IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 23, Issue 12 Ser. 5 (December. 2024), PP 19-28
www.iosrjournals.org

Hypertension In Asia: Prevalence And Risk Factors: Systematic Review And Meta-Analyses

Jayakrishnan K S[1], Babu Rajendra Prasad T R[1], Sarathlal S[1], Jamila Hameed[1*].
Department Of Medicine, Karuna Medical College, Vilayodi, Kerala, 678103, India

Abstract
Objective:
This study aims to evaluate the risk factors and the prevalence of hypertension in the Asian population since there has been a recent increase in incidences of hypertension leading to premature death.
Methods:
Various risk factors like BMI, lifestyle, alcohol, smoking, stress, psychological factors, sodium intake, urbanization, and diabetes were studied in the Asian population. Data analysis was done with SPSS. A total of 9063 studies were identified. Twelve studies with a total subject of 16105851 were selected.
Results:
The Singaporean study shows a strong link between BMI and hypertension with Malaysia showing a similar correlation. Tibet shows a correlation of hypertension with diabetes mellitus and altitude. A prevalence of 14% hypertension in diabetic males was found. Pakistani study expresses a significant correlation between obesity and hypertension. The study by Nepal depicts the relationship between the level of physical activity and hypertension. UAE reports hypertension in males. Saudi exhibits a low overall prevalence of 9.2% in a large sample. Iran shows a moderate gender difference in males while India displays an association between smoking and urbanization with hypertension. The Bangladeshi study marks an urban-rural divide signifying the impact of urbanization. The Vietnamese study suggests a correlation between alcohol consumption and hypertension.
Conclusion:
Preventive measures like lifestyle modifications through regular exercise, a balanced, nutritious diet and early diagnosis could be crucial in averting the condition.
Keywords: *Prevalence, Hypertension, Asia, Risk Factors, Meta-analyses, Lifestyle modification*

Date of Submission: 09-12-2024 Date of Acceptance: 19-12-2024

I. Introduction

The incidence of hypertension in the world is increasing every year with South Asians accounting for 25% of the global population and with India alone burdened with over 300 million individuals suffering from the condition. Hypertension is a serious non-communicable disease which tops the list in the world. It is widely spread among the urban, rural, and tribal groups in all socio-economic classes. It is one of the major causes of mortality and morbidity due to cardiovascular disease(CVD), chronic kidney disease(CKD), and stroke. Hence, it is essential to target the risk factors for hypertension to eradicate the non-communicable disease(NCD). More than 50% of persons are not aware that they are hypertensive and it might be underdiagnosed. The risk factors of hypertension are a diet with unrestricted sodium content and low potassium, alcohol, smoking, a sedentary lifestyle, stress at job, at home, and environmental toxins and air pollution [1]. A vivid idea of the risk factors of hypertension and its final outcome makes an urgent unmet need to implement certain strategies in the healthcare system. It is essential to navigate through the risk factors with the essential knowledge to tackle this disease. In developing countries like India, awareness of hypertension is mandatory. The hypertensive should have a regular check-up and treatment. Recently, The Centre for Chronic Disease Control(CCDC) announced the completion of a study of the control of blood pressure in India conducted by All India Institute of Medical Sciences in collaboration with Imperial College, London with three drugs namely amlodipine, perindopril, and indapamide combined in different orders. However, as the adage goes, “Prevention is better than cure”, it is always better to go for lifestyle modification strategies with a sufficient amount of physical activity and a good, balanced diet.

II. Methodology

This systematic review and meta-analyses followed the Preferred Reporting Item for Systematic Review and Meta-Analyses (PRISMA) guidelines [2].

Literature search

A comprehensive literature search was done to find out studies published between 2019 to 2023 on the prevalence of hypertension, its risk factors, and preventive measures. Electronic database search was done in PubMed, Google Scholar, and Embase using the keywords "Prevalence of hypertension in Asia", "Risk Factors" and "Lifestyle Modifications".

Inclusion and exclusion criteria

The inclusion criteria were: 1.) Cases available with complete data for prevalence of hypertension. 2.) Published in English. 3.) Studies done among adults. 4.) Studies cross-sectional, review, and meta-analyses in nature.

The exclusion criteria were: - 1.) Case series, reports. 2.) Non-Asian countries 3.) Paediatric population 4.) Pregnant hypertensive patients.

Data extraction

The eligibility of the article based on criteria search was completed by 2 authors (B.T.R and L.J) and the full text of the studies was analyzed by using Microsoft Excel 2016. The two authors assessed the methodology and the quality of the articles by using the New Castle Ottawa assessment scale [3]. Finally, a total of 12 studies met the quality of assessment. The data shows different studies from different parts of Asia including 12 countries namely Singapore, Malaysia, Tibet, China, Bangladesh, Vietnam, Nepal, India, Pakistan, UAE, Iran, and KSA with the first author, type of study, year of publication, country, sample size, gender, smoking, alcohol, BMI, physical activity, diabetes, family history, psychological factors, urban, rural and unrestricted use of salt was tabulated. Odds ratios were used for the preparation of forest graph using SPSS software which was based on the random effects model.

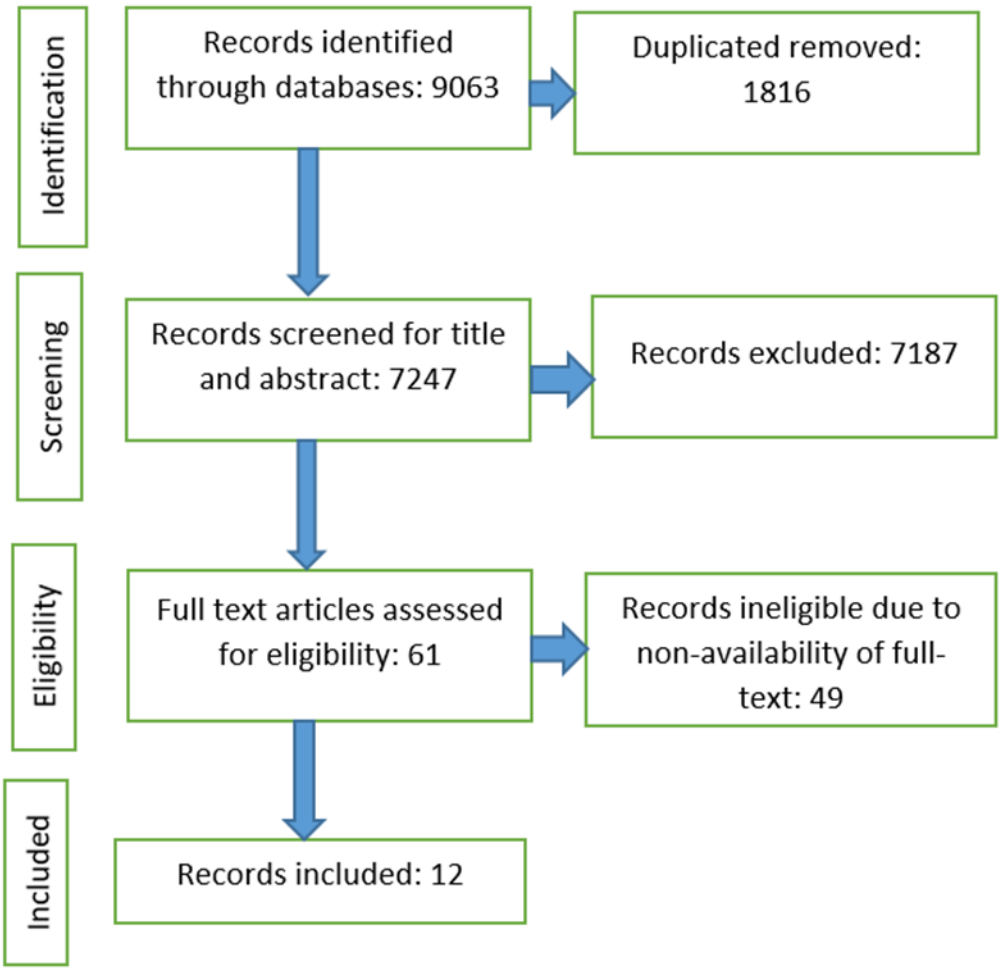

Figure 1. Flowchart explaining the number of studies included in the systematic review and meta analyses

III. Results

Screening flow

According to the search strategy set in advance, a total of 9063 articles were retrieved in the target database (Figure 1). Then 1816 duplicate articles were removed. The remaining 7187 articles that didn't meet the eligibility criteria were removed from 7247 articles by reading the titles and abstracts. Finally, 12 articles were determined to be included in the analysis (Figure 1). A total of 16105851 subjects were studied.

Study characteristics

This is a systematic review and meta-analysis including a total of 12 studies in Asia.

The studies selected were selected to assess the association between various factors and HTN. (Table 1 and 2). The forest plot analysis in the study concentrated on males OR for HTN due to certain vital factors (Figure 2). Males have a higher tendency for cardiovascular disease in comparison to females due to the relation with lifestyle modifiable factors like smoking, alcohol, and stress thereby increasing the prevalence rate [4]. Our study consistently showed complete data specific to males with comparable OR making meta-analyses robust. This strengthened the reliability of our study and helped us to maintain methodological rigor while considering the significance of gender-based analysis in HTN research.

Funnel's test and egger's test

To assess the risk of publication bias, funnel plot analysis, and Egger's test were conducted. The symmetrical funnel plot indicates a good symmetrical distribution of studies that suggests a minimal publication bias (Figure 3). However, a few outliers that are present may need further investigation to understand their impact on the meta-analyses on the whole. The Egger's test showed a p-value of 0.8095 indicating no publication bias.

Meta-analysis of studies on males with hypertension revealed extremely significant heterogeneity ($p<0.0001$, $I2 = 99.99631\%$). The results suggest substantial differences in study outcomes, highlighting the need for personalized treatment approaches. The pooled prevalence of males with hypertension was noted as OR-1.733(95%CI: 1.47-2.02).

Table 1: Hypertension, demographics and risk factors

Sl No	Author	Gender		BMI	Physical Activity(Low)	Diabetes	Smoking	Alcohol	Urbanization	
		Male	Female						Urban	Rural
1	Aqeel et al,2023[5]	0.8352(0.822-0.848)	10%(9.98-10.22%)	-	-	-	-	-	-	-
2	Mohammad Ziaul Islam Chowdhury et al, 2020 [7]	0.6925(0.690-0.696)	21%	-	-	-	-	-	25%(22-28%)	15%(13-16%)
3	Ailian Santosa et al, 2020 [8]	1.136(1.128-1.142)	35.8%	15%(males), 11.5%(females)	71.5(males), 65.4%(females)	14%(Male), 11.4%(Female)	53.6(males), 2.%(females)	32.6%(males),0.8%(females)	-	-
4	Salman Mohammadi et al, 2023 [10]	1.06(1.057-1.062)	25.11%	-	-	-	-	-	-	-
5	Labasangzhu et al, 2020 [13]	0.7801(0.763-0.799)	0.02(OR)	-	-	31.4%(27.1-35.7%)	10.6%	20.7%	0.10	0.17
6	Muhammed Riyas et al, 2021 [20]	0.97(0.82-1.14)	Workingwomen 0.24(0.17–0.34)	1.95(1.55-2.44)	0.16(0.07-0.35)	2.94(1.88-0.35)	1.48(1.19-1.83)	1.47(1.23–1.75)	1.87(1.27–2.76)	-

			House wives 4.13(2.93–5.80)							
7	Prashant Mathur et al, 2021 [26]	1.1552(1.341-0.0774)	27%	Males :23.3 %(21.0 25.7 %) Females: 29.3 %(27.0 31.7 %)	Males: 30.9(28.3 33.7) Females: 52.4(50.0 54.7)	Males: 8.5(7.4–9.7) Females: 10.2(8.8 11.8)	32.8%(30.8-35%)	15.9%(14.2-17.7%)	34%(32-36.1%)	25.7%
8	Fathima Mezhal et al, 2023 [29]	4.4136(4.316-4.536)	9.2%(7.8-10.5%)	-	-	-	-	-	-	-
9	Dhan Bahadur Shrestha et al, 2021 [32]	1.48(1.478-1.487)	Proportion[0.2599(0.2181-0.3065)]	31.6 %[OR:0.6839(0.5203 - 0.8991)]			1.4299(1.1429-1.7889)	2.0729(1.7154-2.500)		
10	Lana Meiqari et al, 2021 [34]	1.8(1.6-2.1)	21.1%	-	-	-	-	-	-	1.9(1.8-2.1)
11	Cheong et al, 2019 [37]	1.981(1.134-3.462)	34.14%	OR=4.053,(CI-1.677 - 9.795), Waist Circumference OR - 1.102 (95% CI-1.070 -	1.040(0.898-1.205)	-	-	-	-	-
12	Seaw Jia Liew et al, 2019 [40]	1.65(1.47-1.85)	29%	OR=1.287, 95% CI1.193-1.387	-	-	-	-	-	-

Table 2: Hypertension association with additional risk factors

Sl No	Authors	Additional Risk Factors
1	Labasangzhu et al[13]	Altitude – 2.05(95%CI: 1.62–2.61)
2	Muhammed Riyas et al[20]	Psychological Factors: anxiety:1.67 (1.34–2.09),stress: 1.39 (1.20–1.61), anger:1.42 (1.16–1.74), and anger-control issues:1.16 (1.09–1.23) Unrestricted Use of Salt : 0.24(0.12–0.47)

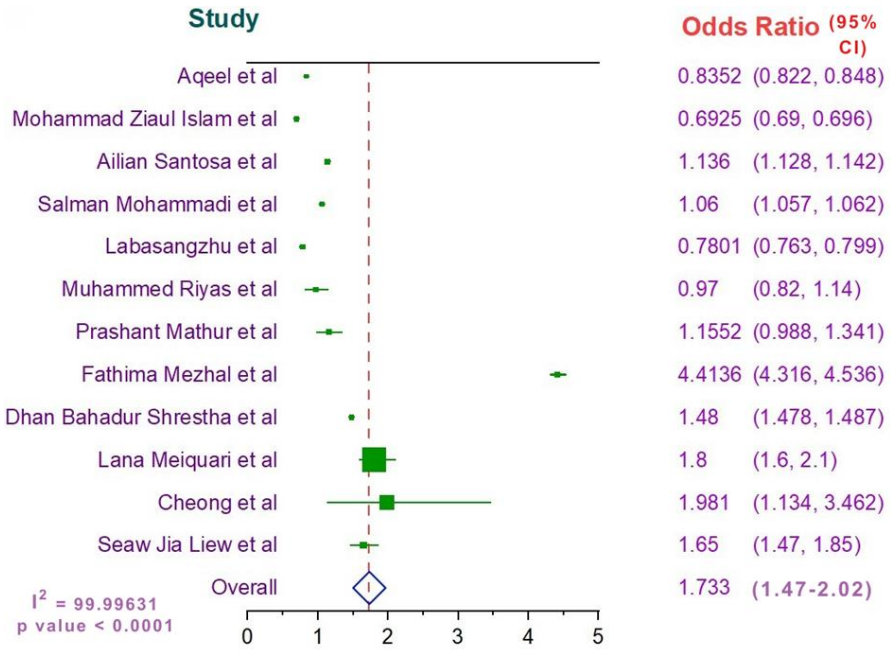

Figure 2. Forest plot depicting hypertension among males.

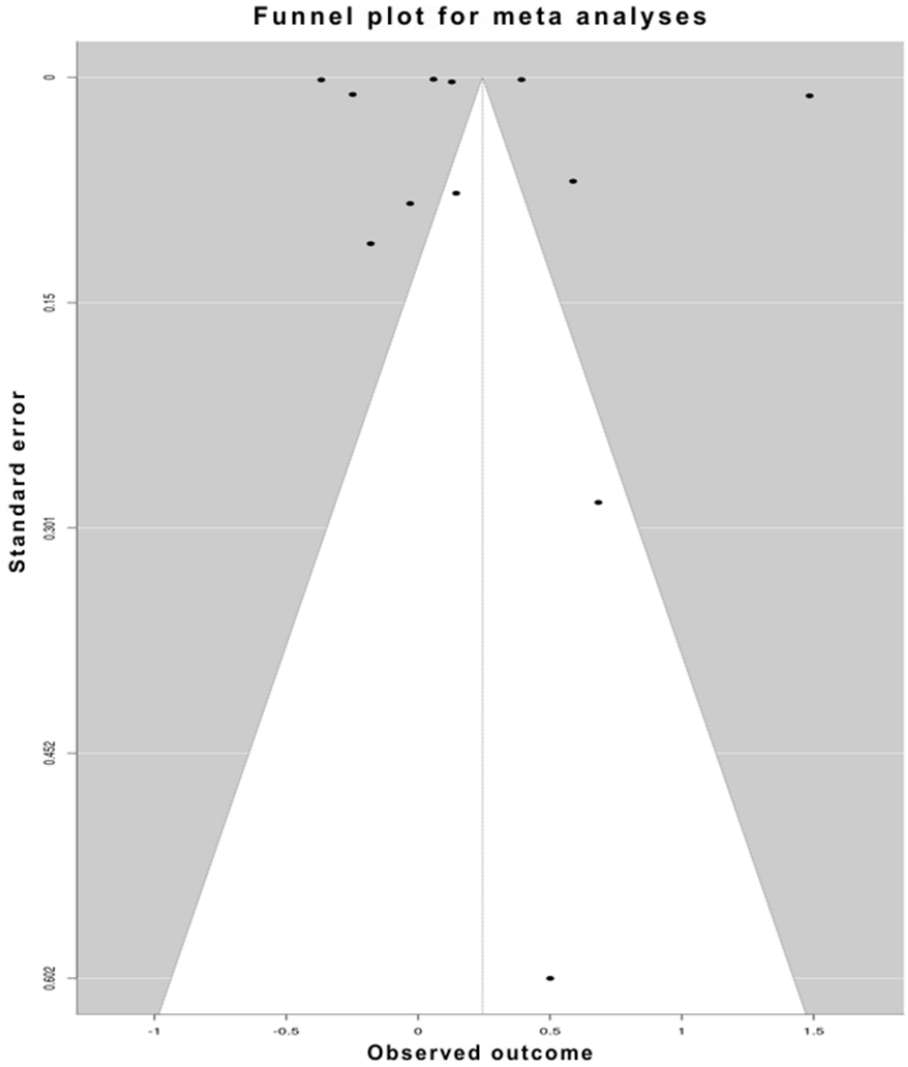

Figure 3. Funnel plot for systematic review and meta-analysis

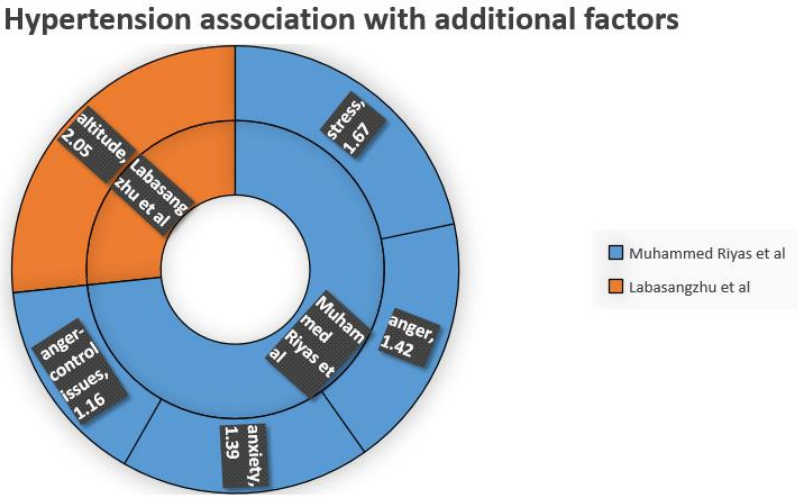

Figure 4. Association of hypertension with additional factors

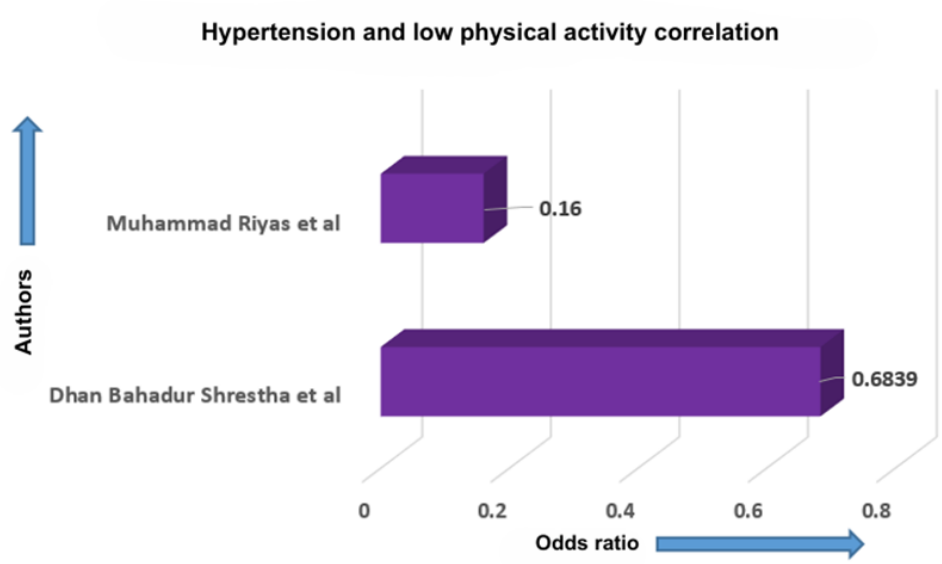

Figure 5: Association between hypertension and low physical activity

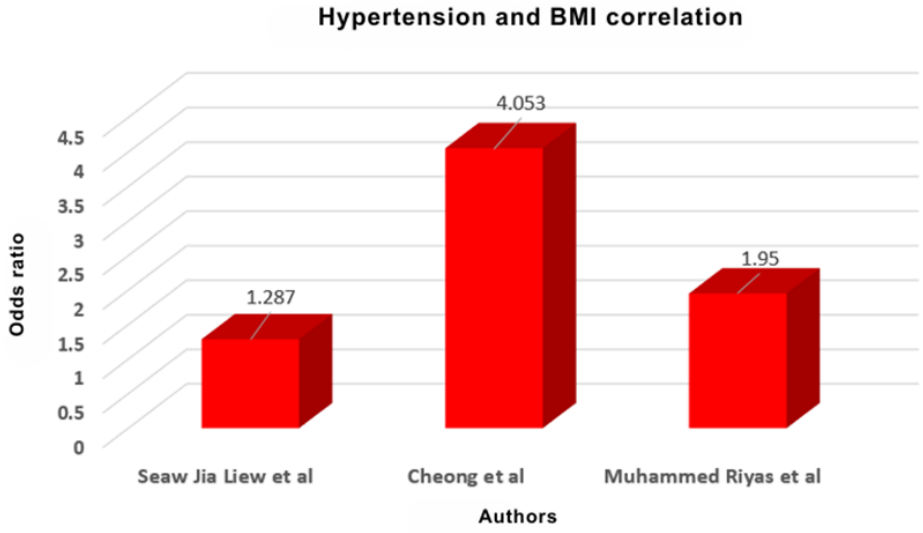

Figure 6. Correlation between hypertension and BMI

IV. Discussion

The risk factors for the prevalence of hypertension have been elaborated in our study. The Saudi study by Aqeel et al claims an overall low prevalence of 9.2% in a massive sample of 14 million. In this study, the self-reported hypertension questionnaire failed to identify the undiagnosed hypertensive. Some risk factors like obesity and physical activity have not been considered. However, they have demonstrated a high-risk group population living in Makkah with hypertension and the sample size is considerably large [5].

The Bangladeshi study by Mohammad Ziaul Islam Chowdhury et al includes 53 studies with a total of 3054220 participants. In this study, the sample size is large. It marks an urban-rural divide (25% vs 15%) indicating urbanization leads to HTN. This is supported by a study [6]. No publication bias was there. However, there was a lack of rigorous population-based cross-sectional study despite a large sample size. High heterogeneity was noted. Blood pressure measurement was not standardized [7].

The study of China by Ailian Santosa et al indicates a prevalence of 14% in hypertensive diabetic males versus a prevalence of 11.4% in hypertensive diabetic females. In this study, diverse risk factors smoking, diet, exercise, age, marital status, educational level, diabetes, alcohol, BMI, family history, and hypercholesterolemia with a large sample size were considered while performing the study. However, the blood pressure was recorded on a single occasion due to which clinical diagnosis of hypertension from multiple occasions wasn't considered which was crucial for the study [8].

Salman Mohammadi et al study consists of comprehensive data using the Joanna Briggs model to confirm high quality [9]. They extracted both national and local data. However, there was variability in blood pressure cut-offs limiting single meta-analyses. Sub-group analyses based on major blood pressure were lacking [10].

In the study by Labasangzhu et al, The Tibetan author evaluates 39 studies in 115403 participants showing a correlation of HTN with diabetes mellitus (31.4%, 95% CI: 27.1%-35.7%). The study also emphasizes the positive association of HTN with increasing altitudes having an OR of 2.05(95%CI: 1.62–2.61). The review was conducted based on NCD. A large-scale survey from different regions of Tibet was conducted with participants from varying altitudes displaying hypertension (Figure 4) This is supported by another study that tells increase in blood pressure is caused by deficient oxygen supply among the individuals living in high altitude leading to cardiac problems [11]. It is noted in another study by the author that there is a polymorphism in the genes among the aboriginal Tibetan people [12]. The Tibetan study by Labasanghzhu is based on self-reported hypertension among people that might have led to overall underdiagnoses of the condition based on awareness. Dietary habit-related data was not considered [13].

The analysis by Pakistani authors Muhammad Riyas et al expresses crucial insight into the different risk factors in the prevalence of hypertension. Smoking(OR-1.48), obesity(OR-1.951), psychological factors with anxiety(OR-1.67) and stress(OR-1.39) and physical activity(OR-1.6) were noted. It was based on high-quality assessment scale that was Newcastle Ottawa. Humongous risk factors had been enlisted. Obesity tops the list as the leading factor for hypertension in this study. BMI and waist-hip ratio predicting the prevalence of HTN is noteworthy in NCD. This fact is supported by another study [14]. Metabolic syndrome associated with lipidemia leads to CVD and CKD and this is reported in another study [15]. The association of HTN leading to Non-Alcoholic Fatty Liver Disease(NAFLD) is a well-known fact [16]. Diabetes is also a risk factor which is mentioned as an association with HTN in this Pakistani study. Hyperinsulinemia, insulin resistance in obese patients lead to metabolic abnormalities due to increased peripheral resistance, and sympathetic activation(RAS) severely in obese patients genetically determined, due to melanocortin-4-receptor mutation causing HTN [17]. Further much stress is laid on stress and psychological factors like that caused by jobs, marriage, and relationships (Figure 4) This statement is further stated by an author[18]. Psychological stress is also associated with metabolic syndrome [19]. However, the Pakistani study only considered the linear effects of explanatory variables and reported bias [20].

Indian authors Prashant Mathur et al evaluated a notable association between smoking (32.8%, 95% CI: 30.8-35%) and urbanization (34%) with hypertension. There is a significant association between smoking and HTN prevalence. However, the paradoxical association between smoking and HTN is provided by another author [21]. Another interesting study states that there is an association between weight gain following smoking cessation and HTN [22]. Alcohol is one of the key drivers of HTN too. This is also mentioned in another study [23]. The Indian study by Prashant Mathur et al focused on NCD baseline future monitoring. The study related to excess salt intake was conducted showing the relation of increased sodium intake causing HTN. This is supported by another study [24]. It is noted that sodium excretion is associated with 6 mmHg higher in systolic BP, and 2.5 mmHg in diastolic pressure. So, it is advisable to restrict salt intake in the diet to prevent CVD, CKD, and stroke. There is an inverse relation between potassium intake and hypertension [25]. However, the major challenge of the Indian study is that state-based estimates were lacking [26].

Fathima Mezhal et al in UAE report a high OR of 4.4136 in males The study includes a large sample size with a multi-ethnic population and reported that men had 3 folds times higher HTN than women. This is

supported by a survey [27]. However, a study by another author states that cardiovascular risk is higher in women in association with HTN and obesity[28]. One of the major limitations of the UAE study taken in our literature review is that the majority were males who were recruited in comparison to females [29].

In the study by Nepali authors Dhan Bahadur Shrestha et al, an association of HTN with a low level of physical activity having an OR of 2.0729(95% CI, 1.7154-2.500) has been highlighted. It states that exercise and an active lifestyle are associated with lower HTN (Figure 5). This is supported by another study [30]. Further, maintaining normal weight reported lower odds of having hypertension. Similar findings have been stated by another author [31]. However, the awareness of HTN was found lacking in the study conducted in Nepal among the public, and the need for longitudinal data was realized [32].

The Vietnamese study by Lana Meiqari et al suggests a correlation between alcohol consumption and hypertension (OR-1.9, 95% CI: 1.8-2.1). It consisted of robust data with no evidence of bias in publication. A higher prevalence of HTN was found to be in the urban setting population. This is also supported by another study [33]. Urbanization, lack of exercise, and alcohol among the high-income group is associated with the prevalence of HTN in the study done in Vietnam. However, most of the studies were excluded due to high heterogeneity and differences in sample size and BP measure standardization [34].

The Malaysian study by Cheong et al shows a positive correlation of HTN with BMI (OR-4.053, 95% CI: 1.677-9.795). It also insists on maintaining a normal BMI to avoid the risk of developing HTN (Figure 6). This is supported by another study that says a 1 cm increase in waist circumference will increase the BP by 1 mmHg [35]. The Malaysian study also indicates that there is no correlation between sleep and HTN. However, this is contradicted by another study [36]. The study by Malaysian authors included a small sample size [37].

The study by Siaw Jia Liew et al includes a significant sample of 10215 participants with a strong association between hypertension and BMI (OR- 1.287, 95% CI:1.193-1.387). The prevalence of HTN was noted to be 33.9%. Men have higher BP than females as noted by another author [38]. And also the level of BP increases in age for both sexes was noted in another study [39]. The Singaporean study stresses the need to modify lifestyle [40].

V. Limitations

The number of studies taken for this systematic review and meta-analysis was small. We considered a short duration of 5 years that might limit the overall scope of the study. The paediatric and pregnant population with BP were not considered leading to the limitation of the data. Also, our study has a high heterogeneity due to factors such as study setting and sample size.

VI. Conclusion

In a developing country like India, awareness of HTN and its diagnosis among the public is mandatory. The free health check-up camps and community help workers, paramedics, health coaches, social media celebrities, sportspersons, TV media, and newspapers should implement the propaganda of the preventing factors. The advertising agencies should focus on the risk factors to prevent HTN rather than promoting and marketing snacks with high-contented sodium. The school children must be encouraged to take part in sports. The mid-day meals provided in the schools must have plenty of fruits, vegetables, and salads. Lifestyle awareness should be implemented from childhood. The nutritional labelling of the packets with the percentage and the calorie content should be mentioned. The free health schemes by the government and the NGOs should be utilized by the public and awareness should be created. The awareness of digital media that includes AI must be made accessible to the public for liberal utilization. The victory over the COVID-19 pandemic gives the globe encouragement and confidence and reinforces that determination and resilience will ultimately lead to success. The discovery of essential HTN was by Fredrick Mahomed in year 1874[41]. Another physician Sir William had contributed much to HTN(1816-1890)[42].Of late, many drugs have been identified and contributed to the field of HTN[43] A unique technique in the evaluation and delivery of the drug by muco adhesive buccal film by solvent casting technique for clinidipine in the treatment of HTN[44,45]. Last but not the least, combination of drugs for treatment of stubborn HTN uncontrolled is of much significance. Yet, leading cause of premature death among the non-communicable diseases is HTN. Lifestyle modification can reduce the cardiovascular risk and mortality as there is a strong association between HTN and lifestyle [46]. Still the unmet need of the hour to prevent HTN is prevailing ,hoping in future, further research may throw light on unsolved puzzle. Much studies have been done over the past years all over the globe yet we have not been able to gain control over high blood pressure and have not been able to conquer over this prevailing condition. The aim of the study insists on this fact.

Acknowledgments

We would like to thank our Principal, Dr.Vasanthamalai, and General Manager, Mr.Rahim for their immense involvement. And Miss.Swathi for her technical assistance with data analysis and illustrations in the preparation of this study.

Source Of Funding:
This research was not supported by any specific grants from public, commercial, or non-profit funding agencies.

Conflicts Of Interests:
The authors report no conflict of interest.

Author Contributions:
Conceptualization and methodology, J.K.S., B.T.R., and S.S.; Formal analysis, B.T.R., and J.K.S..; Visualization and writing – original draft J.K.S., B.T.R., S.S.; Writing – review and editing, J.K.S., B.T.R., and J.H. All authors have read and agreed to the final version of the manuscript.

Ethical Approval:
Not Required

References

[1] Xia Z, Liu Y, Liu C, Dai Z, Liang X, Zhang N, Et Al. The Causal Effect Of Air Pollution On The Risk Of Essential Hypertension: A Mendelian Randomization Study. Frontiers In Public Health. 2024 Feb 15;12:1247149
[2] Moher D, Liberati A, Tetzlaff J, Altman Dg. Research Methods And Reporting. Bmj. 2009 Aug 8;8:332-6.(Prisma)
[3] Wells Ga, Shea B, O'connell D, Peterson J, Welch V, Losos M, Et Al. The Newcastle-Ottawa Scale (Nos) For Assessing The Quality Of Nonrandomized Studies In Meta-Analyses.
[4] Connelly Pj, Azizi Z, Alipour P, Delles C, Pilote L, Raparelli V. The Importance Of Gender To Understand Sex Differences In Cardiovascular Disease. Canadian Journal Of Cardiology. 2021 May 1;37(5):699-710.
[5] Alenazi Am, Alqahtani Ba. National And Regional Prevalence Rates Of Hypertension In Saudi Arabia: A Descriptive Analysis Using The National Survey Data. Front Public Health. 2023 Apr 4;11:1092905.
[6] Sani Rn, Connelly Pj, Toft M, Rowa-Dewar N, Delles C, Gasevic D, Et Al. Rural-Urban Difference In The Prevalence Of Hypertension In West Africa: A Systematic Review And Meta-Analysis. J Hum Hypertens. 2024 Apr;38(4):352-364.
[7] Chowdhury Mzi, Rahman M, Akter T, Akhter T, Ahmed A, Shovon Ma Et Al. Hypertension Prevalence And Its Trend In Bangladesh: Evidence From A Systematic Review And Meta-Analysis. Clin Hypertens. 2020 Jun 1;26:10.
[8] Santosa A, Zhang Y, Weinehall L, Zhao G, Wang N, Zhao Q Et Al. Gender Differences And Determinants Of Prevalence, Awareness, Treatment And Control Of Hypertension Among Adults In China And Sweden. Bmc Public Health. 2020 Nov 23;20(1):1763.
[9] Jordan, Zoe, Lockwood, Craig, Munn, Zachary, Et Al. The Updated Joanna Briggs Institute Model Of Evidence-Based Healthcare. International Journal Of Evidence-Based Healthcare 17(1):P 58-71, March 2019.
[10] Mohammadi S, Hassanipour S, Delam H, Nikbakht Ha, Ghaem Far Z, Firoozi D Et Al. Prevalence Of Hypertension In Iran: An Updated Systematic Review And Meta-Analysis Of Community-Based Studies. Caspian J Intern Med. 2023 Fall;14(4):607-617.
[11] Gianfranco Parati, Grzegorz Bilo, Andrea Faini, Barbara Bilo, Miriam Revera, Andrea Giuliano Et Al. Changes In 24 H Ambulatory Blood Pressure And Effects Of Angiotensin Ii Receptor Blockade During Acute And Prolonged High-Altitude Exposure: A Randomized Clinical Trial, European Heart Journal, Volume 35, Issue 44, 21 November 2014, Pages 3113–3122
[12] Kui Li, Liang Y, Yin Su, Zhang Lx, Xin Yi, Yong Ch, Et Al. The Relationship Between Polymorphisms At 17 Gene Sites And Hypertension Among The Aboriginal Tibetan People. Biomedical And Environmental Sciences. 2012 Jan 1;25(5):526-32.
[13] Labasangzhu L, Zhang R, Qi Y, Shen L, Luobu O, Dawa Z, Et Al. The U-Shaped Association Of Altitudes With Prevalence Of Hypertension Among Residents In Tibet, China. J Hum Hypertens. 2021 Jun;35(6):546-555.
[14] Gwalani R, Yadav A, Shah R, Pandya Ak, Wadhwa M. Exploring Waist-To-Hip Ratio And Health Risks: Insights From Nfhs-5 On Trends, Patterns, And Predictors Among The Indian Population
[15] Litwin M, Niemirska A. Metabolic Syndrome In Children With Chronic Kidney Disease And After Renal Transplantation. Pediatr Nephrol. 2014 Feb;29(2):203-16.
[16] Li G, Peng Y, Chen Z, Li H, Liu D, Ye X. Bidirectional Association Between Hypertension And Nafld: A Systematic Review And Meta-Analysis Of Observational Studies. Int J Endocrinol. 2022 Mar 24;2022:8463640.
[17] Simonds Se, Pryor Jt, Ravussin E, Greenway Fl, Dileone R, Allen Am Et Al. Leptin Mediates The Increase In Blood Pressure Associated With Obesity. Cell. 2014 Dec 4;159(6):1404-16.
[18] Khonde Kumbu R, Matondo H, Labat A, Kianu B, Godin I, Kiyombo G, Et Al. Job Stress, A Source Of Hypertension Among Workers In Sub-Saharan Africa: A Scoping Review. Bmc Public Health. 2023 Nov 23;23(1):2316.
[19] Li C, Tao T, Tang Y, Lu H, Zhang H, Li Het Al. The Association Of Psychological Stress With Metabolic Syndrome And Its Components: Cross-Sectional And Bidirectional Two-Sample Mendelian Randomization Analyses. Front Endocrinol (Lausanne). 2023 Dec 8;14:1212647
[20] Riaz M, Shah G, Asif M, Shah A, Adhikari K, Abu-Shaheen A. Factors Associated With Hypertension In Pakistan: A Systematic Review And Meta-Analysis. Plos One. 2021 Jan 29;16(1):E0246085.
[21] Jareebi Ma. The Association Between Smoking Behavior And The Risk Of Hypertension: Review Of The Observational And Genetic Evidence. J Multidiscip Healthc. 2024 Jul 10;17:3265-3281.
[22] Ninomiya Y, Kawasoe S, Kubozono T, Tokushige A, Ichiki H, Salim Aa Et Al. Association Between Weight Gain Following Smoking Cessation And Development Of Hypertension In The Future. Hypertens Res. 2024 May;47(5):1167-1174.
[23] Cecchini M, Filippini T, Whelton Pk, Iamandii I, Di Federico S, Boriani G Et Al. Alcohol Intake And Risk Of Hypertension: A Systematic Review And Dose-Response Meta-Analysis Of Nonexperimental Cohort Studies. Hypertension. 2024 Aug.
[24] Drenjančević-Perić I, Jelaković B, Lombard Jh, Kunert Mp, Kibel A, Gros M. High-Salt Diet And Hypertension: Focus On The Renin-Angiotensin System. Kidney Blood Press Res. 2011;34(1):1-11.
[25] Laatikainen T, Nissinen A, Kastarinen M, Jula A, Tuomilehto J. Blood Pressure, Sodium Intake, And Hypertension Control: Lessons From The North Karelia Project. Glob Heart. 2016 Jun;11(2):191-9.
[26] Mathur P, Kulothungan V, Leburu S, Krishnan A, Chaturvedi Hk, Salve Hr Et Al. National Noncommunicable Disease Monitoring Survey (Nnms) In India: Estimating Risk Factor Prevalence In Adult Population. Plos One. 2021 Mar 2;16(3):E0246712.
[27] Ministry Of Health And Prevention, Uae National Health Survey Report 2017–2018. Statistics & Research Center (Sarc). (Uae 2019).

[28] Faulkner Jl. Obesity-Associated Cardiovascular Risk In Women: Hypertension And Heart Failure. Clinical Science. 2021 Jun;135(12):1523-44.
[29] Mezhal F, Oulhaj A, Abdulle A, Aljunaibi A, Alnaeemi A, Ahmad A Et Al. High Prevalence Of Cardiometabolic Risk Factors Amongst Young Adults In The United Arab Emirates: The Uae Healthy Future Study. Bmc Cardiovasc Disord. 2023 Mar 15;23(1):137. Doi: 10.1186/S12872-023-03165-3. Pmid: 36922773; Pmcid: Pmc10015775.
[30] Meher M, Pradhan S, Pradhan Sr. Risk Factors Associated With Hypertension In Young Adults: A Systematic Review. Cureus. 2023 Apr;15(4).
[31] Singh S, Shankar R, Singh Gp. Prevalence And Associated Risk Factors Of Hypertension: A Cross-Sectional Study In Urban Varanasi. International Journal Of Hypertension. 2017;2017(1):5491838.
[32] Shrestha Db, Budhathoki P, Sedhai Yr, Baniya A, Lamichhane S, Shahi M, Et Al. Prevalence, Awareness, Risk Factors And Control Of Hypertension In Nepal From 2000 To 2020: A Systematic Review And Meta-Analysis. Public Health In Practice. 2021 Nov 1;2:100119.
[33] Sarki Am, Nduka Cu, Stranges S, Kandala Nb, Uthman Oa. Prevalence Of Hypertension In Low-And Middle-Income Countries: A Systematic Review And Meta-Analysis. Medicine. 2015 Dec 1;94(50):E1959.
[34] Meiqari L, Essink D, Wright P, Scheele F. Prevalence Of Hypertension In Vietnam: A Systematic Review And Meta-Analysis. Asia Pacific Journal Of Public Health. 2019 Mar;31(2):101-12.
[35] Maximova, Katerina, O'loughlin, Jennifer, Paradis, Gilles Et Al. Changes In Anthropometric Characteristics And Blood Pressure During Adolescence. Epidemiology 21(3):P 324-331, May 2010.
[36] Han B, Chen Wz, Li Yc, Chen J, Zeng Zq. Sleep And Hypertension. Sleep And Breathing. 2020 Mar;24:351-6.
[37] Liew Jk, Cheong Xp, Law L, Teo Wh, Eng Ss, Ngim Cf, Et Al. Prevalence And Factors Associated With Hypertension Among Adolescents In Malaysia. Iium Medical Journal Malaysia. 2019 Apr 1;18(1):55-63.
[38] Drury Er, Wu J, Gigliotti Jc, Le Th. Sex Differences In Blood Pressure Regulation And Hypertension: Renal, Hemodynamic, And Hormonal Mechanisms. Physiological Reviews. 2024 Jan 1;104(1):199-251.
[39] Vriend Em, Galenkamp H, Van Valkengoed Ig, Van Den Born Bj. Sex Disparities In Hypertension Prevalence, Blood Pressure Trajectories And The Effects Of Anti-Hypertensive Treatment. Blood Pressure. 2024 Dec 31;33(1):2365705.
[40] Liew Sj, Lee Jt, Tan Cs, Koh Ch, Van Dam R, Müller-Riemenschneider F. Sociodemographic Factors In Relation To Hypertension Prevalence, Awareness, Treatment And Control In A Multi-Ethnic Asian Population: A Cross-Sectional Study. Bmj Open. 2019 May 1;9(5):E025869.
[41] Cameron Js, Hicks J, Carl G. Frederick Akbar Mahomed And His Role In The Description Of Hypertension At Guy's Hospital. Kidney International. 1996 May 1;49(5):1488-506.
[42] Brown Gh (Editor): Munk's Roll Of The Fellows Of The Royal College Of Physicians Of London. Vol. Jv 1826—] 925. Sir William Withy Gull, Royal College Of Physicians, London, 1955, Pp 167—168
[43] Gautham U, Patil A, Hemanth G. Formulation And Evaluation Of Nanoparticle Drug Delivery System For Treatment Of Hypertension. Int J App Pharm. 2023;15(6):90-7.
[44] Duyen Thi My Huynh, Truong Phu Vinh, Tran Dung Tam, Minh-Ngoc T. Le, Phuoc-Vinh Nguyen. Development And Optimization Of Coated Tablet Containing Amlodipine And Valsartan For Hypertension Treatment. International Journal Of Applied Pharmaceutics. 2024; 114-120.
[45] Valishetti Manoj Kumar, Yasarapu Madhu, Monica N., Lingampally Suvid, Nagur Sharone Grace. (2022). To Evaluate The Safety And Efficacy Of Amlodipine And Chlorthalidone In Combination With Telmisartan In Hypertensive Patients Attending Tertiary Care Centre, Telangana. International Journal Of Pharmacy And Pharmaceutical Sciences. 2022; 37-42.
[46] Mehra Ra, Aanchal Ks, Kalsi Sp, Gautam Sp. Hypertension In Relation To Immune System And Way Of Life Along With Treatment. Int J Curr Pharm Sci. 2021;13(6):1-0.