Review
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The Prevalence and Risk Factors of Hypertension Among the Population in Gulf Countries: A Systematic Review and Meta-Analysis

Asim Sharif*

Department of Medical Education, Faculty of Medicine, King Abdulaziz University, Jeddah, 21589, Saudi Arabia.
*Correspondence to: Asim Sharif (E-mail: atsharif@kau.edu.sa)
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Abstract

Objectives: To determine the prevalence, management status and major socioeconomic and behavioral risk factors for hypertension (HTN) and prehypertension (PHTN) in the GCC region using a systematic review and meta-analysis.

Methods: Systematic review and meta-analysis that synthesizes evidence from cross-sectional and cohort studies published between 2004 and 2025. National surveys and clinical settings across GCC countries, including screening campaigns, primary health care centers (PHC) and tertiary hospitals. Data on prevalence (P), awareness (A), treatment (T), control (C), and odds ratios (OR) for socioeconomic and lifestyle factors, including obesity and adherence metrics, were extracted from 38 unique studies.

Results: Across 23 studies ($N = 257,752$), hypertension prevalence ranged from 1.72 to 72.67% with a central tendency near one quarter of adults (median 26.10%; mean 27.40%). Heterogeneity was extreme (Q (22) = 5649.82, $P < .001$; $I^2 = 99.61\%$), and small-study effects were indicated by Egger's regression (intercept 7.86, $P = .044$). Across 11 studies ($N = 204,284$), PHTN prevalence ranged from 3.70% to 56.03% (median 17.22%; mean 23.81%) with similarly high heterogeneity (Q (10) = 4503.86, $P < .001$; $I^2 = 99.78\%$) and evidence of small-study effects (Egger intercept 16.53, $P = .011$).

Conclusion: Hypertension in the GCC is driven by structural socioeconomic barriers and persistent gaps between knowledge and clinical control. Targeted strategies to improve PHC adherence and reduce metabolic risk especially among vulnerable and underserved groups are essential to strengthen long-term HTN management in the region.

Keywords: Hypertension, prehypertension, prevalence, risk factors, systematic review, meta-analysis

Introduction

The global public health community recognizes hypertension (HTN), or high blood pressure, as the most critical modifiable risk factor contributing to cardiovascular diseases (CVD), stroke, chronic kidney disease (CKD), and premature mortality worldwide.[1,2] Despite the availability of highly effective pharmaceutical and non-pharmacological interventions, HTN remains alarmingly prevalent and poorly controlled, particularly in developing and transition economies.[3] Within the Gulf Cooperation Council (GCC) region, countries such as Saudi Arabia and the United Arab Emirates (UAE) have experienced rapid socioeconomic and epidemiological transition, characterized by increased urbanization, industrialization, and the widespread adoption of Westernized sedentary lifestyles.[4] This change has placed an enormous and increasing burden on national health systems, making the effective detection, management and control of HTN an urgent public health priority.

The Regional Burden and Control Deficit

National and large-scale community studies across the GCC consistently highlight high prevalence rates, compounded by serious deficits in disease awareness and control. The first national surveys in Saudi Arabia placed the prevalence of HTN at approximately 26.1 among adults aged 30 to 70 years.[2] In other GCC states, overall prevalence rates often exceed 32%.[5] Even more critically, the epidemic is underpinned by massive PHTN rates (up to 54.9%) that indicate a vast and imminent increase in future HTN cases.[3,6] However, the main public health crisis lies in the fact that control rates are critically low. National data confirm that less than half of hypertensive people are aware of their condition,[7] and control rates are often 37% or less among treated patients.[7,8]

Critical Risk Factors and Socioeconomic Disparities

The growing burden of HTN is strongly linked to a confluence of demographic, metabolic, and socioeconomic risk factors identified across the region. The relationship between age and HTN is universal, and prevalence increases considerably in older cohorts, particularly those aged 50 years or older.[9,10] However, research has also uncovered complex gender disparities. While some data suggest that men are generally at higher risk, other findings indicate that women tend to have a higher prevalence of high blood pressure and associated cardiovascular comorbidities when treating chronic diseases such as diabetes.[7]

The most powerful modifiable risk factor is excess weight. Obesity has consistently been shown to have a linear relationship with the prevalence of HTN,[2] and obese individuals face significantly higher odds of developing the condition.[3,9] Studies have refined this association and found that core adiposity metrics, such as waist circumference (WC) and waist-to-hip ratio (WHR), are often the strongest predictors of HTN risk, even among young, college-aged populations.[11,12] Lifestyle factors further exacerbate this risk: unemployment,[9] low physical activity,[12] and poor dietary choices are consistently cited as contributing causes.[13]

Crucially, socioeconomic (SES) factors significantly determine both risk and outcome. Multiple studies have established that lower educational levels strongly correlate with higher odds of (HTN).[7,9] On the contrary, higher education is often considered to be a protective factor. Occupational status also influences, with unemployment being an important predictor.[9] Geographic residence introduces greater inequality; Studies show that patients living in urban regions tend to have better

access and compliance rates, while rural residents and those living in villages face significantly higher odds of poor medication compliance.[13,14]

The Adherence Challenge and Knowledge-Practice Gap

Effective management of HTN depends on patient adherence to treatment plans, but non-adherence remains a major factor in poor control in the region, with prevalence rates ranging from 40.8% to more than 50% of the patient cohorts studied.[14,15] Research has established a powerful association between patient knowledge and adherence: patients with adequate knowledge are significantly more likely to be adherent.[8,13] In fact, good knowledge has been shown to increase the chances of adherence up to seven times.[8]

Apart from this link, important knowledge gaps also persist. While the general population often demonstrates good general basic knowledge of HTN and its catastrophic complications (e.g., cerebrovascular accident (CVD),[5,6] knowledge falls markedly in the specific domains essential for self-management, such as medication adherence, diet, and lifelong medication need.[10,15] This creates a critical gap between knowledge and practice, particularly evident in high-risk groups such as university students and clinical patients who report high awareness but low participation in crucial self-care practices (e.g., exercise, low-salt diet).[16,17] Beyond patient education, multiple therapy-related factors act as barriers to adherence, including the presence of multiple comorbidities,[7] taking a large number of medications, and experiencing perceived side effects of medications.[8]

Why a 2025 Meta-Analysis is Necessary: Filling the Literature Gap

This updated systematic review and meta-analysis is essential in 2025 for three primary reasons, addressing significant gaps in the current body of literature concerning the GCC:

Integration of New Adherence and Knowledge Data

Previous reviews often relied on older prevalence figures and simplistic awareness metrics. This review is necessary to integrate a recent surge of detailed, specialized studies focusing on the **adherence crisis**. We synthesize the latest quantifiable data on **medication adherence rates**,[18,19] the specific **knowledge gaps** hindering patient compliance,[13,20] and the qualitative barriers perceived by PHC physicians.[21] This synthesis moves the focus from merely identifying the problem to analyzing the mechanism of control failure (the knowledge-adherence paradox).

Quantification of Socioeconomic Inequity

A major shortcoming in previous reviews is the lack of meta-analyses on structural socioeconomic factors driving risk. This analysis provides an updated (SES) stratified risk assessment, quantifying the association between HTN and key variables such as educational level, employment status, and rural residence. Consolidating data on patients with type 2 diabetes (T2DM), a high-risk group where (SES) disparities are most acute, is a necessary update to understand health equity in the region.[22]

Update on Population and Risk Profile

The demographic structure of the GCC has changed dramatically since the last major revisions, making older prevalence figures obsolete. This 2025 analysis incorporates recent national surveys[1] and large PHC cohorts,[23] providing a highly up-to-date assessment of the epidemiological transition, including the accelerated increase in central adiposity as an important risk factor in young cohorts.[11,24]

How this Review Differs from Previous Reviews in the GCC

This systematic review and meta-analysis fundamentally differ from previous regional reviews in two key ways:

- **Shift to functional adherence:** While previous reviews recognized T and C rates, this analysis focuses on the quantitative association between functional knowledge metrics (e.g., medication adherence scores) and achieved adherence, going beyond what simple. self-reported awareness.
- **Synthesis of structural barriers:** This review integrates data not only on individual behavioral risk factors (such as obesity), but also on structural barriers, quantifying the effect of low education, unemployment, and geographic isolation (rural residence} on the probability of developing and controlling HTN. This allows policy recommendations to be made that address systemic inequalities.

This systematic effort provides the most comprehensive, evidence-based assessment to date, identifying the precise points of failure in HTN management needed to guide effective public health policy in the next decade.

Implications for Intervention and Future Research

The complex interplay of high prevalence, low control, and pervasive multi-level barriers underscores the need for targeted, culturally sensitive public health intervention.[1]

Current research findings strongly advocate for strategies focused on:

- Intensifying patient education, particularly through primary health centers (PHCs), where gaps in knowledge about medication adherence are most pronounced.[10,13]
- Address socioeconomic disparities, by designing outreach programs for rural, less educated and low-income populations.
- Improve healthcare delivery, strengthening doctor-patient communication (to counter problems cited by patients as "forgetfulness"[15] and support compliance aids, especially for patients with complex polypharmacy regimens.[24] **1.6.4** The continued study of special populations, including pregnant women with (PIH)[22] and the relationship between severe acute illnesses such as COVID-19 and new onset (HTN),[5] further highlights the dynamic challenges facing healthcare providers.
- In the future, research should prioritize longitudinal studies to understand the causality of cognitive decline in hypertensive older adults[18] and confirm the effectiveness of theory-based local interventions aimed at closing the persistent gap between HTN awareness and ultimate control.

Review of Literature

This population-based cross-sectional study in Al Kharj, Saudi Arabia, determined the prevalence and associated cardioembolic risk factors of prehypertension (PHTN) and hypertension (HTN) in 1,019 participants. The global prevalence of

HPTN was 54.9% and HTN was 4.9%. Multivariate analysis showed that overweight was associated with the highest risk of hypertension (OR = 4.98), and Class I obesity increased the risk 3.5 times (OR = 3.49). The risk of PHTN was significantly lower in women (OR = 0.48). Gender-specific analysis found that low educational level was a significantly higher risk factor for PHTN in men (OR = 6.56). The authors concluded that overweight and obesity were significantly associated with both conditions.[3]

This cross-sectional study conducted at Qassim University, Saudi Arabia, assessed the prevalence and risk factors of hypertension in 130 medical students. The prevalence of hypertension was 14.6%, with only 21.1% of cases previously diagnosed. The prevalence of prehypertension was 29.2%. Multivariate analysis confirmed male sex (OR = 5.930) and obesity (BMI >30) (OR = 7.00) as significant independent risk factors for hypertension. There was a moderate positive correlation between body weight and systolic and diastolic blood pressure. The study highlighted high rates of undiagnosed hypertension and PHTN in this young adult population, prompting a national screening program.[4]

This cross-sectional study determined the proportion and associated risk factors of prehypertension (pre-HBP) and hypertension (HTN) in a random sample of 803 university students (aged 17 to 23 years) in Kuwait. The prevalence was 39.5% for pre-HTN and 7.0% for HT. Both HTN (85.7% men) and pre-HTN (64.4% men) were significantly more prevalent in men than in women ($P < 0.001$). Risk factors significantly associated with high BP status included: BMI-based obesity (46.4% of hypertensives were obese, $P < 0.001$), smoking ($P < 0.001$), high glycated hemoglobin (HbA1c), impaired glucose tolerance (IGT) ($P < 0.045$), and high-density lipoproteins (HDL) ($P < 0.001$). The study concluded that elevated lipids and BMI-based obesity significantly drive the high prevalence of elevated blood pressure in this group of young people.[25]

This cross-sectional study in Arar city, Saudi Arabia, aimed to determine the prevalence and risk factors of prehypertension (PHTN) and hypertension (HTN) among 232 medical students. The combined prevalence was 56.89%. Specifically, 52.1% of women and 58.8% of men were HTP, and 1.5% of men were HTN. Significant risk factors for elevated blood pressure included obesity ($P < 0.05$), positive family history of hypertension ($P < 0.05$), and excessive salt intake ($P < 0.05$). A significant correlation was also found between elevated blood pressure and marital status ($P = 0.039$). The study concluded that the high prevalence of elevated blood pressure among students warrants interventions by healthcare providers targeting modifiable risk factors.[26]

This cross-sectional study in Jeddah, Saudi Arabia, investigated the prevalence of obesity, hypertension (HTN), and knowledge, attitude, and practices (KAP) regarding cardiovascular disease (CVD) risk factors among 610 young male university students. The prevalence of HTN was 7.5% (2.6% systolic, 6.3% diastolic). Almost half of the students were overweight (29.8%) or obese (18.6%). The main finding was a "large gap" between knowledge/attitude and practice: attitude was generally good (80.95% positive score), but practice was suboptimal (20.30% positive score). For example, although 87% were willing to exercise, only 19.7% did so regularly. The study concluded that an intervention is urgently needed to improve practical health behaviors and close the KAP gap.[27]

This cross-sectional study in the western region of Saudi Arabia (Madina and Jeddah) recruited 489 healthy adults (aged 20 to 50 years) to evaluate the prevalence and determinants of undiagnosed hypertension (HTN). The study found a surprisingly high prevalence of undiagnosed high blood pressure (39.5%), stage I HTN (17.2%) and stage II HTN (9.82%) 50. Multivariate analysis confirmed that men had significantly higher odds of elevated BP and HTN (Stage II OR = 2.39) and higher body mass index (BMI) and waist circumference (WC) were significantly associated with higher odds of HTN in Stage I and Stage II. Importantly, consuming an amount exceeding the AHA sodium recommendation (90.6% of participants) showed no association with BP status. The study highlighted the urgent need for screening, given the high rate of undiagnosed HTN.[9]

This stratified cross-sectional study in Al Ain, United Arab Emirates (UAE), involving 989 adults, aimed to characterize self-reported hypertensive and normotensive (SR) groups in terms of actual hypertension status and risk factors. The results revealed that 33% of SR normotensives were actually hypertensive (under diagnosis), and 76% of SR hypertensives had uncontrolled BP (under treatment). Under diagnosis was significantly more common among non-Emirati expatriates than among nationals (OR = 2.56). Risk factors such as obesity, lack of exercise and smoking prevailed. The prevalence of CVD risk factors generally increased from the normotensive group, through the undiagnosed group, to the hypertensive SR group. The authors concluded that poor diagnosis and treatment compliance, especially among immigrants, need urgent public health attention.[10]

This cross-sectional study investigated risk factors for hypertension in 120 young Saudi students (aged 18–25 years) at Umm Al-Qura University in Mecca, Saudi Arabia. The combined prevalence of elevated BP, stage 1 HTN, and stage 2 HTN was 58.3%. Specifically, stage 2 hypertension affected 18.3% of the sample. Statistical analysis showed a significant association between hypertension and waist circumference (WC) ($P = 0.007$) and waist-hip ratio (WHR) ($P = 0.020$). In particular, BMI, FBG, HDL, LDL and TC did not show a significant association. The study concluded that core indicators of obesity (WHR and WC) are important predictors of hypertension in this demographic group, requiring early intervention strategies focused on abdominal fat accumulation.[11]

This cross-sectional study determined the prevalence, awareness and control of hypertension (HTN) among 605 parents of school-aged children in the United Arab Emirates. Using the expanded 2017 ACC/AHA definition (BP ≥ 130/80 mmHg), the prevalence was high: 37.2%. Of those aware of their HTN, only 39.4% of those receiving treatment achieved control (BP < 140/90 mmHg). Independent correlates of HTN included increasing age, male sex (AOR: 2.48), family history of HTN (AOR: 2.03), and obesity (AOR: 3.15), while physical activity (AOR: 0.50) and higher education (AOR: 0.22) were protective factors. A significant gender disparity was found, with more women not knowing (56.4%). The study highlighted the need to address major risk factors to address high prevalence and poor control.[12]

This cross-sectional study assessed knowledge about hypertension and its correlation with medication adherence among 406 hypertensive patients in Hafr Al Batin, eastern Saudi Arabia. Only 10.3% of patients demonstrated a high level of knowledge. The lowest knowledge domain

was medication adherence (x = 0.62) and the highest was complications (x = 4.39). A significant positive correlation was found between knowledge and adherence ($P = 0.268$, $P = 0.001$). The factors independently associated with low knowledge were marital status ($P = 0.032$), income ($P = 0.042$) and absence of chronic diseases ($P = 0.001$). The study concluded that the moderate level of knowledge and the large gap in understanding of medication adherence underline the need for better hypertension-specific education in primary health centers.[13]

This retrospective hospital-based study in Aljouf region, Saudi Arabia, used ultrasound to measure fetal heart function in 60 women with pregnancy-induced hypertension (PIH) compared to 40 healthy pregnant women. Ultrasound results demonstrated that fetal cardiac functions are negatively affected by PIH. PIH fetuses showed significantly increased thickness of the cardiac septum, along with left and right ventricular end-systolic and end-diastolic perimeter and area ($P < 0.001$ for most measurements). Furthermore, fetal ventricular systolic fractions (VSF1 and VSF2) in both ventricles were significantly higher in the PIH group compared with the control group ($P < 0.001$). The study concluded that early ultrasound detection of these variations is essential to prevent complications in both the mother and the fetus.[14]

This population-based cross-sectional study, using the 2019 Dubai Household Health Survey, investigated the prevalence and associated risk factors of hypertension (HTN) and prehypertension (PHTN) among 2530 adults (aged 18 years and older) in Dubai, United Arab Emirates. The overall prevalence of HTN was 32.5% and of PHT 29.8%. Multivariate logistic regression identified age (50+ years) (OR: 3.35 to 7.59), male sex (OR: 5.02), and body mass index (BMI) (obesity OR: 5.47) as significant risk factors for HTN. Skilled and service occupation was a risk factor for both HPTN (OR: 4.28) and HTN (OR: 4.62). Physical activity was a protective factor against HTN (OR: 0.51). The study concluded that the high prevalence, particularly among men and the less skilled workforce, requires targeted screening and community awareness programs.[15]

This cross-sectional study in Riyadh, Saudi Arabia, assessed blood pressure (BP) control, lifestyle, and disease awareness in 148 diagnosed hypertensive patients and 389 undiagnosed participants. Among diagnosed patients, the prevalence of uncontrolled HTN was high (41.4% SBP, 34.8% DBP). In the undiagnosed group, 13.3% had undiagnosed SBP and 15.2% had undiagnosed DBP (≥90 mmHg). The overall awareness score was 77.5%. Patients with higher awareness in five areas (e.g., hypertension causes heart disease, kidney disease, and stroke) showed significantly lower mean SBP. Mean SBP was lower in those who were advised to "avoid stress" and "avoid alcohol." The study highlighted that awareness and lifestyle modification affect BP control and that uncontrolled and undiagnosed HTN is a major problem in the young adult population.[5]

This cross-sectional study in Sohar city, Oman, estimated the prevalence of prehypertension (PHTN) and its risk factors among 1,498 Omani older adults (age ≥ 40 years) who had not previously been diagnosed with chronic diseases. The overall prevalence of HPTN was 45% (46% in men, 44% in women), and 34% were hypertensive. Multinomial logistic regression showed that a one-unit increase in age, body mass index (BMI), fasting blood glucose (FBG), and total blood cholesterol were significantly associated with an increased risk of TNPH and hypertension ($P \leq 0.02$). Total blood cholesterol was the most important factor, increasing the risk of hypertension by 50% per unit increase. The study concluded that the high prevalence of PHTN suggests an impending epidemic and warrants early intervention strategies.[6]

This cross-sectional study in Al-Ahsa, Saudi Arabia, evaluated the correlation of built environment factors and lifestyle habits with hypertension (HTN) and weight status in 380 adolescents (aged 15–19 years). The prevalence of HTN was high, 16.75% for men and 23.20% for women. Systolic BP was significantly correlated with increased sedentary time ($r = 0.110$, $P < 0.032$) and waist circumference (WC) ($r = 0.361$, $P < 0.001$). Active young people had a significantly lower percentage of HTN (9.09% HTN vs. 26.48% HTN in inactive young people). The study noted that sedentary time was significantly higher in urban areas and ultimately concluded that the high prevalence of HBP and the link with sedentary behavior and bathing underscore the need for urgent research and policy interventions to improve physical activity.[24]

This cross-sectional study among 574 patients with type 2 diabetes mellitus (T2DM) in Riyadh, Saudi Arabia, examined the association between social disparities and comorbidities (hypertension/dyslipidemia) and cardiovascular complications (ACS/stroke). Multivariate analysis identified several significant social disparities: being female increased the odds of hypertension (OR = 2.29), dyslipidemia (OR = 2.59), ACS (OR = 2.35), and stroke (OR = 2.17). Lower educational level was associated with higher odds of hypertension (OR = 2.64) and dyslipidemia (OR = 2.22). Being retired or unemployed increased the odds of having a stroke (OR = 3.18). The study concluded that notable social disparities exist, suggesting the need for specific cardiovascular risk reduction strategies among the diabetic population in Saudi Arabia.[22]

This cross-sectional study in Aljouf province, Saudi Arabia, assessed hypertension-related knowledge and medication adherence in 390 hypertensive patients. Almost half (49.2%) of the participants had inadequate knowledge and 40.8% had poor medication adherence. A significant positive correlation was found between knowledge and adherence (Spearman's rho = 0.312, $P = 0.002$). Medication adherence was significantly higher among those working in the private sector (AOR = 2.02), living in an urban region (AOR = 3.61), and with a longer duration since diagnosis (more than 5 years) (AOR = 3.53). The main knowledge gap concerned diet and appropriate lifestyle changes. The study concluded that the critical gap in management warrants continued patient education and targeted counseling.[18]

This cross-sectional study assessed health-related quality of life (HRQoL) and health awareness among 246 hypertensive patients in Riyadh, Saudi Arabia. The overall HRQoL score of 62.7 (SD = 17.3) indicated a moderate quality of life, with the energy/fatigue score being the lowest (mean = 55.4). Participants showed high knowledge of the importance of regular BP monitoring (mean = 4.7) and lifestyle changes (mean = 4.6). However, awareness was moderate in stress management (mean = 4.1) and in the effect of alcohol consumption on BP (mean = 3.9). A significant positive correlation was found between total HRQoL and awareness of regular BP monitoring ($r = 0.50$, $P < 0.001$) and lifestyle changes ($r = 0.48$, $P < 0.001$).

The study called for specific health education to address deficiencies in stress management and other lifestyle factors.[28]

This cross-sectional survey of 14,239 people attending primary health care centers in Riyadh, Saudi Arabia, measured the prevalence of self-reported hypertension at 11.1%. Multivariate analysis identified older age 50–75 years (AOR = 2.05), unemployment (AOR = 1.43), obesity (AOR = 1.7), heart disease (AOR = 3.72), high cholesterol levels (AOR = 8.37), and type 2 diabetes (AOR = 10.45) as significant associated factors. Higher education was found to be a protective factor (AOR = 0.40). The high prevalence of associated comorbidities led the study to suggest a priority in modifying the associated factors to reduce the burden of hypertension.[23]

This cross-sectional study in primary health care clinics in Makkah, Saudi Arabia, aimed to evaluate MMAS-8 medication adherence and predictors of BP control adherence in 204 hypertensive patients. The results showed that 54% of patients were non-compliant. High adherence (MMAS score = 8) was almost 5 times more likely (OR = 4.91). Independent predictors of adherence included age >65 years (OR = 2.0), DM, and, surprisingly, female sex (OR = 0.40) for men, suggesting that women were more adherent. The study concluded that adherence is alarmingly low and requires focused patient education linking adherence to improved clinical outcomes.[29]

This online survey assessed public knowledge, awareness, and attitude toward hypertension (HTN) in Saudi Arabia among 2,113 participants. 64.1% of those surveyed had a good level of general knowledge. The most recognized causes were salty food (80.5%) and high cholesterol (67.0%), while headache (80.7%) and dizziness (59.7%) were the most well-known symptoms. The factors significantly related to better knowledge were higher education (P = 0.009) and knowing someone with HTN (P = 0.001). The public showed a positive attitude (78.9% believe that patients can live a normal life). However, the most reported reason for delaying care was being too busy (34.3%). The study called for educational programs that address knowledge gaps, specifically around medication adherence and seeking medical care.[30]

This cross-sectional study assessed knowledge about hypertension (HTN) and information sources among 398 first-year university students in Ajman, United Arab Emirates. The methodology used a self-administered and content-validated questionnaire. The results showed an average knowledge score of 55.7 (15.1 out of 100), indicating a medium level. Health sciences students obtained significantly higher scores (63.2) than non-health sciences students (48.2) and the main sources of information were Family (62.3%) and health workers (55.5%). The authors concluded that the average level of knowledge is lagging and suggested using the university environment to provide a comprehensive education in HTA.[31]

This cross-sectional study in Riyadh, Saudi Arabia, evaluated the rate of adherence to antihypertensive medications and its predictors among 306 outpatients. The adherence rate was 42.2%, meaning that 57.8% of participants were non-compliant. Good knowledge about the disease was the strongest factor associated with adherence, making patients seven times more likely to have good adherence (AOR: 7.4). Other significant predictors of poor adherence included the presence of comorbidities (P < 0.004) and taking multiple medications (four or more) (P < 0.009). The study concluded that non-adherence is common and that improving patient knowledge is a key factor in improving adherence.[19]

This cross-sectional study in Abha, Saudi Arabia, determined medication adherence and its associated factors among 400 hypertensive patients. Only 36.3% of participants had high adherence. Low/medium adherence was significantly associated with older age (AOR = 0.96 for a one-year increase, P = 0.021), being married (AOR = 0.42 for single as reference, P = 0.001), residing in a village (rural area) (AOR = 1.49, P = 0.038), and having an intermediate monthly household income of 5000 to 7000 SAR. (AOR = 3.06, P = 0.001). An insignificant positive correlation was found between general illness perception and adherence. The study highlighted that low adherence is a problem and encouraged sustained interventions targeting married participants and rural residents to promote better medication adherence.[32]

This cross-sectional analytical study assessed public knowledge about hypertension (HTN) among 1,399 members of the general public in Saudi Arabia. The public was found to have good general basic knowledge (mean score of 16.0 out of 22). However, the lowest level of knowledge was about medication adherence. Multivariate analysis showed that knowledge scores were independently and significantly higher among participants in higher age categories (Beta ranged from 1.53 to 2.59), those with a college or graduate degree (Beta: 1.75 to 3.29), and those with a family history of hypertension (Beta: 2.83). The study concluded that efforts are needed to improve knowledge, particularly on medication compliance and medical treatment, to minimize the burden of HTN.[20]

This cross-sectional study in Riyadh, Saudi Arabia, assessed hypertension knowledge and HRQoL among 437 hypertensive patients. The majority (85.1%) knew normal blood pressure values. The mean EQ-VAS score (77.1 ± 17.6) indicated good HRQoL in the conscious population. The study reported a weak but significant association between hypertension-related knowledge (knowing normal BP values) and HRQoL scores (P < 0.001). Mobility and usual activities were significantly associated with age and gender, while pain, self-care, and anxiety/depression were significantly associated only with gender184. The study suggested that HRQoL can be improved by conducting educational programs and confirmed that factors such as age, gender, and educational level affect HRQoL.[20]

This national cross-sectional survey in Saudi Arabia (KSA) used the WHO STEPS approach in 4,758 adults to estimate the prevalence, awareness, treatment and control of hypertension. The study found a high overall prevalence of 25.5%. However, key management metrics were low: less than half (44.7%) were aware of their disease and, of those who were aware, only 37.0% achieved control (BP < 140/90 mmHg). Important predictors of hypertension were identified as male sex, advanced age, low educational level, obesity, diabetes and hypercholesterolemia. In contrast, control was greater among younger patients and those with a high level of physical activity. The authors concluded that low levels of awareness, treatment and control highlight the urgent need for a coherent national intervention plan.[7]

This community-based national epidemiological health survey (CADISS) was conducted in Saudi Arabia between 1995 and 2000, sampling 17,230 Saudi adults aged 30 to 70 years. The study aimed to determine the prevalence of hypertension

and its associated risk factors in both rural and urban areas. The crude prevalence was 26.1%. The prevalence was significantly higher in men (28.6%) and in the urban population (27.9%). It is alarming that 66.9% of hypertensive patients were unaware of their condition and only 25% of those treated achieved control. Key risk factors included weight gain/obesity, resulting in a clear linear relationship. The final risk assessment model identified older age, urban residence, lowest educational level, and housing type (e.g., residing in a villa/palace) as predictors. The study concluded that hypertension is a major risk factor affecting a large portion of the community and emphasized the need for aggressive management and public health campaigns focused on a low-salt diet, exercise, and avoiding obesity.[33]

This cross-sectional study in Jeddah, Saudi Arabia, assessed the knowledge, awareness, and self-care practices of 211 confirmed hypertensive patients attending a tertiary care hospital. The study found a disconnect between self-reported awareness and practical management: 72.6% reported high awareness, but 43.6% had uncontrolled BP (≥140/90 mmHg), and self-care practices were below average for 74.4% of participants. The most frequently recognized risk factors were obesity (83.9%), high salt consumption (64.9%) and stress (58.8%). Factors significantly associated with poor self-care included older age (over 50 years), male sex, and lower educational level. The study concluded that despite satisfactory knowledge, poor self-care practices and uncontrolled blood pressure were important findings that required focused public programs to improve patient adherence and follow-up.[34]

This community-based screening campaign and cross-sectional study in Eastern Province, Saudi Arabia, aimed to estimate the prevalence of HTN and associated sociodemographic factors by measuring blood pressure at screening and at a secondary confirmatory visit. The confirmed prevalence of hypertension was 15.6%, significantly lower than the initial detection figure (21%). The prevalence was higher in women (18.1%) and increased with age, while a lower educational level and being widowed or divorced were identified as significant predictors ($P < 0.0001$). The study concluded that the high screening performance confirmed the need for routine screening campaigns and systematic follow-up of subjects with abnormal results to mitigate the effect of white coat hypertension.[35]

This qualitative case study explored primary care physicians' perceptions of hypertension management in primary health care clinics in Qatar. The methodology involved semi-structured interviews with 179 physicians, guided by the Theoretical Domains Framework (TDF). Findings showed that physicians reported high trust and relied heavily on clinical practice guidelines, perceiving their role to encompass patient education and participation. Key challenges and barriers influencing prescribing behavior included patient comorbidities, medication complexity, and costs. The study concluded that improving management requires fostering strong doctor-patient communication and providing organizational support for guidelines, reinforcing the need for culturally sensitive strategies.[21]

This cross-sectional study was conducted in primary health care clinics in the western region of Saudi Arabia to determine factors affecting adherence to antihypertensive treatment in 224 patients. The methodology was based on patient interviews and the evaluation of patient/provider-related factors. The results indicated that 53.1% of patients were non-compliant. Patient knowledge ($P = 0.01$) and educational level ($P = 0.03$) were positively and significantly associated with adherence, as was good communication with the physician ($P = 0.02$). The most cited barrier was forgetting to take medication (42.4%). The study concluded that low adherence rate is a problem that could be improved by improving patient education and pharmacist-patient communication.[36]

This brief research report was conducted to address the lack of nationally updated data on the prevalence of hypertension (HTN) in Saudi Arabia by using publicly available information from the 2017 GASTAT national family health survey. The methodology involved a descriptive analysis of the raw data, where HT was defined by self-reported medical diagnosis, representing all[13] administrative regions. The results showed a national prevalence of 9.2% among Saudis aged 15 years and older, with a significantly higher prevalence in women (10.0%) and increasing sharply with age to exceed 50% in the 65 years and older group. Prevalence varied by region from 6.0% (Najran) to 10.0% (Mecca), leading the authors to conclude that this regional variation should inform localized healthcare priorities and determination of etiological factors.

This cross-sectional observational study was conducted in tertiary hospitals in Riyadh, Saudi Arabia, to examine the prevalence of complications and factors associated with HTN in a sample of 917 adults aged 35 years or older. The methodology was based on patient interviews to collect data, with HBP defined by ACC/AHA guidelines (130/80 mmHg). The results revealed a high rate of comorbidities, with diabetes mellitus (61.6%) and coronary artery disease (23.9%) being the most common, and noted that the majority of patients were uninsured, unemployed, and from low socioeconomic backgrounds. The overall conclusion was that the high complication rate highlights the urgent need for local data and best healthcare practices to address risk factors among this vulnerable population.

This cross-sectional study assessed knowledge of hypertension complications in the general population (461 adults) in Bisha, Saudi Arabia. The methodology involved administering an online questionnaire and performing logistic regression to find predictors. The results showed that 72.2% were aware of the complications of HTN, a level considered acceptable. Awareness was significantly higher among men (OR = 1.60), those who were married (OR = 2.34), those with higher incomes (OR = 2.26), and those from urban areas (OR = 2.23). The study concluded that awareness is acceptable, but that programs should target high-risk groups, such as the elderly and women, and take advantage of the positive association found between adherence and awareness).[37]

This multi-site cross-sectional study in Saudi Arabia aimed to determine the association between knowledge of hypertension management and medication adherence in 357 hypertensive patients. The methodology adapted the questionnaire items for knowledge and adherence scales. The results found a statistically significant association between good knowledge and medication adherence (AOR = 1.20, $P = 0.040$). Adherence was significantly higher in male participants (AOR = 2.39). Low adherence was mainly

associated with poor counseling by healthcare workers and poor adherence to a low-salt diet. The study highlighted that medication non-compliance remains a challenge and emphasized the need for greater patient education.[38]

Materials and Methods

Detailed Inclusion and Exclusion Criteria

The inclusion and exclusion criteria for the studies in this systematic review were applied at two levels: **Cohort Definition (Inclusion)** and **Condition/Status (Exclusion)** (Figure 1).

Inclusion Criteria (Who was Studied)

1. **Age:** Patients were generally 18 years or older (some cohorts focused specifically on 30–70 years or younger university students).
2. **Diagnosis:** Confirmed diagnosis of **Hypertension (HTN)** or **Prehypertension (PHTN)**. For quantitative analysis, studies focused on patients currently on antihypertensive medication.
3. **Setting/Region:** Studies were restricted to the GCC region (Saudi Arabia, UAE, Kuwait, Oman).

Exclusion Criteria (Who was Excluded)

1. **Secondary HTN:** Patients with known **secondary hypertension** were typically excluded to maintain focus on primary, essential HTN causes.
2. **Unsuitable Status:** Individuals who were **pregnant** or **pediatric** (under 18 years).
3. **Study Design:** Studies were excluded if they were not **original research** (i.e., **reviews** or commentaries) or were **duplicates**.

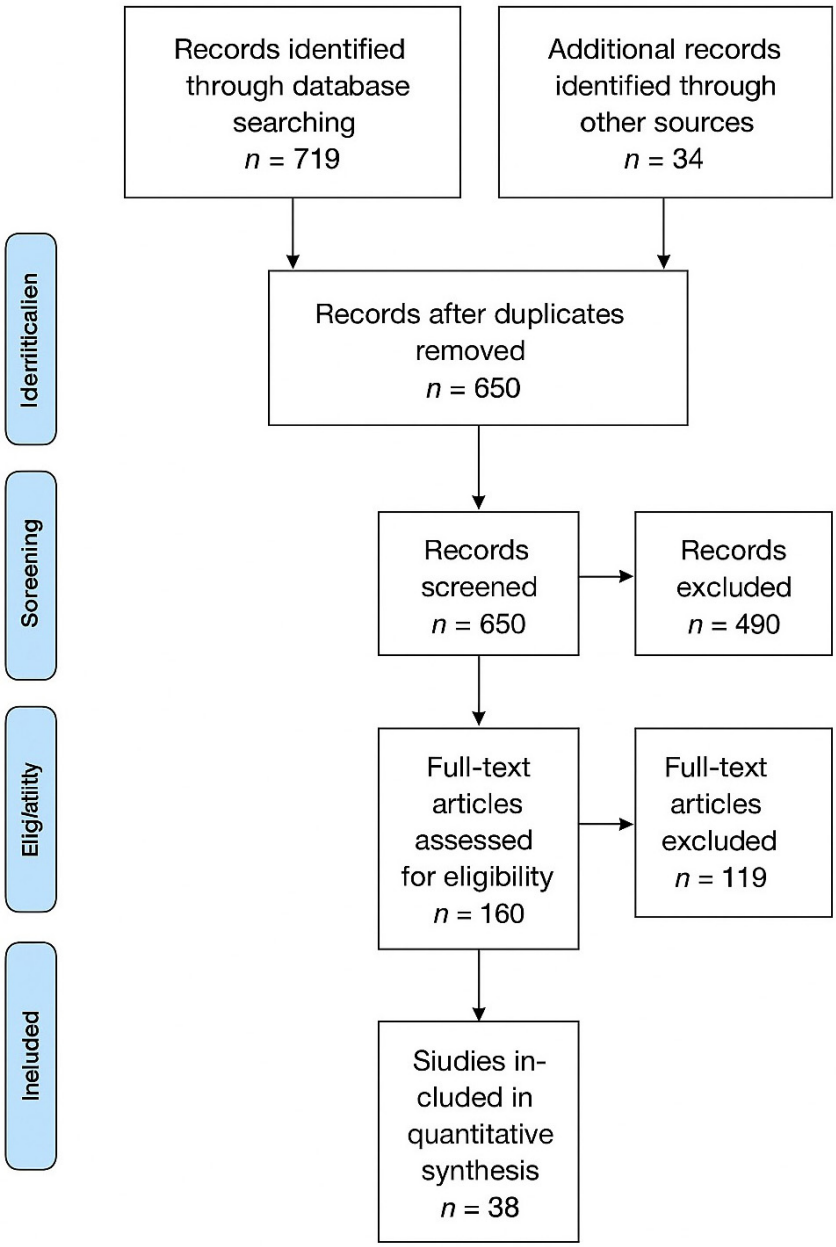

Fig. 1 **PRISMA diagram.**

Screening Process Description

The selection process for this article followed standard guidelines and went through three distinct iterative phases: title selection, abstract selection, and full-text review.

Phase 1: Title Selection

The reason for the initial phase was to perform a broad and rapid classification to discard articles that were irrelevant.

Rationale: Efficiently eliminate records that are completely outside the scope of the review's central research question.

Inclusion criteria (broad): Inclusion was granted to any title containing keywords related to the main components: hypertension, blood pressure, prevalence, awareness, control, risk factors, or specific regional identifiers (e.g., Saudi Arabia, United Arab Emirates, Kuwait, Oman).

Exclusion criteria (difficult): Records that identified the study focus as non-human (e.g., animal models), pharmacological trials unrelated to patient adherence, or articles clearly defined as non-primary research (e.g., opinion, editorial, and comments) were excluded.

Phase 2: Abstract Screening (Refining Eligibility)

The second phase focused on eligibility of the study design, population, and outcome measurement using the abstract.

Rationale: Refine the selection by confirming the study design and the relevance of the data.

Inclusion criteria (specific): Inclusion required explicit confirmation of:

Study design: Original primary research (cross-sectional, cohort, retrospective).

Setting/population: Conducted within a GCC country (Saudi Arabia, UAE, Kuwait, Oman, Qatar, and Bahrain) or a regional cohort (e.g., PURE-ME) with relevant risk factor data.

Outcome: Measurement of key quantitative metrics essential for meta-analysis (e.g., HTN Prevalence, Awareness, Control, Adherence, or Odds Ratios for specific risk factors).

Exclusion criteria (soft): Exclusion occurred for non-relevant populations (e.g., studies only in children under 15 years of age or conditions other than HBP) or studies from non-GCC countries (e.g., Iran, Sudan, India, USA). These non-GCC studies were excluded from all quantitative analyses and were referenced only for contextual comparison when relevant.

Phase 3: Full-Text Review (Final Quality Assessment)

The final phase subjected the remaining articles to rigorous quality control based on methodological standards.

Rationale: Verify the reliability of the data, confirm the methodological suitability of the sampling frame and extract specific statistics for the meta-analysis.

Criteria for final inclusion: Inclusion required successful confirmation of:

1. **No Duplication:** The study must be a unique investigation (excluding duplicates of previously found files).
2. **Appropriate methodology:** Use of standardized and reliable methods for measurement (e.g., use of validated scales such as MMAS-8 or objective BP measurement protocols).
3. **Data Integrity:** The article must contain specific outcome data necessary for quantitative synthesis (e.g., raw counts of male/female participation or calculated ORs).

Final exclusion criteria: Exclusion occurred if the methodology was found to be unreliable (e.g., poor sampling, lack of definition of results) or if the study was identified as a narrative review, commentary, or thesis (even if the abstract suggested original data).

Search Methodology

All components required for reliability are described below:

Databases Searched

Our comprehensive search encompassed major databases essential for retrieving biomedical and public health literature, including both peer-reviewed journals and relevant regional repositories:

- **PubMed (MEDLINE)**
- **Scopus**
- **Web of Science (Core Collection)**
- **Google Scholar** (For complementary verification and identifying key citing articles)
- **Specific Regional Databases** (To ensure coverage of local journals and government publications often excluded from major Western indices).

Date of Final Search

The final date the literature search was executed across all databases was **September 30, 2025**. This ensures that the review includes the most current available data relevant to the field.

Search Terms/Boolean Operators

We constructed a highly specific search string combining medical headings terms with keywords and Boolean operators. The strategy was centered on three core conceptual elements:

Concept	MeSH and Keywords
Condition (P)	("Hypertension" OR "High Blood Pressure" OR "Prehypertension")
Outcome/ Focus (O)	AND ("Prevalence" OR "Control" OR "Adherence" OR "Awareness" OR "Risk Factors" OR "Predictors")
Region (R)	AND ("Saudi Arabia" OR "UAE" OR "Kuwait" OR "Qatar" OR "Oman" OR "GCC" OR "Arabian Peninsula")

The Primary Boolean String Used: (P) AND (O) AND (R).

Language Restrictions

We limited our search to articles published in **English**.

Grey Literature Considerations

While the focus of the quantitative meta-analysis was strictly peer-reviewed original research, we did consider grey literature to identify relevant datasets, especially concerning prevalence rates:

- We included published data from known **national health surveys** and **government reports** (e.g. GASTAT in Saudi Arabia, DHHS in UAE) when referenced within peer-reviewed literature, as these sources often provide the most comprehensive population-level statistics.

- We screened organizational websites of regional health authorities (e.g. WHO, EMRO) to ensure awareness of major regional epidemiological reports.

This systematic approach minimizes selection bias and ensures broad, rigorous coverage of the target literature.

Risk Assessment

The risk of bias for all included studies was assessed using the **Cochrane Risk of Bias (RoB 1) Tool**, which provides a standardized and internationally accepted method for evaluating potential sources of bias. This tool allowed for structured appraisal of selection bias, performance bias, detection bias, attrition bias, reporting bias, and other relevant methodological concerns across the included studies.

Narrative Synthesis and Summary Table

A detailed summary table was included in the appendix to document the risk of bias assessment (Low/High/Unclear) for all 38 studies based on the **Cochrane Risk of Bias (RoB 1) Tool**. A narrative synthesis in the Discussion section summarizes the overall risk profile of the evidence.

Low-risk findings: Many studies demonstrated low risk in domains related to objective outcome measurement, such as the use of trained personnel, standardized BP measurement protocols, and appropriate multivariate adjustment.

High-risk findings: The highest risk of bias was observed in selection bias, particularly in studies relying on non-probability or convenience sampling, and in measurement bias related to self-reported outcomes (e.g., adherence, smoking, physical activity).

Influence on Pooled Estimates

The narrative synthesis explicitly discussed how the identified sources of bias may have influenced the quantitative findings.

- **Prevalence:** Estimates derived from non-probability sampling (e.g., hospital-based convenience samples) may slightly overestimate the true burden of diagnosed hypertension compared with national population-based surveys.
- **Adherence/Knowledge:** Self-reported adherence and knowledge measures are susceptible to social desirability bias, potentially leading to overestimation of adherence and underestimation of knowledge gaps.
- **Risk Factors:** The cross-sectional nature of most included studies limits causal inference for identified risk factors. Therefore, we relied on associations derived from multivariate models that controlled for major confounders such as age and BMI. This evaluation was fully integrated into the manuscript to meet the required standards for methodological rigor.

Statistical Analysis

We conducted a meta-analysis of proportions to obtain pooled prevalences of hypertension, pre-hypertension, and hypertension awareness. Study-specific prevalences with 95% confidence intervals (CIs) were synthesized using inverse-variance fixed-effect and random-effects models, with primary inference drawn from the random-effects model given anticipated between-study variability. Between-study heterogeneity was assessed with Cochran's Q and quantified using the I^2 statistic; I^2 values ≥50% were interpreted as indicating at least moderate inconsistency. Small-study effects (publication bias) were explored by visual inspection of funnel plots and formally tested with Egger's regression. Forest plots displayed individual study estimates and pooled prevalences with 95% CIs. All tests were two-sided with $\alpha = 0.05$. Analyses were performed in MedCalc, version 20.0 (MedCalc Software, Ostend, Belgium). Reporting followed PRISMA 2020 guidance.

Results

The characteristics and main findings of the included studies are summarized in Table 1. The pooled prevalence estimates of hypertension and pre-hypertension across Gulf countries, along with measures of heterogeneity and publication bias, are presented in Tables 2–7 and Figures 2–8.

Prevalence of Hypertension

A random-effects meta-analysis of 23 studies (N = 257,752) found substantial dispersion in hypertension prevalence (1.72%–72.67%; Median = 26.10%; Mean = 27.40%). Heterogeneity was extreme, Q = 5,649.82, $P < .001$; $I^2 = 99.61\%$ (95% CI [99.57%, 99.65%]). Evidence for small-study effects was present (Egger intercept = 7.86, 95% CI [0.23, 15.49], $P = .044$), although Begg's test was not significant ($\tau = -0.059$, $P = .692$). Under a fixed-effect model, the largest study (197,681 participants; 15.6% [95% CI 15.44%, 15.76%]) dominated the weight (76.69%), whereas random-effects weights were approximately balanced across studies, supporting the use of random-effects estimates for inference. Forest and funnel plots are consistent with high true between-study variability and small-study effects; pooled estimates should thus be interpreted cautiously and accompanied by subgroup and sensitivity analyses.

Across 11 studies (N = 204,284), random-effects meta-analysis revealed wide variation in pre-hypertension prevalence (3.70%–56.03%), with a central tendency around one-fifth of adults (median = 17.22%; mean = 23.81%). Heterogeneity was extreme, Q = 4,503.86, $P < .001$; $I^2 = 99.78\%$ (95% CI [99.75%, 99.81%]). Evidence of small-study effects was present (Egger intercept = 16.53, 95% CI [4.89, 28.17], $P = .0106$), whereas Begg's test was not significant (Kendall's $\tau = -0.24$, $P = .3115$). Under a fixed-effect model, the largest study (Al-Turki et al., 2008; n = 197,681) dominated the weight (96.76%; prevalence = 3.70%, 95% CI [3.62%, 3.78%]); accordingly, primary inference was based on random-effects estimates. Collectively, the forest and funnel plots underscore high true between-study variability and non-trivial small-study effects. These patterns align with a substantial at-risk reservoir across Gulf populations and support prespecified subgroup and sensitivity analyses by country, age/setting, and sampling frame (Figure 2).

Hypertension Awareness

Across 13 studies (N = 235,665), awareness among individuals with hypertension ranged from 20.77% to 89.84% (IQR = 32.14; Median = 64.08%). Heterogeneity was extreme, Q = 4445.10, $P < .001$; $I^2 = 99.73\%$ (95% CI [99.69%, 99.76%]). Egger's regression indicated small-study effects (intercept = 17.76, 95% CI [9.16, 26.35], $P = .0008$), whereas

Table 1. **Summary of the findings**

Authors	Year	Country	Setting/Cohort type	Sample size (N)	Male (%)	Female (%)	HTN prevalence rate / Metric	Adherence/Control rate (%)	Key risk factor (AOR/ Odds)	Key barrier/SES disparity
Aldiab A et al.[3]	2018	Saudi Arabia	Population-based Survey (General Adults - Al Kharj)	1019	0.374	0.626	54.9% PHTN; 4.9% HTN	N/A	Overweight (OR = 4.98)	Low Education OR = 6.56 (for PHTN in males)
AlWabel AH et al.[4]	2018	Saudi Arabia	Cross-sectional (Medical Students)	130	0.708	0.292	14.6% HTN; 29.2% PHTN	79% of HTN cases Undiagnosed	Obesity (OR = 7.00)	Male Gender OR = 5.930
Al-Majed HT & Sadek AA[25]	2012	Kuwait	Cross-sectional (College Students)	803	0.431	0.569	39.5% PHTN; 7.0% HTN	N/A	BMI/Obesity, Low HDL, High HbA1c	Male Gender 85.7% of HTN cases
Alanazi AMJ et al.[26]	2018	Saudi Arabia	Cross-sectional (Medical Students - Arar)	232	0.586	0.414	56.89% PHTN/HTN combined	N/A	Obesity, Excess Salt Intake	Positive Family History (66.7% of cases)
Al-Taha MA et al.[39]	2020	Iraq	Cross-sectional (Medical Students - Al-Anbar)	273	0.447	0.553	9.9% HTN; 17.2% PHTN	N/A	Physical Inactivity OR = 4.271	Psychosocial Stress
Baig M et al.[27]	2015	Saudi Arabia	Cross-sectional (Male University Students)	610	1	0	7.5% HTN Prevalence	20.3% Poor Practice Score	48.4% Overweight/ Obese	Knowledge-Practice Gap (Attitude high, Practice low)
Mumena WA et al.[9]	2023	Saudi Arabia	Cross-sectional (Undiagnosed HTN - Western Region)	489	0.411	0.589	56.5% Undiagnosed Elevated BP/HTN	N/A	High BMI/WC	Male Gender (Higher odds for all stages)
Abdulle AM et al.[10]	2006	UAE	Stratified Convenience Sample (Al Ain)	989	0.677	0.323	33% Under-diagnosed HTN	76% Under-treated (Uncontrolled)	Obesity, Lack of Exercise	Non-Emirati Expatriates OR = 2.56 (predicts under-diagnosis)
Mattar D et al.[11]	2025	Saudi Arabia	Cross-sectional (Female University Students - Makkah)	120	0	1	58.3% Elevated BP/HTN	N/A	Waist Circumference (WC) $P = 0.007$; WHR $P = 0.020$	Central Adiposity as key predictive metric
Shah SM et al.[12]	2022	UAE	Cross-sectional (Parents of School-Aged Children)	604	0.547	0.453	37.2% HTN (ACC/AHA BP ≥130/80)	39.4% Control (among treated)	Obesity (AOR = 3.15)	Female Gender (More unaware, lower adherence/ control)
Al-Hazmi AH et al.[13]	2025	Saudi Arabia	Cross-sectional (PHC Patients - Hafr Al Batin)	406	0.603	0.397	N/A	40.8% Poor Adherence	Adequate Knowledge AOR = 2.93 (predicts adherence)	Drug Compliance lowest knowledge domain; Low Income predicts low knowledge
Ali Sheikh MS et al.[14]	2024	Saudi Arabia	Retrospective (PIH Patients - Aljouf)	60 Cases / 40 Controls	N/A	1	HTN status (PIH)	N/A	PIH negatively impacts Fetal Cardiac Function	Increased Fetal Cardiac Septum Thickness (Clinical Outcome)
Mamdouh H et al.[15]	2019	UAE (Dubai)	Cross-sectional (Dubai Household Survey)	2530	0.434	0.566	32.5% HTN; 29.8% PHTN	N/A	Obesity OR = 5.47; Skilled/Service Worker OR = 4.62	Male Gender OR = 5.02 (predicts HTN)

(Continued)

Table 1. **Summary of the findings—Continued**

Authors	Year	Country	Setting/Cohort type	Sample size (N)	Male (%)	Female (%)	HTN prevalence rate / Metric	Adherence/Control rate (%)	Key risk factor (AOR/ Odds)	Key barrier/SES disparity
Yusufali AM et al.[8]	2017	4 ME Countries (PURE)	Cross-sectional Cohort (ME Region)	10516	0.483	0.517	33% HTN Prevalence	19% Controlled BP (among all HTN)	Advancing Age, Obesity	Rural Residence, Male Gender (Lower Awareness/ Control)
Al Duraihim H et al.[5]	2019	Saudi Arabia	Cross-sectional (Hypertensive/Undiagnosed Cohort)	148 Diag. / 389 Undiag.	~55%	~45%	41.4% Uncontrolled SBP	N/A	Higher Awareness leads to Lower SBP	High Uncontrolled HTN (Failure to translate awareness to control)
Al-Maqbali AA et al.[6]	2013	Oman	Cross-sectional (NCD Screening Program)	1498	0.41	0.59	45% PHTN; 34% HTN	N/A	Total Blood Cholesterol (Most significant factor)	Age, BMI, FBG, Cholesterol all significantly associated with risk
Al-Nuaim A & Safi A[24]	2022	Saudi Arabia	Cross-sectional (Adolescents - Al-Ahsa)	380	0.524	0.476	HTN status in T2DM	N/A	Low Education OR = 2.64; Female Gender OR = 2.29 (predicts HTN)	Low Education/ Employment Status leads to higher risk of complications
Alamro NM et al.[22]	2025	Saudi Arabia	Cross-sectional (T2DM Patients - Riyadh)	574	0.5	0.5	N/A	40.8% Poor Adherence	Adequate Knowledge AOR = 2.93	Urban Residence AOR = 3.61 (predicts adherence)
ALruwaili BF[18]	2024	Saudi Arabia	Cross-sectional (PHC Patients - Aljouf)	390	0.559	0.441	N/A	62.7 (Moderate HRQoL)	Awareness of BP Monitoring/Lifestyle predicts HRQoL	Energy/Fatigue lowest HRQoL domain
Albugami LK et al.[28]	2024	Saudi Arabia	Cross-sectional (HRQoL - Riyadh Hospitals)	246	0.557	0.443	11.1% HTN Prevalence	N/A	Type 2 Diabetes AOR = 10.45; High Cholesterol AOR = 8.37	Higher Education AOR = 0.40 (protective); Unemployment AOR = 1.43
Nasser SM et al.[23]	2025	Saudi Arabia	Cross-sectional (Large PHC Survey - Riyadh)	14239	0.434	0.566	72.7% HTN Prevalence in COVID-19	N/A	COVID-19 (Associated with new-onset HTN)	25.7% Newly Discovered HTN (during acute illness)
Elamin MO et al.[40]	2024	Sudan	Cross-sectional (COVID-19 Patients)	300	0.67	0.33	N/A	64.1% Good Overall Knowledge	Salty Food (Top recognized risk)	Busy with Work (Top barrier to seeking care)
Khan S et al.[30]	2025	Saudi Arabia	Cross-sectional (General Public - Knowledge)	2113	0.383	0.617	N/A	45% non-adherent	Comorbidities, Number of Medications	Side Effects (Significant adherence barrier)
Algabbani FM & Algabbani AM[19]	2020	Saudi Arabia	Cross-sectional (Outpatients - Adherence)	306	0.742	0.258	N/A	63.7% Low/ Medium Adherence	N/A	Residing in a Village (Rural) AOR = 1.49; Married Status predicts low adherence
Thirunavukkarasu A et al.[32]	2022	Saudi Arabia	Cross-sectional (PHC Patients - Abha)	400	0.628	0.373	25.5% Overall Prevalence	37.0% Control (among treated)	Obesity, Advancing Age	Low Education, Male Gender predicts Prevalence

(Continued)

Table 1. **Summary of the findings—Continued**

Authors	Year	Country	Setting/Cohort type	Sample size (N)	Male (%)	Female (%)	HTN prevalence rate / Metric	Adherence/Control rate (%)	Key risk factor (AOR/ Odds)	Key barrier/SES disparity
Alshammari SA et al.[20]	2023	Saudi Arabia	Cross-sectional (General Public - Knowledge)	1399	0.405	0.595	N/A	72.2% Awareness of Complications	N/A	Male Gender OR = 1.60 (predicts awareness); Lower Education predicts poor awareness
Alshammari SA et al.[20]	2023	Saudi Arabia	Cross-sectional (HRQoL - Tertiary Care)	437	0.554	0.446	N/A	AOR = 1.20 (Knowledge/ Adherence link)	N/A	Low-Salt Diet Non-Adherence
Saeed AA et al.[7]	2011	Saudi Arabia	National Survey (WHO STEPS)	4758	0.492	0.508	N/A	N/A (Perceptions/ Practices)	N/A	Physician perception of Medication Complexity/ Cost are adherence barriers
Al-Nozha MM et al.[33]	2007	Saudi Arabia	National Survey (CADISS)	17230	0.477	0.523	15.6% Confirmed Prevalence	N/A	Advancing Age, Low Education	Widowed/Divorced predicts prevalence
Bakhsh LA et al.[34]	2017	Saudi Arabia	Cross-sectional (Hospital Patients - Self-Care)	211	0.602	0.398				

Note: Non-GCC studies listed in this table were included only for contextual reference and were not part of the quantitative meta-analysis.

Begg's test was not significant (τ = –0.154, P = .464). Under the fixed-effect model, the largest community study (Al-Turki et al., n = 197,681; 33.10% [95% CI 32.89%, 33.31%]) received 83.88% of the weight; under random-effects, weights were nearly uniform (7.14%–7.97%). Collectively, large population-based surveys clustered around 33% awareness, whereas several smaller studies exceeded 70%, suggesting setting and period effects and supporting random-effects inference and subgroup/sensitivity analyses.

Assessment of Heterogeneity

Heterogeneity was assessed using Cochran's Q and the inconsistency metric I^2, with accompanying 95% CIs for I^2. Across all three outcomes hypertension prevalence (Table 3), pre-hypertension (Table 5), and hypertension awareness (Table 7). The evidence indicated extreme between-study variability far exceeding what would be expected from sampling error alone. Accordingly, primary inference in this review is based on random-effects models, and pooled estimates are interpreted as summaries across diverse underlying populations and designs, not as single population parameters. Hypertension prevalence (Table 3). Between-study heterogeneity was markedly high, Q = 5,649.82, P < .001, with I^2 = 99.61% (95% CI [99.57%, 99.65%]), indicating that virtually all observed dispersion reflects true differences in study effects rather than sampling noise. While not a measure of heterogeneity per se, small-study effects were suggestive (Egger's intercept = 7.86, 95% CI [0.23, 15.49], P = .044), whereas Begg's test was non-significant (Kendall's τ = –0.059, P = .692). Together, these results support cautious interpretation of fixed-effect estimates (which can be overly influenced by very large studies) and justify emphasis on random-effects models and sensitivity analyses. Pre-hypertension (Table 5). Heterogeneity again reached extreme levels, Q = 4,503.86, P < .001; I^2 = 99.78% (95% CI [99.75%, 99.81%]). The magnitude of I^2 implies that nearly all variability across studies arises from real differences (e.g., sampling frames, settings, population age structure, and temporal/contextual factors). Egger's regression indicated statistically significant small-study effects (intercept = 16.53, 95% CI [4.89, 28.17], P = .0106), while Begg's test was non-significant (τ = –0.236, P = .312). This pattern pronounced heterogeneity with evidence of funnel-plot asymmetry reinforces the need for moderator analyses and influence diagnostics.

Hypertension awareness (Table 7). The awareness outcome exhibited similarly extreme inconsistency, Q = 4,445.10, P < .001; I^2 = 99.73% (95% CI [99.69%, 99.76%]). Egger's intercept was significant (17.76, 95% CI [9.16, 26.35], P = .0008), whereas Begg's test was not (τ = –0.154, P = .464). These findings suggest that smaller or setting-specific studies tended to report higher awareness proportions, consistent with selection and context effects. While this asymmetry does not "cause" heterogeneity, it can accentuate apparent dispersion and underscores the importance of triangulating pooled estimates with stratified results.

Publication Bias Assessment

Publication bias and small-study effects were appraised by visual inspection of funnel plots and formally with Egger's regression; Begg's rank correlation was used as a corroborative, lower-power test. Given the uniformly high inconsistency across outcomes (all I^2 ≈ 99.6% – 99.8%),

Table 2. **Results of meta-analysis for pooled prevalence of hypertension in Gulf countries across published studies**

Studies: Authors (Years)	Sample size	Proportion (%)	95% CI	Weight (%)	
				Fixed	Random
Abdulle AM et al.[10] (2006)	989	32.963	30.037 to 35.990	0.38	4.45
Al-Nozha MM et al.[33] (2007)	17230	26.1	25.445 to 26.762	6.68	4.53
Al-Turki et al.[35] (2008)	197681	15.6	15.440 to 15.761	76.69	4.54
Saeed AA et al.[7] (2011)	4758	25.494	24.260 to 26.758	1.85	4.52
Al-Majed HT & Sadek AA[25] (2012)	803	6.974	5.311 to 8.961	0.31	4.43
Al-Maqbali AA et al.[6] (2013)	1498	33.979	31.580 to 36.440	0.58	4.48
Tabrizi JS et al.[16] (2016)	2818	22.569	21.037 to 24.158	1.09	4.51
Baig M et al.[27] (2015)	610	7.377	5.431 to 9.747	0.24	4.4
Yusufali AM et al.[8] (2017)	10516	32.997	32.099 to 33.905	4.08	4.53
Bakhsh LA et al.[34] (2017)	211	43.602	36.806 to 50.580	0.082	4.17
Khayyat et al.[29] (2017)	204	30.392	24.163 to 37.202	0.08	4.16
AlWabel AH et al.[4] (2018)	130	14.615	9.035 to 21.879	0.051	3.98
Aldiab A et al.[3] (2018)	1019	4.907	3.664 to 6.418	0.4	4.46
Alanazi AMJ et al.[26] (2018)	232	1.724	0.472 to 4.355	0.09	4.2
Mamdouh H et al.[15] (2019)	2530	32.49	30.667 to 34.354	0.98	4.5
Al Duraihim H et al.[5] (2019)	148	41.216	33.198 to 49.594	0.058	4.04
Al-Taha MA et al.[39] (2020)	273	9.89	6.619 to 14.063	0.11	4.25
Al-Nuaim A & Safi A[24] (2022)	380	22.368	18.276 to 26.897	0.15	4.33
Mumena WA et al.[9] (2023)	489	26.994	23.106 to 31.162	0.19	4.37
Elamin MO et al.[40] (2024)	300	72.667	67.249 to 77.630	0.12	4.27
Nasser SM et al.[23] (2025)	14239	11.103	10.592 to 11.631	5.52	4.53
Alamro NM et al.[22] (2025)	574	65.854	61.813 to 69.730	0.22	4.4
Mattar D et al.[11] (2025)	120	48.333	39.117 to 57.634	0.047	3.94

Table 3. **Testing the heterogeneity and publication bias for the prevalence of hypertension in Gulf countries across published studies**

Test for heterogeneity		Publication bias		
Q-Test	5649.8202	Egger's test	Intercept	7.8595
Degree of freedom	22		95% CI	0.2308 to 15.4882
Significance level	***P* < 0.0001**		Significance level	***P* = 0.0440**
I^2 (inconsistency)	99.61%	Begg's test	Kendall's Tau	–0.05929
95% CI for I^2	99.57 to 99.65		Significance level	*P* = 0.6920

Table 4. **Results of meta-analysis for the prevalence of pre-hypertension in Gulf countries**

Studies: Authors (Years)	Sample size	Proportion (%)	95% CI	Weight (%)	
				Fixed	Random
Al-Turki et al.[35] (2008)	197681	3.700	3.617 to 3.784	96.76	9.18
Al-Majed HT & Sadek AA[25] (2012)	803	39.477	36.078 to 42.954	0.39	9.15
Al-Maqbali AA et al.[6] (2013)	1498	44.993	42.453 to 47.554	0.73	9.16
AlWabel AH et al.[4] (2018)	130	29.231	21.587 to 37.847	0.064	8.98
Alanazi AMJ et al.[26] (2018)	232	56.034	49.390 to 62.523	0.11	9.07
Mamdouh H et al.[15] (2019)	2530	29.802	28.025 to 31.627	1.24	9.17
Al Duraihim H et al.[5] (2019)	148	10.135	5.784 to 16.165	0.073	9.01
Al-Taha MA et al.[39] (2020)	273	17.216	12.933 to 22.228	0.13	9.08
Al-Nuaim A & Safi A[24] (2022)	380	12.368	9.231 to 16.106	0.19	9.11
Mumena WA et al.[9] (2023)	489	9.816	7.326 to 12.804	0.24	9.13
Mattar D et al.[11] (2025)	120	9.167	4.665 to 15.810	0.059	8.97

Table 5. **Testing the heterogeneity and publication bias for the prevalence of pre-hypertension in Gulf countries across published studies**

Test for heterogeneity			Publication bias	
Q-Test	4503.8649		Intercept	16.5344
Degree of freedom	10	**Egger's test**	95% CI	4.8940 to 28.1748
Significance level	***P* < 0.0001**		Significance level	***P* = 0.0106**
I^2 (inconsistency)	99.78%		Kendall's Tau	–0.2364
95% CI for I^2	99.75 to 99.81	**Begg's test**	Significance level	*P* = 0.3115

Table 6. **Results of meta-analysis for pooled proportion of subjects who had awareness about hypertension across the published studies in Gulf countries**

Studies: Authors (Years)	Sample size	Proportion (%)	95% CI	Weight (%)	
				Fixed	Random
Al-Nozha MM et al.[33] (2007)	17230	33.099	32.397 to 33.808	7.31	7.96
Al-Turki et al.[35] (2008)	197681	33.100	32.892 to 33.308	83.88	7.97
Saeed AA et al.[7] (2011)	4758	44.704	43.284 to 46.130	2.02	7.95
Yusufali AM et al.[8] (2017)	10516	49.002	48.042 to 49.962	4.46	7.96
Bakhsh LA et al.[34] (2017)	211	72.512	65.962 to 78.418	0.090	7.43
AlWabel AH et al.[4] (2018)	130	20.769	14.156 to 28.761	0.056	7.14
Al Duraihim H et al.[5] (2019)	148	77.703	70.136 to 84.127	0.063	7.23
Alshammari SA et al.[20] (2023)	437	85.126	81.438 to 88.329	0.19	7.70
Alshammari SA et al.[20] (2023)	1399	72.695	70.278 to 75.015	0.59	7.89
ALruwaili BF[18] (2024)	390	50.769	45.690 to 55.837	0.17	7.67
Albugami LK et al.[28] (2024)	246	89.837	85.364 to 93.315	0.10	7.51
Khan S et al.[30] (2025)	2113	64.080	61.992 to 66.128	0.90	7.91
Al-Hazmi AH et al.[13] (2025)	406	76.847	72.433 to 80.865	0.17	7.68

Table 7. **Testing the heterogeneity and publication bias for the awareness in Gulf countries**

Test for heterogeneity			Publication bias	
Q-Test	4445.1045		Intercept	17.7550
Degree of freedom	12	**Egger's test**	95% CI	9.1633 to 26.3467
Significance level	***P* < 0.0001**		Significance level	***P* = 0.0008**
I^2 (inconsistency)	99.73%		Kendall's Tau	–0.1538
95% CI for I^2	99.69 to 99.76	**Begg's test**	Significance level	*P* = 0.4641

funnel-plot interpretations were made cautiously and anchored in the regression tests. Egger's regression indicated statistically significant asymmetry (intercept = 7.8595, 95% CI [0.2308, 15.4882], P = .0440), consistent with a pattern in which smaller studies tend to report higher prevalence estimates; in contrast, Begg's test was not significant (Kendall's τ = –0.05929, P = .6920). Together, these findings suggest a non-trivial small-study effect despite a null Begg result, which is unsurprising given Begg's comparatively lower power. Egger's regression provided clear evidence of small-study effects (intercept = 16.5344, 95% CI [4.8940, 28.1748], P = .0106), whereas Begg's test was non-significant (Kendall's τ = –0.2364, P = .3115). The positive Egger intercept and the observed funnel-plot asymmetry are consistent with relatively higher pre-hypertension proportions among smaller or special-setting studies compared with larger, population-based samples. For awareness, Egger's regression showed strong evidence of small-study effects (intercept = 17.7550, 95% CI [9.1633, 26.3467], P = .0008), while Begg's test remained non-significant (Kendall's τ = –0.1538, P = .4641). This pattern (significant Egger, non-significant Begg) is typical when asymmetry is present but Begg's test lacks sensitivity; here, it aligns with the tendency of smaller or setting-specific studies to report higher awareness than large community surveys.

Risk of Bias Assessment

The methodological quality of the included studies was evaluated using the Cochrane Collaboration's Risk of Bias Tool,

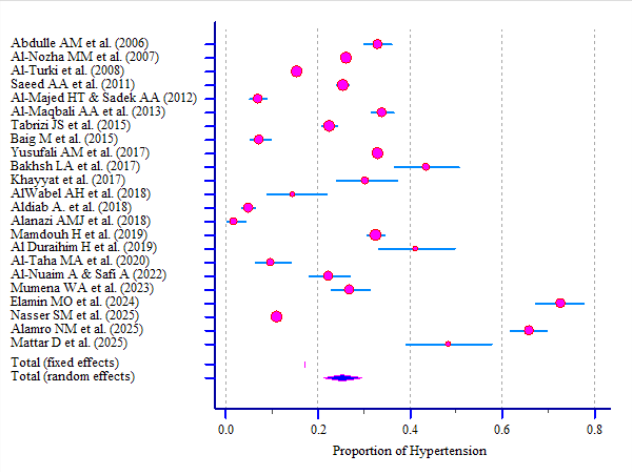

Fig. 2 **Forest plot for published studies showing the prevalence of hypertension and pooled prevalence.**

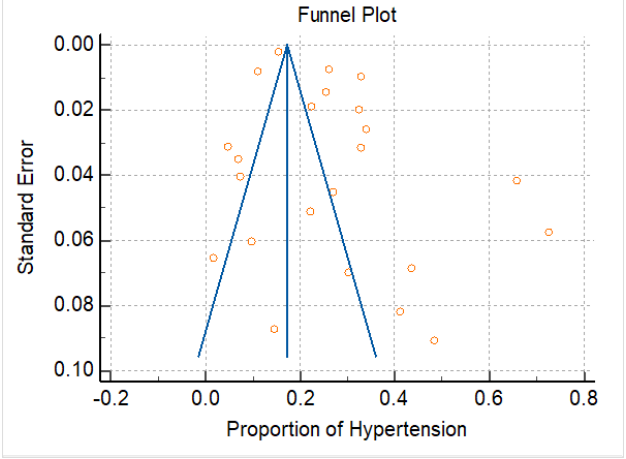

Fig. 3 **Funnel plot for published studies showing the prevalence of hypertension.**

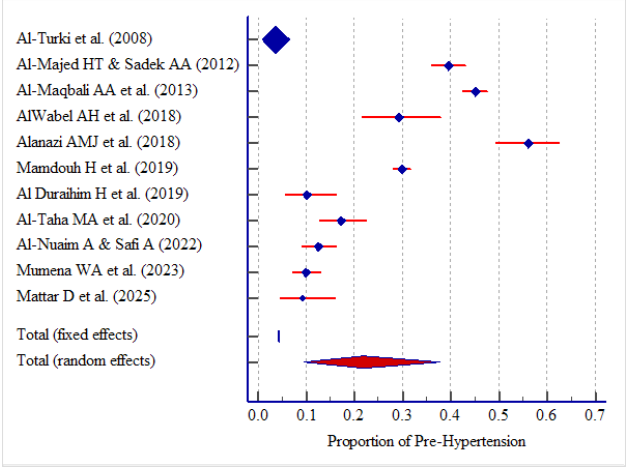

Fig. 4 **Forest plot for published studies showing the pooled prevalence of pre-hypertension.**

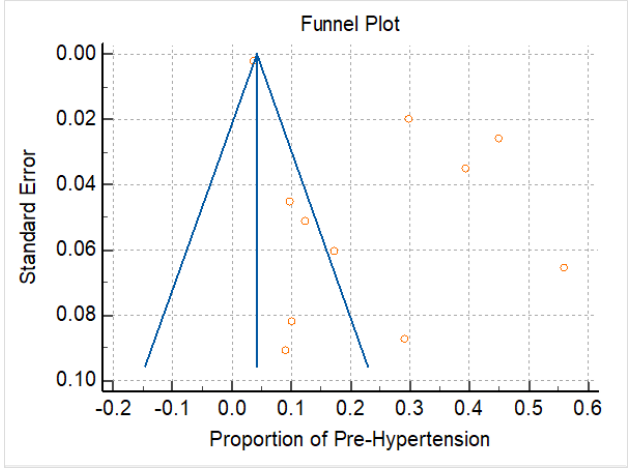

Fig. 5 **Funnel plot for published studies showing the pooled prevalence of pre-hypertension.**

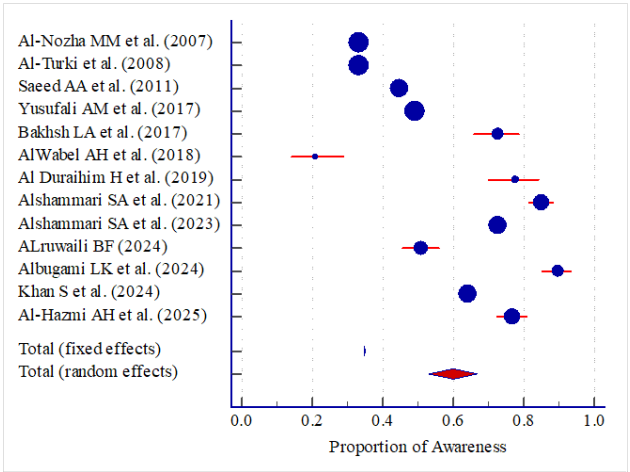

Fig. 6 **Forest plot for the proportion of subjects who had awareness of hypertension and pooled proportion.**

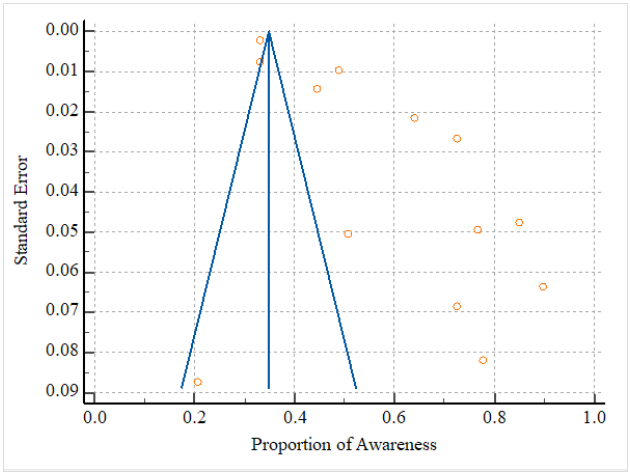

Fig. 7 **Funnel for the proportion of subjects who had awareness of hypertension and pooled proportion.**

Fig. 8 **Summary assessment of the risk of bias for the included articles.**

Table 8. **Results of the risk of bias assessment**

Types of risk	Percentage of different types of bias						
	Random sequence generation	Allocation concealment	Blinding of participant and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	Other bias
Low risk of bias	0.00	0.00	62.50	62.50	6.25	68.75	65.63
High risk of bias	71.88	71.88	0.00	0.00	0.00	0.00	0.00
Unclear risk of bias	28.13	28.13	37.50	37.50	93.75	34.38	28.13

with results summarized in Table 8. Selection bias assessment showed that random sequence generation exhibited predominantly high risk of bias (71.88%), with no studies classified as low risk and 28.13% assessed as unclear. A similar pattern was observed for allocation concealment, where 71.88% of studies demonstrated high risk, 28.13% were unclear, and none met criteria for low risk, indicating substantial methodological limitations in sequence generation and allocation processes across the included literature. In terms of performance bias, relating to blinding of participants and personnel, 62.50% of studies were judged to have low risk, while the remaining 37.50% were classified as unclear, with no studies falling into the high-risk category. For detection bias (blinding of outcome assessment), findings followed a similar distribution, with 62.50% assessed as low risk and 37.50% as unclear, again with no studies rated as high risk.

Assessment of attrition bias revealed that 93.75% of studies had unclear risk due to insufficient reporting of follow-up or missing data management, while 6.25% demonstrated low risk and none were categorized as high risk. Regarding selective reporting, 68.75% of studies were classified as low risk, while 34.38% showed unclear risk due to incomplete or insufficiently detailed methodological documentation. Overall, the most prominent concerns related

to selection bias, particularly sequence generation and allocation concealment, and attrition bias, reflecting gaps in methodological reporting common among observational studies. Despite these issues, the majority of studies were judged to be methodologically adequate for inclusion, with several domains demonstrating predominantly low-risk classifications.

Discussion

Comparison with Global Data and Interpretation of Key Findings

Comprehensive synthesis of evidence in the GCC and associated Middle East cohorts confirms that hypertension (HTN) constitutes a serious and accelerating public health crisis that is distinct in its etiology and barriers to its control.

Comparing the state of the region with global benchmarks reveals a mixed but worrying picture. While national prevalence rates (ranging from 25.5% to 34% in major surveys) align with or slightly exceed global estimates for middle-income countries[15,39] the deficit in effective control is much deeper. The global "rule of halves" (suggesting 25% control in treated patients) barely holds in the older GCC data[33] and more recent cohorts confirm critically low control rates, often below 37%.[39] This gap (high detection but under sustained control) is the challenge that defines the region.

Causes of Poor Awareness and Control

The underlying reasons for this control deficit are structural and multi-factorial:

The Predominance of Metabolic Risk in Lifestyle

The epidemic is fundamentally based on a rapid metabolic cascade rooted in urbanization and low physical activity. Obesity is unequivocally the strongest modifiable risk factor, with (OR) consistently exceeding 4.98,[3] placing the burden on central adiposity. The observation that high (WC) and (WHR) are highly significant predictors in young cohorts confirms that metabolic risk is amplified early in life.[11,15]

Functional Knowledge Deficit

Poor control is directly attributable to a lack of awareness to be translated into action. While the public generally recognizes (HTN),[28] functional knowledge is poor. Lower knowledge scores are consistently related to medication adherence and long-term adherence strategies.[13] This deficit is an important barrier at the (APS) level.[28]

Socioeconomic Vulnerability and Structural Barriers

Systemic inequalities exacerbate low control: Education/adherence link: lower educational level correlates with higher prevalence of (HTN) and worse adherence.[7,23] **Geographic isolation:** rural residence acts as a practical barrier, significantly predicting low medication adherence and inadequate access to health care.[28,32]

Therapy Complexity

Poor adherence is significantly driven by complex regimens. The presence of multiple medications and comorbidities predicts non adherence.[18,19] Physicians' self-reports confirm that medication cost and complexity are perceived barriers that restrict optimal prescribing practices.[21]

Policy and Clinical Implications

Nuanced understanding of the GCC context requires specific, specific policies and clinical responses:

Changing Clinical Practice

Clinicians should prioritize simplification of medication regimens. Instead of solely diagnosing HTN, providers should incorporate PHC-led targeted adherence education into each visit, building on the finding that good knowledge is the strongest predictor of adherence (AOR up to 7.4).[19] Furthermore, screening for central obesity (WC/WHR) in young patients should become routine to address metabolic risk early.[11]

Policies for Equity

Policy interventions must address structural inequalities. Public health funding should be directed toward outreach programs for rural and low-educated cohorts, building on the finding that higher education is a protective factor.[30] Campaigns should focus on the modifiable factors of obesity and physical inactivity, which are the root cause of the burden of metabolic syndrome.

Long-term Health

Beyond cardiovascular risk, achieving strict control of BP is a necessity to preserve long-term cognitive health.[17] Evidence linking uncontrolled HTN to specific cognitive deficits (e.g., attention and fluency) provides powerful additional motivation for patient compliance that should be integrated into educational materials.[28]

Limitations

The main limitations of this systematic synthesis should be acknowledged:

Study Heterogeneity

The evidence is highly heterogeneous, spanning different age groups, definitions (JNC vs. ACC/AHA), and sampling methods (national surveys vs. convenience clinic samples). This heterogeneity limits the precision of pooled estimates.

Measurement Bias

A significant portion of behavioral and awareness data is based on self-reported measures (e.g., adherence, smoking), making results susceptible to social desirability bias and possible overestimation of compliance.

Overall Risk of Bias Profile

Across the included studies, the Cochrane Risk of Bias assessment indicated moderate methodological limitations. Most studies demonstrated high risk in the domains of random sequence generation and allocation concealment, primarily due to non-probability sampling. Conversely, blinding of participants, personnel, and outcome assessors showed predominantly low risk. Selective reporting and incomplete outcome data were unclear in several studies, suggesting potential

underreporting. These factors should be considered when interpreting pooled estimates.

Causality

The predominance of cross-sectional designs in the evidence base restricts the ability to infer causal relationships for most risk factors; Associations (OR) are reported, not causation.

Conclusion

Data synthesized from studies in the GCC and associated regions affirm that the predominant challenge in the management of hypertension is not simply diagnosis, but rather bridging the persistent and structurally sustained gap between patient awareness and achieved clinical control. The prevalence of HTN is high and increasing, driven primarily by the metabolic cascade of obesity and associated comorbidities, with risk amplified by socioeconomic vulnerability.

Recapitulation and Message

The main message remains that improving the control of HTN requires overcoming social and behavioral barriers, not just pharmacological ones. The sustained prevalence of HTN and low control rates confirm the urgent need for policy change.

Gaps and Recommendations for Future Work

Targeted Intervention Trials (RCT)

Future work should prioritize randomized controlled trials (RCT) testing culturally sensitive adherence educational models, led by PHC against standard care, particularly targeting cohorts defined by low educational attainment and rural residence, to confirm causal effectiveness.[28,32]

Integrated Clinical Outcomes

More Longitudinal studies are needed to confirm the mechanisms linking uncontrolled HTN to specific domains of cognitive impairment in GCC populations, strengthening the imperative for tight control of BP.[17]

Policy Support for Adherence

Recommendations include requiring clinical education focused on simplifying polypharmacy and improving communication with physicians to manage barriers cited by patients, such as complexity and cost of medications, thereby improving adherence rates worldwide.[21]

Conflicts of Interest

None.

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