and socioeconomic determinants that vary across different demographic groups (Hou and Xang, 2024; Mills *et al.*, 2020; Joseph *et al.*, 2019). A recent multi-cross-sectional study across 46 low- and middle-income countries, provided



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causal evidence for the relationship between risk factors and hypertension, whereas the overweight and obesity were the foremost risk factor for hypertension in adults, followed by a sedentary lifestyle and low physical activity (Hou and Xang, 2024). Pharmacotherapy for hypertension has evolved substantially with updated clinical practice guidelines published in 2024 and 2025 (McCarthy *et al.*, 2025). The 2024 European Society of Hypertension clinical practice guidelines provide comprehensive recommendations for the management of arterial hypertension in various patient populations (Kreutz *et al.*, 2024). In spite of these advances in hypertension management, the blood pressure control remains suboptimal worldwide (Farrar and Frieden, 2025). A systematic review revealed that the global prevalence of uncontrolled hypertension stands at 54.6%, indicating that more than half of hypertensive patients do not achieve target blood pressure levels (Cheraghi *et al.*, 2025). Significant knowledge gaps persist regarding the real-world prevalence, risk factor profiles, and pharmacotherapy patterns in outpatient settings (Moiz *et al.*, 2024). Most studies have focused on either community-based populations or inpatient settings, with limited comprehensive analysis of outpatient cohorts (Neal *et al.*, 2011). Understanding the contemporary patterns of hypertension prevalence, associated risk factors, and pharmacotherapy utilization in outpatient clinics is essential for optimizing treatment strategies and improving patient outcomes (Zhu *et al.*, 2026). Therefore, this study aimed to analyze the prevalence, risk factors, and pharmacotherapy patterns of hypertension among hypertensive patients attending AL-Thawra hospital in Sana'a city, Yemen. The findings will contribute to the existing literature by providing contemporary data that can inform interventions and healthcare policy decisions for hypertension management in outpatient settings.

MATERIALS AND METHODS

Study Design and Setting

A cross-sectional analytical study was conducted among the hypertensive patients attending the Hypertension Outpatient Clinic at AL-Thawra hospital, Sana'a city, Yemen.

Study Population and period

The study population consisted of hypertensive patients aged ≥ 30 years with a confirmed diagnosis of essential hypertension, based on clinical records using standard diagnostic criteria (Whelton *et al.*, 2018). A total of 120 patients were included during the study period spanned a 3-months from September to November 2022.

Inclusion criteria

- Adult patients aged 30 years or older.
- Diagnosed with hypertension and receiving antihypertensive therapy.

- Patients with or without associated comorbidities such as diabetes mellitus, ischemic heart disease, heart failure, or renal failure.
- Patients with complete and accessible medical records.

Exclusion criteria

- Had incomplete medical records.
- They were critically ill during data collection.
- They were not receiving antihypertensive medications at the time of the study.
- They refused participation where direct patient interaction was required.

Sample Size Determination and Sampling

The sample size was calculated using the single-population proportion formula:

$$n = (Z^2 \times p \times (1-p)) / d^2,$$

Where $Z=1.96$ (95% confidence level), $p=0.50$ (anticipated proportion of adherence to non-pharmacologic therapy, maximizing sample size in the absence of precise local estimates), and $d=0.09$ (margin of error). This yielded a minimum required sample of 119 participants. Accounting for an anticipated 5% non-response rate, the target sample was set at 125. Ultimately, 120 eligible patients completed the study, providing adequate statistical power for descriptive and stratified analyses. A consecutive sampling technique was employed to recruit eligible patients presenting for routine follow-up visits. This approach was chosen to minimize selection bias while ensuring feasibility within the operational constraints of the clinical setting.

Study Variables

The study examined a set of dependent and independent variables to characterize hypertension management practices. The primary dependent variables comprised three interrelated outcomes: (i) adherence to non-pharmacologic therapy, (ii) antihypertensive drug class prescribed, (iii) drug combination pattern. The key independent variables included comorbidity status, patient gender, and age group. This variable framework enabled comprehensive examination of how demographic and clinical factors influence both behavioral adherence and pharmacological decision-making in the management of hypertension within the study setting.

Data Collection and Management

Data were extracted from patient medical records using a structured, piloted proforma. Variables included demographic characteristics, comorbidity profile, documented lifestyle counselling, and prescribed antihypertensive regimens. Data

entry was performed in Microsoft Excel® (Version 16.0), with double-entry verification by two independent researchers to minimize transcription errors. Discrepancies were resolved by consensus with reference to source documents.

Statistical Analysis

All analyses were conducted using IBM SPSS Statistics for Windows, Version 28.0 (IBM Corp., Armonk, NY, USA). All variables were summarized as frequencies (n) and percentages (%). Descriptive results are presented for the whole sample, and non-comparative inferential statistics were not calculated to compare groups. No missing data were observed for the variables included in the present analyses. All 120 participants contributed complete information for the cross-tabulations reported.

Ethical Considerations

This study was reviewed and approved by Lebanese International University, School of Pharmacy, Department of Biomedical Sciences, Republic of Yemen. All procedures adhered to the ethical standards of the Declaration of Helsinki for inclusion in the journal. The purpose of the study and information about confidentiality and anonymity, and that participation was voluntary and they could withdraw from the survey were included in the cover letter of the questionnaire. No identifiable personal data were collected.

Table 1: Socio-demographic Characteristics of the Study sample (n=120).

Variable	No.	%
Gender		
Male	50	41.67
Female	70	58.33
Age (year)		
(30-40)	10	8.33
(41-50)	29	24.17
(51-60)	38	31.67
(61-70)	32	26.67
(71-80)	11	9.17

RESULTS

Demographic Characteristics of the Study sample

In the current research, there have been used 120 hypertensive patients. The results are provided according to the characteristics of patients, compliance to non-pharmacological treatment, and patterns of antihypertensive medication use. In Table 1 shows that the number of females among the participants was higher than that of males, with the former representing 58.33% ($n=70$) and the latter being equal to 41.67% ($n=50$). As for the age composition, the biggest share of the patients was 51-60 years old, making up 31.67% ($n=38$), followed by 61-70 years old patients with 26.67% ($n=32$). Patients of the age of 41-50 comprised 24.17% ($n=29$) of the participants. Patients aged 71-80 and 30-40 years old made up 9.17% ($n=11$) and 8.33% ($n=10$) respectively.

Adherence to Non-Pharmacologic Therapy by Comorbidity Status

Table 2 highlights the extent to which patients comply with lifestyle modification practices within various categories of comorbidity. In total, 70% ($n=84$) of patients were compliant with lifestyle modifications while 30% ($n=36$) of patients were not adherent to non-pharmacological interventions. The highest compliance rate was recorded among patients with hypertension complicated by heart failure or ischemic heart disease (29.17%, $n=35$) and followed by those with only hypertension (27.50%, $n=33$). The lowest compliance rate was found in patients with hypertension and diabetes mellitus or renal failure (13.33%, $n=16$).

Prescription Patterns of Antihypertensive Drug Classes by Gender

In Table 3 gives an indication of the distribution of antihypertensive drug groups according to gender. The most prescribed antihypertensive drugs are ACE inhibitors and angiotensin receptor blockers (ACE/ARB) at 61.67% ($n=74$). These drugs were more prescribed among females (39.17%, $n=47$) as compared to males (22.50%, $n=27$). The second most prescribed drug group was β -blockers at 29.17% ($n=35$). Males had higher usage (15.83%, $n=19$) as compared to females (13.33%, $n=16$). Thiazides and DHP CCBs were less prescribed at 5.83% ($n=7$) and 3.33% ($n=4$), respectively.

Table 2: Patient adherence to non-pharmacologic therapy across comorbidity types (n=120)

Variable	HTN No. (%)	HTN with HF/IHD No. (%)	HTN with DM/ RF No. (%)	Total No. (%)
Follow life style	33 (27.50)	35 (29.17)	16 (13.33)	84 (70)
Do not follow life style	13 (10.83)	15 (12.5)	8 (6.67)	36 (30)
Totals	46 (38.33)	50 (41.67)	24 (20)	120 (100)

Hypertension (HTN), Diabetes Mellitus (DM), ischemic heart disease (IHD), Heart Failure (HF), Renal Failure (RF).

Table 3: Use of antihypertensive drug groups across gender types (n=120).

Drug Class	Males n (%)	Females n (%)	Total n (%)
ACE/ARB	27 (22.50)	47 (39.17)	74 (61.67)
β-Blockers	19 (15.83)	16 (13.33)	35 (29.17)
Thiazide	2 (1.67)	5 (4.17)	7 (5.83)
CCB DHP	2 (1.67)	2 (1.67)	4 (3.33)
Total	50 (41.67)	70 (58.33)	120 (100)

Table 4: Antihypertensive drug groups across comorbidity types.

Regimen Pattern	HTN with HF/IHD n (%)	HTN Only n (%)	HTN with DM/RF n (%)	Total n (%)
ACE/ARB monotherapy	15 (12.50)	19 (15.83)	13 (10.83)	47 (39.17)
ACE/ARB + β-blocker	12 (10)	5 (4.17)	3 (2.50)	20 (16.67)
β-Blocker monotherapy	12 (10)	3 (2.50)	4 (16.67)	19 (15.83)
ACE/ARB + thiazide	8 (6.67)	7 (5.83)	2 (1.67)	17 (14.17)
ACE/ARB + CCB DHP	2 (1.67)	5 (4.17)	1 (0.83)	8 (6.67)
CCB DHP monotherapy	0 (0)	5 (4.17)	0 (0)	5 (4.17)
CCB DHP + β-blocker	1 (0.83)	1 (0.83)	1 (0.83)	3 (2.50)
CCB DHP + thiazide	0 (0)	1 (0.83)	0 (0)	1 (0.83)
Total	50 (41.67)	46 (38.33)	24 (20)	120 (100)

[Angiotensin Converting Enzyme Inhibitors (ACE-I), Angiotensin Receptor Blockers (ARBs), Calcium channel blockers Dihydropyridine (CCB DHP)], [Hypertension (HTN), Diabetes Mellitus (DM), ischemic heart disease (IHD), Heart Failure (HF), Renal Failure (RF)].

Antihypertensive Regimen Patterns across Comorbidity Subgroups

The distribution of antihypertensive treatment regimens by comorbidity is presented in Table 4. The regimen of ACE/ARB monotherapy was the most prevalent among all patients, accounting for 39.17% ($n=47$). ACE/ARB monotherapy was more commonly used among patients with isolated hypertension (15.83%, $n=19$), hypertension with heart failure/ischemic heart disease (12.50%, $n=15$), and hypertension with diabetes mellitus/renal failure (10.83%, $n=13$). Combination treatment with ACE/ARB and β-blockers ranked second in terms of prevalence, constituting 16.67% ($n=20$) of all cases, especially among patients with heart failure/ischemic heart disease (10%, $n=12$). β-blocker monotherapy was prescribed in 15.83% ($n=19$) of all patients, particularly those with heart failure/ischemic heart disease. Thiazide diuretics in combination with ACE/ARB accounted for 14.17% ($n=17$) of cases, while ACE/ARB in combination with CCB-DHP accounted for 6.67% ($n=8$). Combinations of other types of medications, like CCB-DHP and β-blockers, and CCB-DHP and thiazide diuretics, were seldom prescribed. In general, the observed treatment prescription pattern revealed a predominance of ACE/ARB based therapy regimens, particularly among patients with associated cardiovascular and metabolic comorbidities.

DISCUSSION

The present study analyzed demographic features, adherence to non-pharmacological treatment, and prescription patterns for antihypertensive drugs in patients with hypertension and various comorbid conditions. The results showed that females comprised the majority of the patient sample, high prevalence of hypertension among middle-aged and elderly people, relatively good adherence to lifestyle interventions, and extensive use of ACE inhibitors/angiotensin receptor blockers (ACE/ARBs) both as monotherapies and combinations. As for demographic features, females accounted for the majority of the patient sample (58.33%), whereas the highest percentage of patients belonged to the age group between 51 and 60 years. The results agree with the findings of other studies which indicate high prevalence of hypertension among middle-aged and elderly people, especially postmenopausal women due to hormonal changes and increased risk of vascular complications (Wang *et al.*, 2019; Oliveros *et al.*, 2020). In addition, a study performed in Ethiopia found that 59.8% of patients had hypertension, and most of the participants were older than 50 years (Yazzie *et al.*, 2022), which is quite similar to the demographic profile revealed in the current study. The dominance of older age groups could be explained by progressive arterial stiffness and endothelial dysfunction caused by aging. The current study also shows that 70% of patients followed recommendations concerning lifestyle modifications, whereas 30% of patients failed to follow non-pharmacological

measures. This result corroborates the conclusions drawn by Biffi *et al.* in a systematic review, which shows that adherence to antihypertensive treatment and lifestyle recommendations depends on many behavioral and socioeconomic factors, rather than on patients' sex or presence of comorbidities (Biffi *et al.*, 2020). In addition, another study found that adherence to lifestyle recommendations in hypertensive patients was moderate and depended on patient education, continuity of care, and disease awareness, rather than on clinical diagnosis (Adinkrah *et al.*, 2020). In this connection, the relatively high level of adherence revealed in the current study can be explained by growing patient awareness about the significance of diet modification, salt restriction, smoking cessation, and regular exercise. However, the fact of low adherence to recommendations in almost one third of patients calls for further efforts aimed at providing education and counseling to patients. In relation to antihypertensive medication usage based on gender, ACE/ARBs had the highest prevalence (61.67%), followed by β -blockers (29.17%). The ACE/ARBs were prescribed more for females than males. These results align with various studies around the world showing the widespread use of ACE inhibitors and ARBs in the treatment of hypertension due to their well-established cardio renal protection, good safety profile, and compliance with modern hypertensive treatment guidelines (Jarari *et al.*, 2016). As well as, similar patterns of prescription have been found in the work of Wang *et al.* Where ACE inhibitors were found to be one of the most used drugs among antihypertensive medications for men and women (Wang *et al.*, 2019). Additionally, antihypertensive prescriptions among women have shown high rates of ACEI/ARB use because of their ability to prevent cardiovascular complications and renal disease progression (Biffi *et al.*, 2020). However, the low rate of thiazide diuretics and calcium channel blockers prescription seen in this study contrasts with findings from some studies conducted in Africa and Asia, where diuretics and calcium channel blockers were more widely used as first-line treatment (Yazzie *et al.*, 2022). This may be attributed to differences in local guidelines, doctors' preference, and availability of drugs, disease burden, and individual patient factors. Based on the analysis of antihypertensive medication regimens with respect to comorbid conditions, it was found that monotherapy of ACE/ARB was the most frequent type of antihypertensive regimen (39.17%), and the second one - combination of ACE/ARB with β -blockers (16.67%). Patients with heart failure or ischemic heart disease often received combination antihypertensive therapy, including ACE/ARBs and β -blockers. Such results are consistent with evidence-based recommendations for the prescription of ACE inhibitors and β -blockers in patients with cardiovascular comorbidities due to the proven benefits in terms of mortality reduction, improvement in cardiac function, and prevention of cardiovascular events (Jarari *et al.*, 2016). Similarly, a study recently showed that the prescription of ACEI/ARB-based medications and β -blockers is quite frequent among patients with

hypertension who suffer from ischemic heart disease and heart failure (Abdelkader *et al.*, 2023). In patients with diabetes mellitus or renal failure were also usually put on an ACE/ARB regimen alone. This result corresponds with the international guidelines for treating high blood pressure which indicate ACE inhibitors and ARBs as first-choice medications in diabetic and renal patients due to their protective role against kidney damage as well as their capability to decrease proteinuria and cardiovascular risks (Jarari *et al.*, 2016). This therefore indicates compliance with the latest treatment guidelines for high blood pressure. The limited use of combinations including calcium channel blockers and thiazide-containing treatments can be attributed to prudent treatment approaches in light of the potential side effects, electrolyte disturbance, or contraindications. On the other hand, the lower prevalence of some combinations suggested by clinical guidelines could reveal possibilities for improving patient-specific treatment approaches and selecting appropriate combination therapy in resistant hypertension. Generally, the results obtained in the current study have revealed that the patterns of antihypertensive prescription mostly coincided with the current evidence-based guidelines with a particular emphasis on the predominance of ACE/ARB-based treatment in patients with concomitant CVD, renal, and metabolic disorders. Nevertheless, the presence of poor adherence to healthy lifestyles in many patients requires the implementation of regular patient education, counseling efforts and regular follow-up to improve long-term blood pressure control and reduce hypertension-related complications.

CLINICAL IMPLICATIONS, STRENGTHS, AND LIMITATIONS

These findings suggest that hypertension management in Sana'a demonstrates commendable adherence to lifestyle advice and a strong orientation toward guideline-recommended drug classes. However, the underutilization of thiazides and CCBs, alongside suboptimal combination therapy patterns, indicates opportunities for protocol standardization, prescriber education, and supply chain stabilization. The study's strengths include its focus on an underrepresented, conflict-affected urban population and its granular analysis of prescribing patterns stratified by gender and comorbidity. Limitations encompass the cross-sectional design, reliance on self-reported lifestyle adherence, single-center sampling, and the absence of objective blood pressure control or medication possession ratio data. Future prospective, multi-site studies incorporating clinical outcomes and health system metrics are warranted to evaluate treatment efficacy, persistence, and the impact of targeted quality improvement initiatives.

CONCLUSION

Hypertension management at AL-Thawra Hospital reflects a practice landscape that partially aligns with international guidelines, characterized by high lifestyle adherence and predominant use of ACE/ARB agents. Addressing gaps in

combination therapy optimization, ensuring consistent drug availability, and implementing structured patient education could enhance clinical outcomes. These insights provide a foundational evidence base for refining hypertension care pathways in Yemen and comparable LMIC settings facing systemic healthcare constraints.

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ABBREVIATIONS

ACE-I: Angiotensin Converting Enzyme Inhibitors; **ARBs:** Angiotensin Receptor Blockers; **CCB DHP:** Calcium channel blockers Dihydropyridine; **HTN:** Hypertension; **DM:** Diabetes Mellitus; **IHD:** Ischemic Heart Disease; **HF:** Heart Failure; **RF:** Renal Failure.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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