

Prevalence and Risk Factors of Hypertension Among Adults Attending UST-Hospital Sana'a

Bushra AL-Ghaffari*, Safia Al-Qashae, Monia Al-Beshari, Elham Awn, Ala'a Al-Khabash, Aya Maresh, Sumaia kamel, Fatma Al-Dairy, Thuraia AL-Manari

Department of Community Medicine, Faculty of Medicine and Health Sciences, University of Science and Technology, Sana'a, Yemen
Email: bushraghaffari2020@gmail.com

ABSTRACT

Background: Hypertension is a major public health challenge and a leading modifiable risk factor for cardiovascular, cerebrovascular, and chronic renal diseases worldwide. Despite its burden, local data in Yemen remain limited. **Objective:** This study aims to estimate the prevalence of hypertension and identify its associated risk factors among adults attending University of Science and Technology Hospital, Sana'a, Yemen. **Methods:** A descriptive cross-sectional study was conducted in 2024 among 241 adults aged ≥ 18 years. The data were collected using a face-to-face structured questionnaire. P-value < 0.05 was considered statistically significant. **Results:** The overall prevalence of hypertension was 23.6%. the proportions of Current smokers and diabetes mellitus were 16.6% and 18.7% respectively. Multivariable analysis showed that age (OR= 1.043, 95% CI: 1.017 – 1.070, $P < 0.001$), marital status (OR= 2.898 – 10.476, $P = 0.015 - 0.006$) for married and widowed respectively, diabetes mellitus (OR= 4.400, 95%, $P < 0.001$), current smokers (OR= 4.359, $P = 0.035$) were significantly associated with hypertension, while past smoking was not significant. **Conclusion:** hypertension is prevalent among adults attending the study setting, and significantly associated with modifiable and non-modifiable risk factors. Early screening and targeted public health interventions are recommended.

Keywords Cross-sectional; Hypertension; Prevalence; Risk factors; Yemen

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INTRODUCTION

Hypertension is the leading modifiable cause of mortality worldwide, responsible for approximately 10.8 million deaths annually, predominantly from stroke, myocardial infarction, and chronic kidney disease. In Yemen, a nation devastated by prolonged armed conflict, hypertension constitutes the fourth leading cause of death and compounds a substantial non-communicable disease burden(1,2).

The 2024 European Society of Cardiology (ESC) guidelines define hypertension as office blood pressure $\geq 140/90$ mmHg, confirmed by repeated measurements, with preference for out-of-office monitoring to exclude white-coat and masked hypertension. The etiology is predominantly multifactorial, arising from the interaction between polygenic susceptibility and environmental exposures; secondary causes, including endocrine disorders and renal artery stenosis, are identifiable and potentially reversible(3). When blood pressure exceeds 180/120 mmHg, the critical distinction lies in the presence or absence of new or worsening target organ damage, differentiating hypertensive emergency from urgency(4).

The pathophysiological cascade originates at the vascular endothelium. Activation of the renin-angiotensin-aldosterone system promotes vasoconstriction and sodium retention, while psychosocial stress and physical inactivity exacerbate hemodynamic load. Regular

physical activity attenuates these mechanisms by reducing peripheral vascular resistance. Untreated hypertension is associated with progressive target-organ damage, including cerebrovascular disease, left ventricular hypertrophy, and chronic kidney disease(5,6).

State of the Art

Globally, 1.4 billion adults—one in three—have hypertension, concentrated in low-income countries where awareness is critically low(2). Regionally, prevalence reaches 54.7% in Iraqi Kurdistan(7), and 21.2% in Hawassa, Ethiopia(8).

Sana'a data are sparse. A 2013 survey estimated 6.4% prevalence—a likely underestimate—with coastal areas higher than inland(9). Later studies report 20.5% in Mukalla, where family history, diabetes, and obesity predicted hypertension; khat chewing was common but not independently significant(10). In Sana'a, hypertensive patients were mostly overweight or obese, with female sex, younger age, and inactivity as predictors(11). A 2024 study of cardiac and renal patients linked hypertension to age, obesity, smoking, diabetes, and non-adherence(12). No study has examined Sana'a's general adult population since.

Khat chewing is central to Yemen's hypertension literature. Its association with elevated blood pressure is documented nationally(13), with one in five Mukalla outpatients chewing regularly(10). Cathinone, the active alkaloid, is a sympathomimetic amine causing vasoconstriction and tachycardia. A 2024 meta-analysis of fifteen studies found khat chewers had 2.4-fold increased odds of hypertension(14). An Ethiopian study corroborated this with elevated diastolic pressure among regular users(14).

Yemen's healthcare system faces existential challenges. In 2025, 453 health facilities were at risk of closure, with the system facing systemic collapse(15). The 2024 ESC guidelines recommend home blood pressure monitoring, yet implementation in resource-limited settings encounters substantial barriers(3). Only 30% of Yemeni hypertensive patients were aware of home monitoring(16). Lifestyle modification—dietary sodium restriction, physical activity, and weight reduction—remains the foundation of prevention. One review delineated evidence-based non-pharmacological strategies(5), and a Saudi feasibility study showed lifestyle counseling improves blood pressure control in primary care(17).

Controversies and Diverging Hypotheses

The role of khat in hypertension etiology remains contested. Early studies, including the Mukalla investigation(10), reported high khat prevalence without independent significance after multivariate adjustment, suggesting confounding by lifestyle factors. Conversely, pharmacological evidence of cathinone's sympathomimetic activity and the 2024 meta-analysis showing 2.4-fold increased odds support a direct causal association(14). This divergence—between population studies failing to isolate khat and mechanistic evidence confirming cardiovascular risk—remains unresolved in Sana'a, where no study has evaluated khat exposure in general adults.

Novelty and Research Gap

Three gaps persist. First, Sana'a data are over a decade old and do not reflect current demographics(9). Second, recent studies focused on clinical populations(12) or regions outside the capital(10), leaving general adults in Sana'a uncharacterized. Third, although khat's cardiovascular risks are consolidated through meta-analysis(14), this exposure has not been evaluated in general adults from Sana'a. No prior study has assessed hypertension prevalence and its determinants, with specific attention to khat chewing, among general adults at a major Sana'a teaching hospital.

Research Objectives

This study addresses these gaps by determining hypertension prevalence and identifying associated risk factors—including khat chewing—among adults attending University of Science and Technology Hospital (UST-Hospital) in Sana'a, Yemen, in 2024.

METHODS

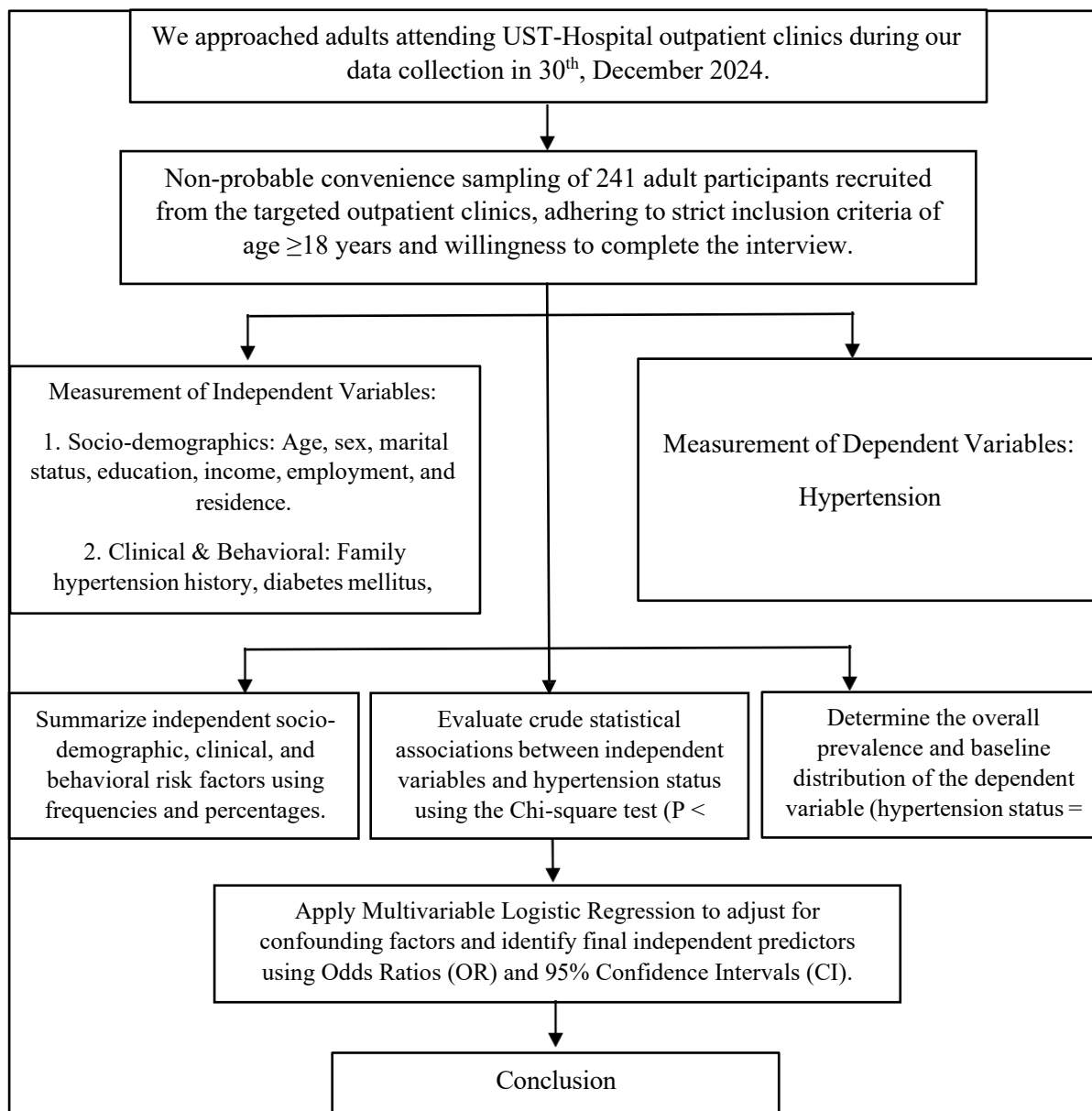


Figure 1. Prevalence and Risk Factors of Hypertension Among Adults Attending UST-Hospital Sana'a, 2024 Stages Flowchart

This cross-sectional study was carried out at UST-Hospital in Sana'a, Yemen. We collected data on 30th, December 2024 and updated the analysis in 2026 to bring it in line with current reporting standards and the latest evidence.

We recruited 241 adults by convenience sampling, approaching anyone aged ≥ 18 present at the hospital that day outpatients, inpatients, companions, staff, and visitors. We cast the net this wide because hypertension rarely announces itself; narrowing recruitment to symptomatic attenders would have missed the very cases we were looking for and produced a biased, artificially low prevalence. UST-Hospital is among Yemen's largest and oldest private healthcare facilities, drawing referrals from Sana'a city, surrounding towns, and nearby villages. This broad catchment area yielded a sample with both urban and rural representation, enhancing generalizability.

A two-part structured questionnaire was administered face-to-face. The first section covered age, sex, education, income, and residence. The second covered family history of hypertension, diabetes, tobacco smoking, khat chewing, exercise habits, and salt intake. Our main outcome was hypertension, defined simply as self-reported physician diagnosis with current use of antihypertensive medication.

Questionnaires were checked manually for completeness, then coded and entered into IBM SPSS Statistics version 26.0. Some questions had follow-up items that only applied to certain respondents; after applying skip-logic and dropping missing entries, nested exercise items yielded valid denominators of $n=92$ (frequency) and $n=91$ (duration).

Frequencies and percentages described the sample and estimated prevalence. Chi-square tests assessed crude associations between each exposure and the outcome. Multivariable logistic regression identified independent predictors while adjusting for confounders, with findings reported as adjusted Odds Ratios (OR) and 95% Confidence Intervals (95% CI). We set statistical significance at $P < 0.05$ (two-tailed). The research stages are illustrated in Figure 1.

RESULTS

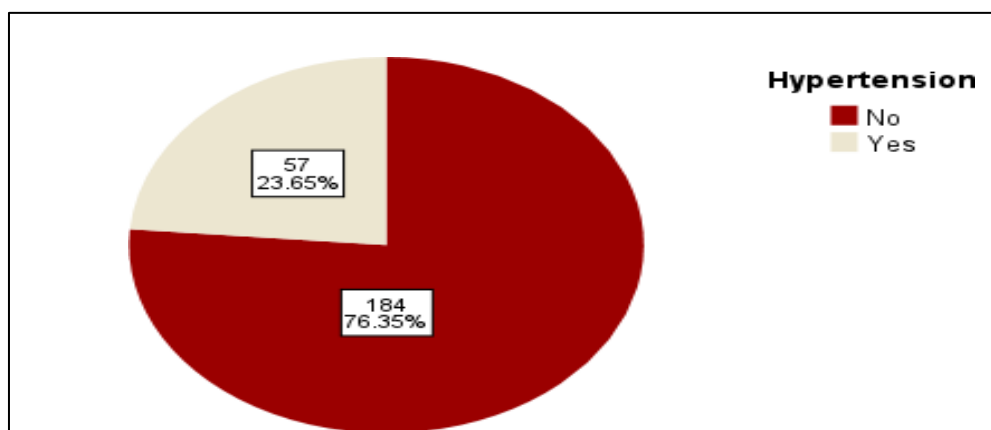
Survey was done at 30th of December, 2024 in UST -Hospital, Sana'a, Yemen.

1. Baseline Characteristics of participants:

Table 1. Sociodemographic, clinical, and behavioral characteristics of adults attending UST Hospital, Sana'a, 2024.			
Variable		Frequency	Percentage (%)
Sex	Male	128	53.1
	Female	113	46.9
	Total	241	100
Age (years)	Age in years (mean $\pm$ S.D)	36.9 $\pm$ 13.1	CI=1.017 – 1.070
	18-29	88	36.5
	30-39	58	24.1
	40-49	47	19.5
	≥ 50	48	19.9
	Total	241	100
Marital status	Single	62	25.7
	Married	167	69.3
	Divorced	5	2.1
	Widowed	7	2.9
	Total	241	100
Educational status	Illiterate	41	17.0
	Primary school level	42	17.4

	Secondary school level	60	24.9
	Diploma	21	8.7
	Bachelor	77	32.0
	Total	241	100
Employment status	Employed	97	40.2
	Unemployed	53	22.0
	Housewife	62	25.7
	Others	29	12.1
	Total	241	100
Monthly income	<50000	110	45.6
	50000-100000	77	32.0
	>100000	54	22.4
	Total	241	100
Place of residence	Inside city	156	64.7
	Outside city	85	35.3
	Total	241	100
Positive family history of HTN	Yes	139	57.7
	No	102	42.3
	Total	241	100
Diabetes mellitus	Yes	45	18.7
	No	196	81.3
	Total	241	100
Smoking status	Never smoked	178	73.9
	Past smoker	23	9.5
	Current smoker	40	16.6
	Total	241	100
Khat chewing status	Never chewed	100	41.5
	Past chewed	25	10.4
	Current chewed	116	48.1
	Total	241	100
Fruit consumption\week	None	19	7.9
	1-3 days	140	58.1
	4-7 days	49	20.3
	Unknown	33	13.7
	Total	241	100
Vegetable consumption\week	None	19	7.9
	1-3 days	132	54.8
	4-7 days	72	29.8
	Unknown	18	7.5
	Total	241	100
Exercise	Yes	96	39.8
	No	145	60.2
	Total	241	100
If yes, how many days/weeks? (n=92) *	Daily	14	15.2
	3-5 times	47	51.1
	<3 times	31	33.7
	Total	92	100
Duration of single exercise session (n=91) *	>60 min	24	26.4
	30-60 min	26	28.5
	<30 min	41	45.1
	Total	91	100
* Percentages for sub-questions were calculated based on the number of valid respondents (n=92 for frequency and n=91 for duration) after cleaning missing data and skip-logic errors.			

2. Prevelence of hypertension:



Graph1. Hypertension prevalence among adults attending UST - Hospital, Sana'a,2024.

3. Hypertension related risk factors:

Variable		Hypertension			P-value
		Yes n (%)	No n (%)	Total n (%)	
Age (years)	18-29	9(10.2)	79(89.8)	88(100)	< 0.001*
	30-39	13(22.4)	45(77.6)	58(100)	
	40-49	17(36.2)	30(63.8)	47(100)	
	≥50	18(37.5)	30(62.5)	48(100)	
Marital status	Single	7(11.3)	55(88.7)	62(100)	0.014*
	Married	45(26.9)	122(73.1)	167(100)	
	Divorced	1(20.0)	4(80.0)	5(100)	
	Widowed	4(57.1)	3(42.9)	7(100)	
Diabetes mellitus	Yes	22(48.9)	23(51.1)	45(100)	< 0.001*
	No	35(17.9)	161(82.1)	196(100)	
Smoking status	Never smoked	41(23.0)	137(77.0)	178(100)	0.035*
	Past smoker	10(43.5)	13(56.5)	23(100)	
	Current smoker	6(15.0)	34(85.0)	40(100)	

4. Analysis of factors associated with hypertension:

Table 3. Multivariable logistic regression analysis of factors associated with hypertension among adults attending UST-Hospital, Sana'a ,2024.

Variable		Hypertension	
		OR	P-value
Age		1.043	< 0.001
Marital status	Married	2.898	0.015
	Widowed	10.476	0.006
Diabetes mellitus		4.400	< 0.001
Current smoking		4.359	0.016

DISCUSSION

Our survey revealed an overall hypertension prevalence of 23.65%, which approximates local data from Mukalla (20.5%) and regional community figures from Southern Ethiopia (21.2%)(8). However, hospital-based samples are not directly comparable to community or public-facility data.

Regarding age, a highly significant statistical association was observed ($P < 0.001$), with prevalence substantially higher among participants aged >50 years (37.5%) compared to those aged 18–29 years (10.2%). This trend is consistent with data from Mukalla, which reported 43.75% in the older group versus 3.23% among the youngest, and aligns with regional meta-analysis confirming that advanced age multiplies the odds of hypertension ($OR = 4.37$)(18). Physiologically, this link is driven by age-related structural decline and vascular fibrosis, where increased collagen deposition and elastin degeneration cause arterial stiffness, endothelial dysfunction, and a loss of elasticity(19).

The prevalence of hypertension was slightly higher among females (27.4%) compared to males (20.3%), though this difference was not statistically significant ($P = 0.194$). This pattern is consistent with studies from Nigeria reporting female predominance(20) (Gender disparities in hypertension prevalence, awareness and healthcare seeking behavior among young adults in Nigeria). In contrast, other regional studies have found higher male prevalence, such as in Mukalla(10), Iraq(7), and Southern Ethiopia(8). The absence of a significant gender difference in our study may reflect limited statistical power due to the modest sample size. Alternatively, changes in women's behavior, such as chewing khat, smoking shisha, and increasing psychosocial responsibilities in a developing country exposed to wars, may contribute to the higher prevalence of hypertension. These hypotheses require testing in larger, population-representative studies.

Our study demonstrated a statistically significant association between marital status and the prevalence of hypertension ($P=0.014$). Hypertension was more prevalent in widowed subjects (57.1%) and married individuals (26.9%), and less in single subjects (11.3%). Other studies revealed similar findings, in which widowhood and marriage were positively correlated with higher rates of hypertension, such as 48.5% in China (2024)(21), 53.2% in Korea (2022)(22). The Saudi survey similarly reported elevated rates in widowed/separated (35.3%-39.5%) and married groups (16.1%-29.3%) compared to those never married (3.2%-5.9%)(23). An Iraqi study showed higher hypertension prevalence in ever-married individuals (57.3%) versus singles (29.6%)(7). The significant association between hypertension and widowhood might be attributed to the advanced age within this group, which is naturally linked to increased arterial stiffness in older people(19). Our second hypothesis is that the higher prevalence among married participants compared to singles may be related to changes in lifestyle and increasing psychosocial responsibilities—such as securing family needs and financial burdens—which contribute to the higher prevalence of hypertension(22).

Our study revealed a highly significant association between diabetes mellitus and hypertension ($p < 0.001$), with 48.9% of hypertensive patients having concurrent diabetes. This strong coexistence is primarily driven by shared pathophysiological mechanisms; specifically, insulin resistance and hyperinsulinemia activate the sympathetic nervous system and the renin-angiotensin-aldosterone system, causing sodium retention and intravascular volume expansion. Diabetes, hypertension, and cardiovascular disease: clinical insights and vascular mechanisms(24). Additionally, hyperglycemia-induced oxidative stress and endothelial dysfunction directly increase arterial stiffness(25). Hypertension in diabetes: an update of basic mechanisms and clinical disease. Hypertension. Rates noticeably higher than ours were reported in North Africa, including Egypt where a systematic review found a 60.25% prevalence of hypertension among diabetic patients(26) while a cross-sectional study published

in Saudi Journal of medicine reported a significantly higher coexistence rate of 70.1%(27). This regional disparity is largely driven by higher rates of obesity, sedentary lifestyles, and specific dietary trends that heavily contribute to metabolic syndrome in these nations(28). In comparison to an Ethiopian study (37.4%), this lower rate in Ethiopia is largely attributed to socio-environmental factors shared with Yemen, including chronic stress, dietary differences, and gaps in early screening(8). southern Ethiopia.

Our study observed a paradoxical smoking pattern: past smokers showed the highest hypertension prevalence (43.5%), never-smokers intermediate (23.0%), and current smokers the lowest (15.0%). However, multivariable analysis identified current smoking as an independent risk factor (OR = 4.359, P = 0.016), consistent with established pathophysiology implicating sympathetic activation and renin-angiotensin-aldosterone system-mediated sodium retention(29). The elevated prevalence among past smokers likely reflects post-cessation weight gain(30) and cumulative vascular damage from chronic smoking(31), rather than a protective effect of smoking.

Regarding khat chewing status, 48.1% of our participants were current chewers, 10.4% were past chewers, and 41.5% had never chewed. Despite this high prevalence, multivariate analysis demonstrated no statistically significant association with hypertension (P = .581). This shares the null finding with the Mukalla study (P = .233)(10), but contrasts sharply with a comprehensive meta-analysis of 12,409 participants, which established that regular khat chewers are 2.4 times more likely to develop hypertension (P < .001)(32). This discrepancy likely reflects methodological limitations rather than a true null effect. In our Sana'a cohort, the statistical association was masked by cultural ubiquity: khat chewing is a socially normalized practice distributed across the population rather than concentrated in a distinct risk group, limiting contrast between exposed and unexposed individuals. Similarly, the lack of significance in the Mukalla study stemmed from a predominantly non-chewing sample (57.29%)(10).

CONCLUSION

Hypertension represents a significant health burden among adults attending UST-Hospital in Sana'a, Yemen, with a considerable proportion of the study population affected. Our findings highlight age, marital status, diabetes mellitus, and current smoking as key determinants of hypertension risk — the first being non-modifiable, the latter two offering clear targets for intervention. This reinforces the importance of practical, sustained public health efforts: routine blood pressure screening, early identification of high-risk individuals, smoking cessation programs, and optimal glycemic control. These measures, though straightforward, hold substantial potential to reduce both the individual and societal burden of hypertension and its complications. Nevertheless, the cross-sectional, hospital-based design and convenience sampling approach limit the generalizability of our findings and preclude causal inference. We therefore recommend larger, community-based longitudinal studies to yield more representative evidence and inform comprehensive hypertension prevention and control strategies in Yemen

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Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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