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Prevalence and Risk Factors of Hypertension in Saudi Arabia: A Systematic Review

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Abstract

Background:
Hypertension is a major health problem; it affects more than 1.39 billion people worldwide and is responsible for cardiovascular diseases and early mortality in most of the cases. However, in Saudi Arabia, hypertension is a critical public health challenge, and the prevalence differs significantly across the regions. From available literature, modifiable risk factors for hypertension that have been strongly associated include obesity, physical inactivity, smoking, and dietary habit, which again underscore the imperatives for appropriate public health strategies.

Objective:
The systemic review aims to synthesize evidence on the prevalence of hypertension, associated risk factors, and regional disparities in Saudi Arabia to inform targeted public health interventions and policy strategies.

Methods:
An extensive search of the literature was carried out in PubMed and Google Scholar, in addition to looking into regional databases, using a time frame from 1996 to the end of 2023. It includes all research articles that report on studies related to the prevalence of high blood pressure or associated risk factors among adults, defined as participants aged ≥15 years residing within the borders of Saudi Arabia. Publications in the form of systematized reviews or as meta-analyses, and other studies dealing with expatriates, were excluded. Only entitled studies were critically analyzed and qualitively synthesized.

Results:
Prevalences on hypertension vary highly across different studies of Saudi Arabia, including very huge differences, between 11.1% and 36.2%, with serious region-wide inequalities in prevalence estimates. The available national-level studies showed prevalence rates in the studies of El Bcheraoui et al. (2014), based on urbanization and altered lifestyle, were 15.2%, while prevalence from Al-Nozha et al. (2007) is 26.1%, strongly connected to obesity and aging in their populations. Regionally, the Eastern Region exhibited prevalence ranging from 15.6% to 16%, influenced by sedentary behavior and dietary transitions. The Western Region including Al-Taif had the highest prevalence of 36.2%, reflecting the impact of urbanization, smoking and high salt intake. The lowest prevalence rate, 11.1%, was registered in the Southern Region of Saudi Arabia. The main contributory factors here are the maintenance of a traditional diet with minimal exposure to fast food, as well as active lifestyles of people residing in this part of Saudi Arabia. The Northern Region did not give specific prevalence rates but identified major risk factors like smoking, obesity, and sedentary behavior. Al-Kharj, a semi-urban region, showed a very high prehypertension prevalence of 54.9% and hypertension prevalence of 4.9%, mainly due to obesity and low educational attainment. These results further underscore the urgent need

for region-specific public health strategies in order to address hypertension and its associated risk factors effectively.

Conclusions
This review represents a call to action for region-specific public health interventions in response to the rising burden of hypertension in Saudi Arabia. The interventions should focus on reducing modifiable risk factors through the promotion of lifestyle modifications, increasing screening programs, and ensuring equity in access to health care. Future studies should pay greater attention to the use of standardized diagnostic criteria and longitudinal assessment of the outcomes of interventions in order to limit regional disparities and improve management of hypertension.

Keywords: Hypertension; Prevalence; Saudi Arabia; Risk factors; Obesity; Smoking; Urbanization; Public health interventions

1.Introduction

Hypertension is a global public health challenge that affects an estimated 1.39 billion individuals worldwide and is significantly contributing to CVDs and premature mortality. The condition's burden is particularly pronounced in low- and middle-income countries, where two-thirds of cases are concentrated due to rapid urbanization, dietary transitions, and limited access to healthcare[1].

Chronic smoking has been considered one of the major modifiable risk factors that play a crucial role in the pathogenesis of arterial stiffness and vascular dysfunction, further accelerating the development of hypertension and its complications[2].

It represents one of the major public health burdens, with higher prevalence observed in urban settings, compared to rural areas, due to changes in lifestyles driven by urbanization. There has been a clear trend seen wherein obesity, apart from being a major risk factor identified for hypertension, shares a highly linear relationship with hypertension prevalence, which underscores modifiable lifestyle factors[6]. Data from neighboring countries, such as Lebanon and the United Arab Emirates, reveal a similar trend, with demographic and lifestyle factors playing a crucial role in the prevalence and management of hypertension. In Dubai, for example, the prevalence of hypertension was 32.5%, and obesity and sedentary behavior were identified as major contributors, especially among males. Similarly, Lebanon also recorded a prevalence of 29.3%, though it was characterized by significant awareness and control gaps. In both countries, the rates were higher in urban areas compared to rural areas, reflecting the influence of urbanization on lifestyle-related risk factors[3,4]. Despite the growing recognition of hypertension as a major public health issue in Saudi Arabia, the large variability in prevalence rates across different regions calls for tailored interventions. This systematic review synthesizes existing evidence on the prevalence of hypertension, its associated risk factors, and regional disparities across Saudi Arabia in order to provide an overall understanding that would inform targeted public health strategies.

2.Materials and Methods

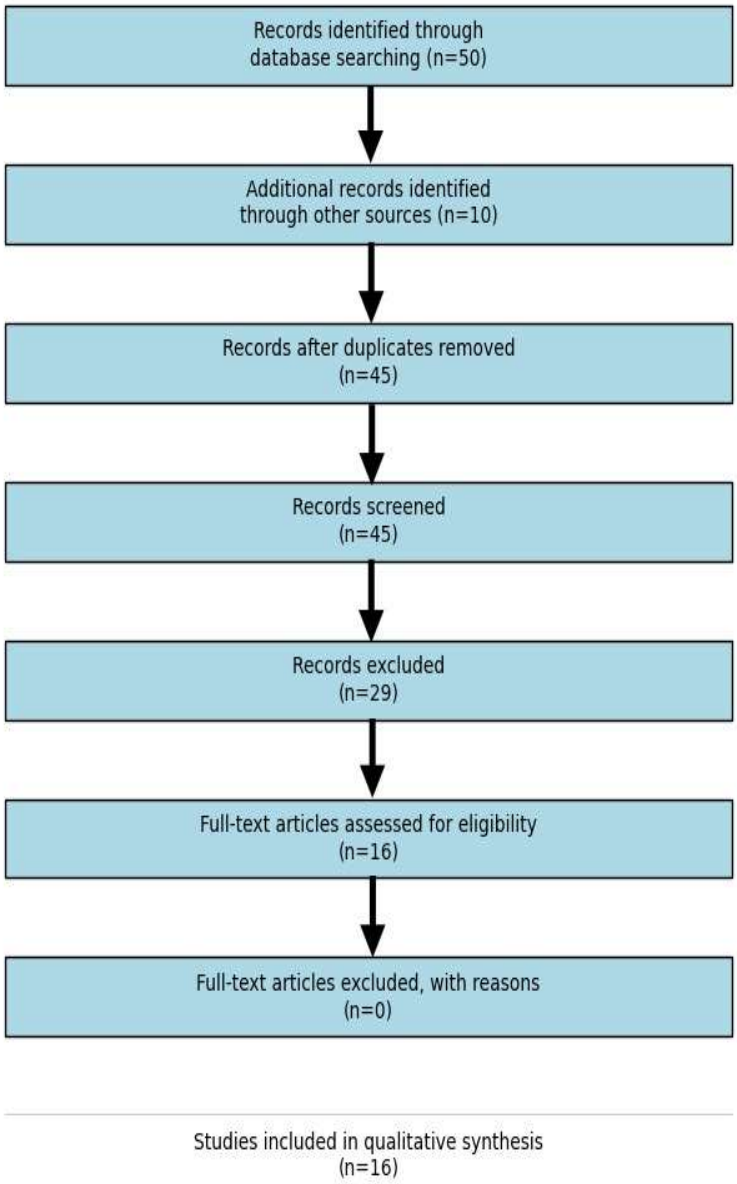
2.1. Search Strategy

A systematic search was conducted through PubMed, Google Scholar, and regional academic databases using the search terms "hypertension Saudi Arabia," "prevalence hypertension," and "risk factors hypertension." Boolean operators like (AND,OR) were used for refining the search. Articles that appeared between 1996 and 2023 in the English language were included, while grey literature, conference proceedings, and unpublished studies were excluded.

2.2. Eligibility Criteria

Inclusion Criteria:
- Original articles reporting the prevalence of, or risk factors associated with hypertension in Saudi Arabia.
- Studies involving adults aged ≥15 years.
- Articles published in English.
Exclusion criteria include:
Systematic reviews, meta-analyses, or case reports.

2.3. Study Selection
Eligibility was assessed by reviewing the records, and full-text reviews were conducted to verify whether the inclusion criteria were met. Figure 1 PRISMA flow diagram reflects the process of study selection.



3.Results

3.1.Prevalence by Region

•National Studies:

National studies report the prevalence of hypertension in Saudi Arabia to range from 15.2% to 26.1%[6,7], reflecting significant variability depending on the methodology, target population, and time of data collection. El Bcheraoui et al. (2014): This national survey consisted of 10,735 participants aged 15 years and above. The overall prevalence of hypertension in Saudi Arabia was found to be 15.2%. Prevalence increased significantly with age and was higher among men than women. Of greater concern is the fact that as many as 57.8% of the individuals with hypertension were undiagnosed, and of those diagnosed, 78.9% were on medication. Yet, only

45% of the subjects who received treatment had their blood pressure well controlled, showing significant gaps in hypertension management. The main risk factors determined to contribute to the prevalence of hypertension included obesity, diabetes, and hypercholesterolemia. The findings underscore the need for urgent national strategies to decrease modifiable lifestyle factors, improve awareness, enhance early diagnosis, and improve control efforts[7].

Al-Nozha et al. (2007): This cross-sectional survey conducted on 17,230 participants aged 30-70 years from various regions in Saudi Arabia yielded an overall crude prevalence of hypertension of 26.1%, with an age-adjusted prevalence of 24%. There was also a gender disparity: males had a higher prevalence, 28.6%, compared to females, 23.9% ($p<0.001$). The prevalence in urban areas was 27.9%, while in rural areas it was 22.4% ($p<0.001$). A very important risk factor was obesity, with a linear increase in the prevalence of hypertension. Another major contributing factor was age, where the prevalence rose steeply for those aged 60 years or older, reaching 44.6% among men and 50.4% among women in this age group. These results again strongly underscore the urgent need for targeted intervention on modifiable risk factors, especially in urban settings, for reducing the steadily growing burden of hypertension among the Saudi population[6].

Again, the study, in which Al-Nozha et. al (1998), reflected geographical trends in the prevalence rates across the regions of Saudi Arabia presented further influences of regional and ecological influences of health. The prevalences of systolic hypertension (≥ 160 mm Hg): were from 8-9 % in Farasan down to 2.2 percent in Asir, while diastolic Hypertension (≥ 95 mm Hg) was the highest in Al Qassim at 10.6% and lowest in Makkah at to 4.2%. Using the threshold ≥140/90 mm Hg, the prevalence of systolic hypertension was highest in Makkah at 27.9%, and lowest in Jeddah, 14.9%, while the peak prevalence of diastolic hypertension was in Al-Taif at 36.2%, lowest in Asir and Makkah at 22% each. Comparison by gender revealed that females had a higher rate of hypertension than males in eight out of twelve regions, especially among people aged 40–75 years[16]. These results draw attention to a need to take into consideration regional variability of the prevalence rate of hypertension in an area and accordingly tailor the public health interventions to meet the specific demographic, dietary, and life-style characteristics unique to that region.

Al-Osman et al. also carried out a study which indicated that, among Saudis, hypertension was strongly associated with CAD. Hypertensive patients, in general, bear an extremely high risk of CAD development, and the chances are much worse in patients whose blood pressure is poorly controlled. Co-existing diseases like diabetes and hyperlipidemia were seen to contribute enormously to this heightened risk[15]. Such findings indicate the importance of integrated management strategies in an attempt to reduce the burden of CAD in the hypertensive population.

Al-Diab et al.'s study in Al-Kharj pointed out the high prevalence of prehypertension and its risk factors in this semi-urban area. In general, the overall prevalence of prehypertension was as high as 54.9%, with a higher prevalence among males, 66.1%, compared to females, 48.1%. The prevalence of hypertension was comparatively low, at 4.9%, with males slightly higher than females at 4.2%. Overall, the strongest association was established with obesity and overweight status and both prehypertension and hypertension, non-obese people with class I obesity increasing the risk of hypertension by 3.5 times compared to non-obese individuals (OR = 3.49, 95% CI: 1.42–8.63). The status of educational attainment constitutes another highly significant factor. As observed from the estimates among males in the group, primary education has recorded an overwhelmingly high OR of developing prehypertension (OR = 6.56, 95% CI: 1.27–33.85)[10]. These findings emphasize the need for modification of modifiable risk factors, especially obesity and education, to manage and prevent the development from prehypertension to hypertension.

3.2.Regional Variability

Eastern Region:

The prevalence estimates for hypertension ranged from 15.6% to 16%, according to studies arising from large-scale community-based screening campaigns[5]. These studies showed that changes in lifestyle, such as increased sedentary behavior, dietary changes, and high rates of obesity, contribute to the prevalence of hypertension in the region. The mass screening campaign in the Eastern Province revealed that approximately 21% of the participants had positive test for hypertension at initial screen tests, though it became a little lower 15.6%[5], with confirmation by the standardised diagnostic criteria. These findings underline priorities for public health interventions to deal with modifiable risk factors such as physical inactivity and high salt intake through diets in overall populations.

Western Region:

The prevalence of undiagnosed hypertension was indicated to be 17.2% based on data from a study conducted in the cities of Madinah and Jeddah. Such a study underlines that undiagnosed hypertension is one of the substantial public health challenges in urban areas where physical inactivity and dietary factors further deteriorate the condition. These studies emphasize the urgent need for enhanced and targeted screening programs so that the undiagnosed cases of hypertension are picked up as early as possible and appropriately managed[11].

Northern Region:

The reviewed studies in the Northern Region did not clearly give a prevalence rate for hypertension, but rather major risk factors, including sedentary lifestyles, obesity, smoking, and poor dietary habits among the market worker population in Arar City. These findings emphasize the urgent need for targeted public health interventions that can help address modifiable risk factors in this population. This vision ensures that the content of the study is accurately reflected without the inclusion of any unsupported prevalence rates[9].

Southern Region:

The prevalence of hypertension in the Southern Region of Saudi Arabia was 11.1%, with age-adjusted rates of 10.6% for men and 11.4% for women. Data are from a large-scale population survey with standardized measurements of blood pressure and structured interviews. A marked increase in the prevalence of hypertension was observed with increasing age. Of note, there is a wide discrepancy in that while 76% of the hypertensive were on antihypertensive medications, only 20% achieved adequate blood pressure control. These findings emphasize the urgent need for targeted interventions to enhance adherence to treatment, improve practices of management, and ultimately achieve better hypertension control rates, especially in the older demographic groups[12].

3.3.Risk Factors

Key modifiable risk factors included:

Obesity was Consistently associated with higher prevalence rates[6]. Urban populations in regions such as Riyadh (Central), Makkah and Madinah (Western), and the Eastern Province exhibit higher hypertension prevalence. Among these, Makkah shows the highest rate at 10.25%, followed by Madinah (9.59%) and Riyadh (9.52%)[8]. Smoking was one of the highest risk factors that developed hypertension in both Northern and Western Saudi Arabia. The prevalence of smoking among market workers in Arar City within the northern region was higher, significantly contributing to overall the risk factors of developing Hypertension and CVDs, which signifies the need for intervention on smoking cessation among the market workers[9]. At the same time, in the Western region, smoking was identified to be strongly associated with hypertension among urban males, as obtained in cities like Madinah[11]. These indicate the importance of addressing smoking as an essential modifiable risk factor that improves management among such hypertensive patients.

Dietary Habits: Most of the reviewed studies have mentioned dietary habits as one of the major risk factors for hypertension, especially in those areas with high urbanization. A high intake of salt and low consumption of fruits and vegetables were consistently found to be associated with a high prevalence of hypertension in Eastern

and Southern Saudi Arabia. A community-based screening in the Eastern Province pointed, amongst other factors, to the dietary habits as the influence. Higher risks in urban rather than rural populations were due to nutritional transitions[5]. In addition, the traditional high-sodium intakes were expressed in the Southern region with high hypertension rates, particularly among advanced age and indviduals with poor access to vegetables and fruits[12].

Other main risk factors include physical inactivity, especially within urbanized parts of Saudi Arabia, in the face of rapid socio-economic changes that promote sedentary lifestyle because of greater use of motor vehicles and less avenues for physical exercise. Analysis of the 2023 national and regional prevalence data indeed noted lifestyle transition through urbanization contributes most to decreasing physical activities which increases risk for hypertension[7]. However, the findings from the 2014 nationwide survey give a different twist by indicating that even though the level of exercises was measured, after controlling for other confounders, physical inactivity was not significantly associated with hypertension[8]. These inconsistent findings reflect the complex interaction between lifestyle behaviors and the risk of hypertension, and further studies are needed to precisely establish the contribution of physical activity to the reduction in hypertension prevalence in various regions and populations of Saudi Arabia.

4.Discussion

With high degrees of burden in various regions within Saudia Arabia. It needs a special focus on this major modifiable lifestyle factor, plus the consideration of regional differences. All these results would contribute to better understandings of the prevalence patterns of hypertension and the different at-risk factors associated with a potentially targeted public health intervention focus.

4.1.Regional variation in hypertension prevalence

The prevalence of hypertension in Saudi Arabia varies considerably by region due to the differences in lifestyle factors, urbanization, and access to healthcare. Studies conducted at the national level indicate that the prevalence rates range between 15.2% and 26.1% with a considerable variation between methodologies and target populations. For example, the prevalence in the Eastern Region ranged from 15.6% to 16%, while in the Western Region, the undiagnosed prevalence was 17.2%. This prevalence was 11.1% in the Southern Region, and age-adjusted rates were relatively similar across both genders. These differences suggest the importance of region-specific interventions to account for local demographic, environmental, and lifestyle factors.

Such observations point to some regional inconsistencies throughout the country of Saudi Arabia and major deviations in hypertension prevalence. Specific sites like Al-Taif in their diastolic blood pressure hypertension are at an unmatched average of 36.2%; Hail at 27.1% average for systolic blood pressure hypertension were noted during observations[15]. In this manner, the report points at the need to have various interventions that cater to their specific regions for modifiable factors, improve blood pressure control, and reduce the burden of hypertension-related complications.

The Al-Kharj study findings highlight the alarming levels of prehypertension prevalent in this semi-urban population, especially among males[10]. The strong associations between obesity and low education attainment and the prevalence of prehypertension call for focused intervention efforts on these risk factors. Regional disparities in hypertension and prehypertension prevalence have also been underlined, further underlining the importance of localized public health strategies that would manage cardiovascular risk factors effectively in Saudi Arabia.

Isolated diastolic hypertension was reported in 3.95% of the Saudi Arabian adults aged 15–64 years. It accounted for 18.9% of hypertensives. It occurred more often among men, and between 35-44 years of age, than other ages. There is a correlation of the disease with obesity, hypercholesterolemia, smoking, and less commonly to dietary habits, physical activities, but no direct relation of them. Of particular interest, almost half of the IDH patients were unaware of their condition, while many of the treated indviduals were lacking proper blood

pressure control[14]. These results reflect the need for targeted screening and early diagnosis with management interventions toward modifiable risk factors to effectively treat IDH.

4.2.Modifiable Risk Factors

In fact, obesity was a consistent and significant risk factor for hypertension in all regions, particularly in urban populations such as Riyadh, Makkah, and Madinah. The fact that obesity and the prevalence of hypertension are directly related in a linear manner underlines the urgent need for intervention strategies promoting weight management and healthy lifestyles. This is further exacerbated by an emerging epidemic of obesity due to urbanization and socioeconomic changes, leading to increased risk for hypertension.

Smoking was emphasized in both the Northern and Western regions as a major risk factor, especially among the male populations and special occupational groups such as market workers. The high prevalence of smoking and its association with high blood pressure make specific smoking cessation programs and public health campaigns quite imperative.

Dietary habits also play a major role in the prevalence of hypertension, with high intake of salt and low consumption of fruits and vegetables contributing greatly. Nutritional transitions, such as the adoption of high-sodium diets, were associated with increased risk in urban areas of the Eastern and Southern regions. Public health interventions to promote healthy dietary behaviors, including a reduction in salt intake and improvement in access to fresh produce, will be required to help minimize this modifiable risk factor.

Sedentary behavior has also been established as one of the leading factors causing hypertension, especially in urban settings where socioeconomic transformations provide minimal avenues for physical activity. While the review in 2023 showed urbanization as one of the main determinants reducing the level of activity, the national survey results in 2014 indicated a non-statistically significant relationship when controlled against other variables. The contradictions in findings underline the fact that physical inactivity and hypertension interact in a very complex way and point out the need for further investigations regarding its role in decreasing hypertension prevalence.

5.**Limitations and Methodological Considerations**

This again may be because of the difference in prevalence rates and risk factors, apart from population demographics and their diagnostic criteria. Actually, most variability in studies could be due to threshold values of blood pressure for diagnosis, such as systolic and diastolic cutoffs. For this reason, whether populations including urban or rural people are representative of hypertension prevalence may become an issue depending on characteristics of physical activity and socio-economic background.

Such findings point toward different methodological and representative conditions among these studies. That explains the large variations of these findings. Also, to make this review suitable for such a scenario, this paper tried to synthesize the findings by giving this advantage to studies with methodologies and national representativeness only to estimate the overall prevalence. Regional studies were utilized to identify localized patterns and outliers, such as the higher diastolic hypertension prevalence in Al-Taif (36.2%) and prehypertension rates in Al-Kharj (54.9%). This approach allowed the identification of overarching trends, such as the higher prevalence of hypertension in urban areas and the strong influence of modifiable risk factors like obesity, smoking, and physical inactivity.

Variability brings into focus again the need for future research to lay down uniform diagnostic and reporting standards. While the methodologies vary, the identified trends of this review provide evidence-based quite consistent directions for targeted public health interventions and further research.

5.1.Variation in diagnostic criteria:

The differences in threshold diagnostics, such as the use of Joint National Committee (JNC) criteria versus World Health Organization (WHO) guidelines, add up to differences in prevalence rates. This usually means that lower thresholds raise the prevalence rate; therefore, the adoption of the same diagnostic protocols is

important.

5.2.Population and Methodological Differences:

Indeed, the review has focused on very divergent populations and methodological studies. While almost all urban populations studied reported comparably higher prevalence of hypertension compared to rural areas for obvious reasons related to lifestyle transition, falling into sub-groups such as adolescents, occupational groups etc introduced more variability and as a result weakened the generalisation of such findings.

6.Implications for Public Health Strategies

This geographic variation in hypertension prevalence underlines the need for region-specific public health strategies in Saudi Arabia. It is now beyond the fact that specific interventions need to be adapted to urban areas where such lifestyle factors of obesity, physical inactivity, and dietary transitions are more pronounced and target these modifiable risks. Targeted health promotion campaigns, community-based screening programs, and better access to health care will lead to improvement in early detection and management.

Moreover, there is a dire need to address the large gaps in awareness, diagnosis, and control. Studies revealed that a substantial proportion of hypertensive individuals remain undiagnosed or inadequately managed, with low rates of blood pressure control among those on medication. For this, strengthening of health systems is required to focus on management regarding hypertension, including follow-ups and treatment guidelines, in order to reduce the burden of complications resulting from uncontrolled hypertension.

7.Research Recommendations

Future studies shall focus on:

1. investigating the change in the role of physical activity in reducing the risk of hypertension, especially in more urbanized settings.
2. Long-term effects of targeted lifestyle interventions on the prevalence and control of hypertension.
3. Assessing the effectiveness of regional public health strategies in relation to modifiable risk factors.
4. Standardization of data collection methods and diagnostic criteria will enable meta-analyses and stronger conclusions in future systematic reviews.

8.Conclusion

Hypertension is still a significant public health concern in Saudi Arabia, varying greatly by region, and is largely influenced by demographic, socio-economic, and lifestyle parameters. The review highlights the urgent need for targeted interventions that can help reduce disparities and modifiable risk factors, such as obesity, physical inactivity, smoking, and poor dietary habits. Where there are lifestyle transitions with urbanization, prevalence is consistently higher in urban areas, while traditional diets and active lifestyles prevails in rural populations. Yet, certain unique challenges, such as a high prevalence of prehypertension in semi-urban regions, or gender-specific trends in the prevalence of hypertension, do point toward more tailored strategies that are specific to the region.

This review also points out formidable gaps in the knowledge, diagnosis, and management of high blood pressure in Saudi Arabia. The high prevalence detected in subjects with undiagnosed and poorly controlled hypertension underscores the imminent need for enhanced systematic tracking programs, better medical therapy of the disease, including complete access to the available health care, particularly in periphery rural areas. Furthermore, the findings highlight the impact made by comorbidities such as diabetes mellitus and hyperlipidemia that add to the severity of complications associated with HTN, including CAD.

Public Health Strategies Recommendations

1. National Awareness Campaigns: Educate on regular monitoring of blood pressure, eating healthier, exercising, and avoiding smoking. These need to be adapted to regional peculiarities in order to really engage

and make a difference.
2. Community-Based Interventions: Design programs targeted to region-specific risk factors, such as dietary salt intake reduction in urban areas and access to health care increase in rural regions.
3. Integration of Hypertension Screening: Establish routine checks of blood pressure in both the clinical and non-clinical settings, such as health organizations and companies; a move out towards places with concentrations of people, which offer opportunities for early detection and management, especially among target groups such as the aged and obese.
4. Policy Initiatives: Advocacy for regulations on the content of salt in processed foods, restriction of tobacco advertising, and promotion of physical activities through urban planning initiatives like walking tracks and public parks.
5. Improved healthcare infrastructure should be assured as a way of promoting equity in the access to health services and enhancing primary healthcare services, especially for the underserved populations, realizing the full potential of using telemedicine to reach resource-scarce rural areas where access is poor.
6. Long-term Investigations and Evaluation: Public health intervention assessments to gauge reach and sustainability. The normalization of diagnostic criteria in study design should allow for comparability and meta-analyses, as appropriate. Emerging factors influencing the successful management of hypertension will continue to be investigated.
Further research directions should include attempts to identify a unified diagnosis criteria, common methodology in data collection, and the establishment of public health policies at each region separately. Long-term monitoring also needs to be carried out concerning the effects and sustainability of certain public health measures. Such strategies will contribute significantly to the possibilities of policy-makers and healthcare workers in stemming the increasing hypertension burden and complications in an effort to maximize overall public health outcomes across Saudi Arabia.

Conflict of Interest
The authors declare no conflicts of interest related to this study.

Disclosure and Ethical Approval
This study is a systematic review that utilized publicly available data from previously published studies. As such, no new human or animal participants were involved, and ethical approval was not required. The authors adhered to established guidelines for systematic reviews, including the PRISMA framework, to ensure transparency and rigor in study selection and data synthesis.

Tables
Table 1: Prevalence of Hypertension by Region

Region	Prevalence Range (%)	Major Factors
Eastern	15.6-16.0	Sedentary behavior, dietary shifts
Western	17.2-27.9	Urbanization, smoking, dietary habits
Northern	Not specified	Sedentary lifestyles, obesity
Southern	11.1	Traditional diets, active lifestyle

Table 2: Key Risk Factors Identified Across Studies

Risk Factor	Associated Prevalence (%)

Obesity	Up to 26.1
Smoking	19.8
Dietary Habits	15.2
Physical Inactivity	Mixed findings

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