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PREVALENCE OF HYPERTENSION AND ITS DETERMINANTS AMONG INDIAN ADULTS: A META-ANALYSIS

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ABSTRACT

Hypertension is a major public health concern in India and a leading risk factor for cardiovascular morbidity and mortality. Despite multiple community-based studies, evidence on its pooled prevalence and associated risk factors remains fragmented. The present study aimed to estimate the pooled prevalence of hypertension and identify associated risk factors among the adult Indian population through a systematic review and meta-analysis. A comprehensive literature search was conducted using PubMed, Google Scholar, Scopus, and other electronic databases for studies published between 2020 and 2025. Community and institution-based cross-sectional studies reporting hypertension prevalence among adults (≥18 years) in India were included. A random-effects meta-analysis model was applied to estimate pooled prevalence, and heterogeneity was assessed using the I^2 statistic. A total of 53 studies comprising 45,646 participants from different regions of India were included in the analysis. The pooled prevalence of hypertension was estimated at 31.02% (95% CI: 26.38-35.66). Substantial heterogeneity was observed across studies (I^2 = 98.76%), reflecting variations in population characteristics, geographic regions, and study settings. Increasing age, male sex, tobacco use, alcohol consumption, high salt intake, overweight and obesity, physical inactivity, family history of hypertension, and co-morbid conditions such as diabetes were consistently identified as significant risk factors. The findings indicate that nearly one-third of the adult population in India is affected by hypertension, highlighting a significant and growing public health burden. Strengthening population-based screening, promoting lifestyle modification, and improving awareness and management of hypertension through primary healthcare services are essential to reduce the burden of cardiovascular diseases among adults in India.

KEYWORDS: Hypertension, Socio-Demographic Lifestyle factors, Indian Adults, Meta-Analysis.

INTRODUCTION

Non-Communicable Diseases (NCDs) like hypertension (HTN), diabetes and cancers pose a significant burden for global population and needs an immediate action.[1] Being one of the most significant NCDs, HTN affects 1.13 billion people worldwide and referred as 'silent killer',[2,3,4], hence, it is one of the leading targets to reduce the hypertension prevalence by 33% between 2010 to 2030.[5] HTN is considered as a pathological condition, generally characterized by abnormally high arterial blood pressure (BP)[6] and defined as a systolic blood pressure ≥140mmHg and/or diastolic blood pressure ≥90 mmHg.[7] It is found to be associated with both modifiable and non-modifiable risk factors; some mentionable modifiable risk factors are unhealthy diets, physical inactivity, smoking and alcohol consumption and excessive salt intake while, the important non-modifiable factors are age, family history of HTN and genetic predisposition.[3] HTN as one of the most common Non-Communicable diseases, regarded as leading cause of death.[8,9] HTN stands in seventh place in causing premature death in developed countries and fourth in developing countries.[2,10,11,12] It is adequately controlled only in less than one-third of the effected

individuals, not only in developing but also in the developed countries.[7,13] As per the National Family health survey-5 (NFHS-5) data, nationally 21% of women and 24% of men under ≥15 years have hypertension and the rate of pre-hypertension was 39% and 49% among the mentioned age group females and males respectively[4,14] and the prevalence of hypertension among women in rural India is 20.2%, and among men, it is 22.7%.[15] Occurrence of HTN is much higher among women in comparison to men due to some additional internal stressors experienced by them.[11] According to the 2023 World Health Organization report on HTN, the global prevalence was 34% in males and 32% in females (with an overall 33% prevalence), which estimated to cause 7.5 million annual deaths worldwide.[9]

People being hypertensive remains unaware due to absence of any warning signs and symptoms; it is one of the important risk factors for renal failure, cardio-vascular disease and stroke.[4,16,17] The prevalence of HTN found to be declined in many high-income countries but rise could be observed in middle and low-income countries including India, as the rates of awareness, treatment and control programs are lower than the proposal targets by WHO.[18] HTN is a multifaceted medical condition that also impacts not only population health but also the Indian healthcare system.[19] It is found to be attributed to 1.63 million deaths in India in the year 2016.[20] Rapid urbanization, lifestyle transition and social development are some of the major reasons for high prevalence of HTN in India.[21] Some psychological factors such as, anxiety and depression that have been shown to be associated with developing and/or worsening of hypertension, yet not been explored extensively till date.[22] Except these, poor control of BP and increased healthcare expenses are caused in part by low health literacy and negligence in self-care and low adherence to treatment plans in India.[19] Due to the growing prevalence of HTN among the population, India was the first country to adopt the global Non-Communicable Disease Action Plan in 2014 with a target to reduce 25% in HTN prevalence by 2025.[14] Several studies reported diet, BMI, adiposity, physical activity[2,10,14,23,24,25] and lifestyle factors[4,7,8,23,24,26,27,28,29,30] influence the hypertension levels among adult Indian men and women. In India, HTN has been identified as one of the five major risk factors contributing to disability-adjusted life years (DALY) with an increase in the prevalence from 1990-2016.[31] Studies not only showed the gender difference for HTN prevalence among the Indian population rather residential difference based in urban-rural setting was also found.[14,32] Traditionally, the prevalence of HTN was found to be higher among the urban population (due to more sedentary lifestyles, diet patterns and greater stress), but this scenario changed with the modern transition and the gap of urban-rural HTN prevalence become narrowing with time.[14,28]

Meta analyses provide an opportunity to synthesize evidence from multiple studies to generate more precise and reliable estimates. Although a few earlier meta-analyses have examined hypertension prevalence in India, many have included older studies or limited geographical coverage. In recent years, a large number of community-based studies have been conducted across diverse regions of India, reflecting current epidemiological realities. A comprehensive synthesis of this recent evidence is essential for informing public health planning, monitoring national NCD targets, and designing context-specific interventions. With this background this article will generate- a) national pooled estimates of HTN (both prevalence and associated factors); b) highlights regional disparities in India (based on last five years studies).

MATERIALS AND METHODS

Meta-analysis is a part of systematic reviews; a path for efficiently joining qualitative and quantitative data from a few studies to create one conclusion that has more prominent statistical power. This conclusion is statistically more grounded than the analysis of a study; expanded quantities of subjects, there will be more noteworthy, assorted variety among subjects, or collected impacts and results.[33,34]

Study Design

The present review is sectional in nature, systematically gathering information on prevalence of hypertension and its associated factors in India by using the subsequent key words were hypertension, adults, socioeconomic demographic determinants, associated lifestyle factors, India. The analysis was divided into two parts. Aggregated data were utilized to see the pooled prevalence as well as the associated factors of HTN among the adult Indian population based on the last 5 years data (2020-2025). A total of 53 studies were found to fit the criteria hence those 53 studies were analysed for the present review. Out of these 53 studies, 34 studies also depicted various associated factors hence adopted for this review.

Inclusion and Exclusion Criteria

Studies were included if they met the following criteria: (i) conducted among adult populations (≥18 years) in India; (ii) reported prevalence of hypertension based on standard diagnostic criteria; and (iii) published in English between 2020 and 2025. Studies focusing exclusively on pregnant women, children, or patients with specific diseases, as well as review articles, editorials, and case reports, were excluded.

Data searching and Meta-analysis

The relevant studies were searched in various search engines as PubMed/Medline, Google scholar, Web of Science, Google, Research Gate, etc. The period of the selected reviewed articles was from 2020 to 2025. The statistical method applied to estimate the overall prevalence of hypertension among the adult Indian

population in MedCalc software. Heterogeneity (Cohran's Q & I^2 statistic) and publication biases were also performed following standard statistical methods. The p value less than 0.05 (0.10 for I^2) is considered as statistically significant.

RESULTS

Total sample size for the present review varied from 30 to 7035, and in most of the studies individuals aged ≥18 years. Table 1 presents details of 53 studies included in the present review paper. The overall studied individuals were 45646. It shows with proportion, 95% CI and Weight (%). The total prevalence of hypertension was 31.02% for random effects (95% CI: 27.19-34.38). The high heterogeneity observed among studies (Q = 4187.61, df = 52, p < 0.0001; I^2 = 98.76%) justified the use of the random-effects model. The lowest confidence interval found for the Tertiary care centre of Rajasthan[35] and highest confidence interval found for the individual of Uttar Pradesh.[24] The heterogeneity of the study is higher than 75% (I^2), so we took a random effect model. According to Egger's and Begg's test the pooled analysis indicated that there was no publication bias. The lowest prevalence of hypertension was reported by Jaipal et al., 2020 (8.0%)[35] and highest prevalence was reported by Prajapati et al., 2024 (69.4%).[24] Table 1 shows the details of study area, population, age in years, and sample size with reference.

Table 1: Studies related to Hypertension among Adult Indian population (both men & women) with age, sample size and Prevalence.

Study Area	Population (type)	Age (years)	Sample Size	Prevalence (%)	95% CI	Weight (%)		References
						Fixed	Random	
Arunachal Pradesh	Wancho Tribe	20-60	318	17.3	13.303 to 21.910	0.70	1.88	Basumatary & Begum, 2020[36]
Katihar, Bihar	Rural (tribal)	≥18	1800	14.8	6.994 to 9.588	3.94	1.93	Poddar et al., 2020[13]
Katihar, Bihar	Rural (tribal)	≥18	820	15.7	13.192 to 18.278	1.80	1.92	Anand & Hussain, 2020[37]
Maharashtra	Urban	20-45	1950	20.3	18.493 to 22.110	4.27	1.93	Inamdar et al., 2020[38]
Rajasthan	Tertiary care centre	18 and above	150	8.0	4.202 to 13.557	0.33	1.82	Jaipal et al., 2020[35]
Tamil Nadu	Tribal	30 and above	89	16.5	8.875 to 24.982	0.20	1.74	Geetha et al., 2020[17]
Kancheepuram, Tamil Nadu	Rural	25-65	30	30.0	14.735 to 49.396	0.068	1.45	Ajeeth et al., 2020[7]
Medak, Telengana	Rural	<20 and above	7035	24.0	23.000 to 25.010	15.40	1.94	Wassey et al., 2020[39]
Rishikesh, Uttarakhand	Urban	>19-60	478	32.4	28.045 to 36.612	1.05	1.90	Dakshinamurthy et al., 2020[10]
Singur, West Bengal	Rural	≥20	651	26.1	22.777 to 29.668	1.43	1.91	Saha et al., 2020[40]
Puducherry	Sanitary workers	18 and above	311	36.6	31.290 to 42.279	0.68	1.88	Jayaseelan et al., 2020[26]
Barmer, Rajasthan	Rural	30 and above	300	22.0	17.443 to 27.120	0.66	1.88	Godara et al., 2021[20]
Udaipur, Rajasthan	Factory workers	20 and above	456	31.1	26.915 to 35.613	1.00	1.90	Khatri et al., 2021[41]
West Bengal	Santal	>18	472	22.9	19.166 to 26.941	1.04	1.90	Das et al., 2021[42]
Kashmir	Tribal	20-109	4038	41.4	39.857 to 42.919	8.84	1.94	Ganie et al., 2021[31]
Vellore, Tamil Nadu	Tribal	>40	502	36.4	32.042 to 40.631	1.10	1.90	Shriraam et al., 2021[43]
Puducherry	Urban	18-69	1686	63.1	60.694 to 65.358	3.69	1.93	Lakshmanasamy & Kaur, 2021[44]
Tamil Nadu	Rural	30-60	204	29.4	23.255 to 36.178	0.45	1.85	Prageetha et al., 2021[45]
Paschim Medinipur, West Bengal	Rural	>18	805	36.8	33.431 to 40.207	1.76	1.92	Chanak & Bose, 2021[46]
Chittor, Andhra Pradesh	Rural	18 and above	1742	21.5	19.562 to 23.474	3.81	1.93	Udayar et al., 2021[23]

South Gujarat	Rural	30 and above	738	41.7	38.148 to 45.387	1.62	1.92	Damor & Mehta, 2021[2]
Tiruvandrum, Kerala	-	30-60	1710	27.3	25.209 to 29.489	3.74	1.93	Cao et al., 2021[22]
Cuttak, Odisha	Tribal	18 and Above	832	16.7	14.233 to 19.418	1.82	1.92	Giri et al., 2022[16]
Port Blair, Andaman	Bhantu community	18-60	305	26.6	21.686 to 31.890	0.67	1.88	Mukherjee et al., 2022[47]
Varanasi, Uttar Pradesh	Rural	25-64	425	31.5	27.136 to 36.182	0.93	1.90	Mishra, 2022[27]
Gandhinagar, Rajasthan	Urban	30 and above	328	23.2	18.432 to 27.798	0.72	1.88	Bardhar et al., 2022[6]
Bagalkot, Karnataka	Urban	20-40	420	17.9	14.313 to 21.862	0.92	1.90	Sidenur& Shankar, 2023[12]
Bastar, Chhattisgarh	Tribal	25-60	330	47.3	41.780 to 52.815	0.72	1.88	Meshram et al., 2023[48]
Dimapur, Nagaland	Urban (tribal)	30-60	660	25.9	22.605 to 29.431	1.45	1.91	Sanglir et al., 2023[8]
Raipur, Chhattisgarh	Urban	30 & above	422	24.2	20.161 to 28.547	0.93	1.90	Krishna et al., 2023[28]
Rural Andhra Pradesh	Tertiary Care Hospital	30 and above	300	27 .0	22.059 to 32.402	0.66	1.88	Daniyala et al., 2024[49]
Northern Coast, Andhra Pradesh	Tertiary Care Centre	30-45	310	50.0	44.296 to 55.704	0.68	1.88	Prasad et al., 2024[50]
Gujarat	Tertiary care centre	18 and above	732	60.2	56.459 to 63.678	1.60	1.92	Hirani et al., 2024[51]
Nagaon, Assam	Tea Tribal Community	25 and above	384	25.5	21.233 to 30.190	0.84	1.89	Das & Sahoo, 2024[52]
Thrissur, Kerala	Tribal	18-69	206	48.0	41.064 to 55.109	0.45	1.85	Aswin et al., 2024[30]
Bhopal, Madhya Pradesh	Urban+Suburb	20-40	1000	21.9	19.372 to 24.594	2.19	1.92	Jain et al., 2024[19]
Manipur	Tribal	20-79	416	23.6	19.560 to 27.936	0.91	1.90	Thanglen et al., 2024[53]
Etawah, Uttar Pradesh	Teaching Institution	18 and above	392	69.4	64.564 to 73.916	0.86	1.89	Prajapati et al., 2024[24]
Puducherry	Rural	40-75	1000	25.0	22.343 to 27.805	2.19	1.92	Malathy & Gomathy, 2024[54]
Tangra, (Kolkata), West Bengal	Urban	45-59	100	32.0	23.022 to 42.077	0.22	1.76	Patra et al., 2024[55]
Salem, Tamil Nadu	Rural	18 and above	382	62.0	56.700 to 66.676	0.84	1.89	Radhakrishnan et al., 2024[29]
Murshidabad,West Bengal	-	18-67	2000	33.5	31.432 to 35.617	4.38	1.93	Rahaman & Panigrahi, 2025[18]
Jalaun, Uttar Pradesh	Rural+Urban	30-60	1600	16.3	14.534 to 18.216	3.50	1.93	Thomas et al., 2025[14]
Rajkot, Gujarat	Hospital Nurse	20-59	360	16.4	12.716 to 20.625	0.79	1.89	Jena et al., 2025[56]
Patna, Bihar	School teacher	≤30 & above	1283	14.1	38.368 to 43.824	2.81	1.93	Kumar et al., 2025[25]
Patna, Bihar	Rural	>19	840	24.5	21.648 to 27.579	1.84	1.92	Ranjan et al., 2025[4]
Deoghar, Jharkhand	Tertiary care centre	>18	416	33.4	28.893 to 38.172	0.91	1.90	Ranjan et al., 2025[57]
Ernakulam, Kerala	Rural+Urban	>30	1110	49.8	46.747 to 52.714	2.43	1.92	Ajay et al., 2025[3]
Manipur	Rural+Urban	18 and above	392	34.9	29.986 to 39.635	0.86	1.89	Rajkumari et al., 2025[58]
Shillong,	Urban	18-25	274	17.9	13.533 to	0.60	1.87	Sundaram et al.,

Meghalaya					22.944			2025[1]
Ludhiana, Punjab	Rural+Urban	20and above	992	62.0	58.893 to 65.028	2.17	1.92	Singh et al., 2025[59]
Jaisalmer, Rajasthan	Tribal	18 and above	150	55.3	47.007 to 63.445	0.33	1.82	Kalam & Pal, 2025[60]
Pali, Rajasthan	Semi-urban+Rural	18 and above	1000	31.2	28.337 to 34.174	2.19	1.92	Mathur et al., 2025[61]
Total (Fixed effect)	Overall	-	45646	30.26	29.845 to 30.690	100.00	100.00	
Total (Random effect)	Overall	-	45646	31.02	27.195 to 34.985	100.00	100.00	

Figure 1 shows the forest plot of meta-analysis of proportion of hypertensive adult population of different states and UTs in India. The width of the diamond shows the 95% confidence interval for the overall estimate. Each horizontal line represents an individual study with the result plotted as a box and the 95% confidence interval of the result displayed as the line. The diamond at the bottom of the forest plot shows the result when all the individual studies are combined and averaged. The horizontal points of the diamond are the limits of the 95% confidence intervals and are subject to the same interpretation as any of the other individual studies on the plot. The funnel plot displayed the Meta analysis in a plot of effect size against the sample size (Figure 2).

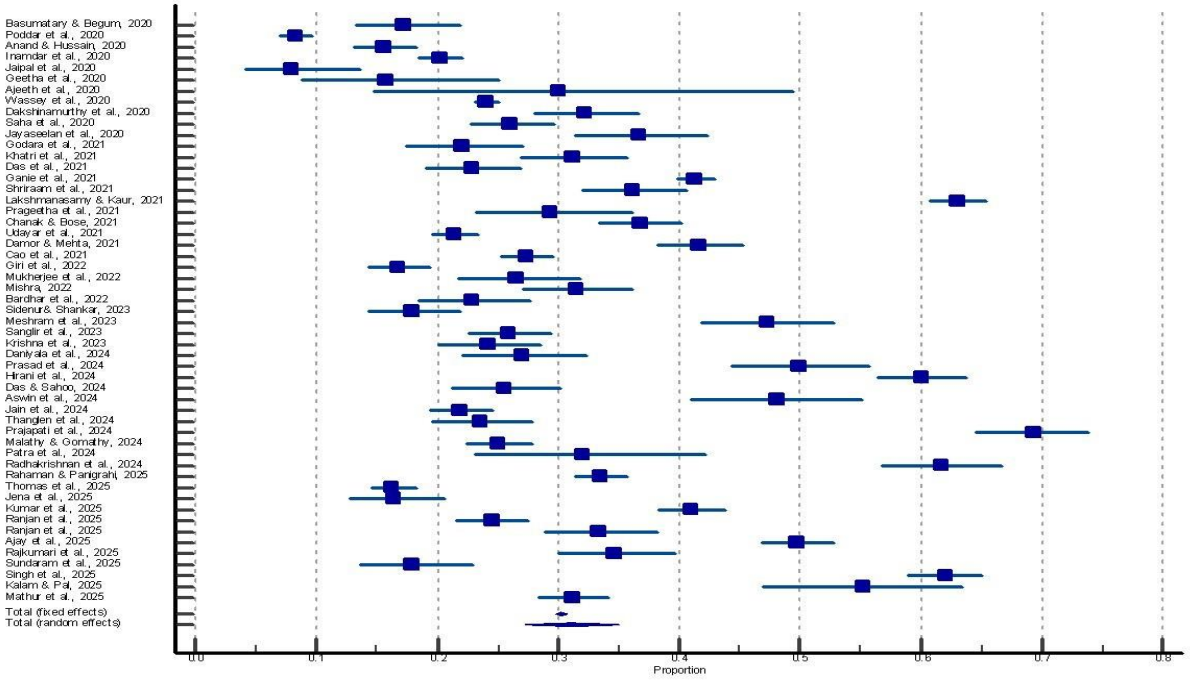

Figure 1: The forest plot of meta-analysis of proportion among hypertensive adult population of different states and UTs in India.

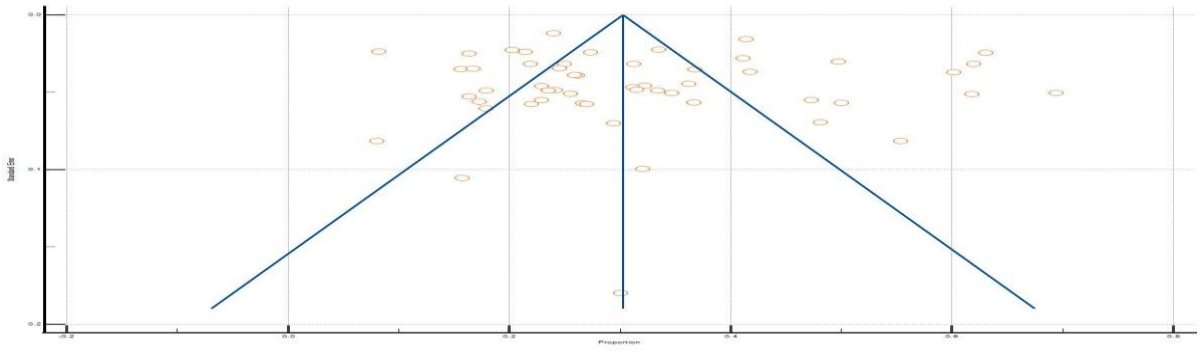

Figure 2: The funnel plot displayed the Meta analysis in a plot of effect size against the sample size.

Table 2 shows study area, population, reference along with the associated factors influencing hypertension among men and women of various states and UTs of India. There were 34 studies reviewed; only the significant associated factor of hypertension among adults was reported in the table.

Table 2: Associated risk factors of Hypertension among adult Indian Population (from different states and/or UTs).

Study Area		Population (type)	Associated Factors	References
1	Katihar, Bihar	Rural (tribal)	Age, additional salt intake, smoking, drinking alcohol, being male	Anand & Hussain, 2020 [37]
2	Maharashtra	Urban	Age, occupation, SES, family history of HTN, sedentary lifestyle, smoking, smokeless tobacco and alcohol consumption	Inamdar et al., 2020 [38]
3	Kancheepuram, Tamil Nadu	Rural	Obesity, excessive salt intake, alcoholism, smoking, physical activity	Ajeeth et al., 2020 [7]
4	Medak, Telengana	Rural	Age, gender, education	Wassey et al., 2020 [39]
5	Rishikesh, Uttarakhand	Urban	Age, WC, BMI, triglycerides level, physical activity	Dakshinamurthy et al., 2020 [10]
6	Singur, West Bengal	Rural	Religion (being Muslim), education, tobacco usage, obesity and sedimentary lifestyles	Saha et al., 2020 [40]
7	Puducherry	Sanitary workers	Age, marital status, obese, current tobacco users, alcohol users	Jayaseelan et al., 2020 [26]
8	Barmer, Rajasthan	Rural	Age, gender, overweight, monthly income	Godara et al., 2021 [20]
9	Udaipur, Rajasthan	Factory workers	Age, duration of service, rank, education	Khatri et al., 2021 [41]
10	Bankura, West Bengal	Tribal	Age, family type, nutritional status	Das et al., 2021 [42]
11	Kashmir	Tribal	Higher age, male gender, lower SES, lower education level, unemployment	Ganie et al., 2021 [31]
12	Vellore, Tamil Nadu	Tribal	Age, sex, BMI, WC, diabetes mellitus	Shriraam et al., 2021 [43]
13	Tamil Nadu	Rural	Diabetes mellitus, salt intake, sedentary lifestyle, stress, family history of HTN, disturbed sleep pattern	Prageetha et al., 2021 [45]
14	Chittor, Andhra Pradesh	Rural	Age, gender, marital status, BMI, abdominal obesity, tobacco, smoking, physical activity	Udayar et al., 2021 [23]
15	South Gujarat	Rural	Age, family history of HTN, increase salt intake, consuming mixed diet, WC, WHR, BMI	Damor & Mehta, 2021 [2]
16	Kerala	Rural	Demographic factors, behavioral factors, anthropometric, psychosocial factors, clinical measures	Cao et al., 2021 [22]
17	Cuttak, Odisha	Tribal	Tribe type, age range, tobacco use, marital status, stress, extra salt intake	Giri et al., 2022 [16]
18	Varanasi, Uttar Pradesh	Rural	Age, marital status, educational status, occupational status, socioeconomic class, family size, type of family, tobacco consumption, alcohol	Mishra, 2022 [27]

			consumption, WC, WHR, BMI	
19	Bagalkot, Karnataka	Urban	Age, marital status, family type, family history, tobacco chewing, stress and BMI	Sidenur& Shankar, 2023 [12]
20	Dimapur, Nagaland	Urban (tribal)	Male, older age, family history of HTN, alcohol consumption, perceived stress, load of participation in stress relief activities, overweight/obesity	Sanglir et al., 2023 [8]
21	Raipur, Chhattisgarh	Urban	Elderly age, male gender, daily tobacco use, greater WC, daily salt intake(>5 g)	Krishna et al., 2023 [28]
22	Andhra Pradesh	Rural	Age, education, SES, BMI, smoking, intake of alcohol, family history of HTN, salt consumption	Daniyala et al., 2024 [49]
23	Thrissur, Kerala	Tribal	Education, work status, tobacco use, alcohol use, physical activity, BMI, obesity, diabetes	Aswin et al., 2024 [30]
24	Bhopal, Madhya Pradesh	Urban+Suburban	Age, education, occupation, SES, tobacco and alcohol consumption, smoking	Jain et al., 2024 [19]
25	Etawah, Uttar Pradesh	Teaching Institution	Tobacco and alcohol, obesity, physical inactivity, stress and strain, unhealthy diet	Prajapati et al., 2024 [24]
26	Tangra, (Kolkata), West Bengal	Urban	Occupation, family history and BMI	Patra et al., 2024 [55]
27	Salem, Tamil Nadu	Rural	Older age, obesity, employment, diabetes, alcohol consumption, lack of physical activity	Radhakrishnan et al., 2024 [29]
28	Murshidabad, West Bengal	-	Age, sex, marital status, level of education, occupation, and income	Rahaman & Panigrahi, 2025 [18]
29	Jalaun, Uttar Pradesh	Rural+Urban	Urban residents, non-veg diet, high salt intake and use of extra salt	Thomas et al., 2025 [14]
30	Rajkot, Gujarat	Hospital Nurse	Age, work experience, marital status, WHR, BMI, diabetes mellitus	Jena et al., 2025 [56]
31	Patna, Bihar	School Teacher	Gender, age, dietary practice, fast food consumption, tobacco use, physical activity, BMI	Kumar et al., 2025 [25]
32	Patna, Bihar	Rural	Age, family history of HTN, tobacco chewing, obesity and salt consumption	Ranjan et al., 2025 [4]
33	Deoghar, Jharkhand	Tertiary care centre	Family history of HTN, non-veg diet, cigarette smoking, coronary artery disease	Ranjan et al., 2025 [57]
34	Shillong, Meghalaya	Urban	Non-BPL status, obesity and smoking	Sundaram et al., 2025 [1]

Table 3 reveals the possible associated factors responsible for hypertension among the adult Indian population. Age (67.64%) was a highly significant associated factor among all variables following tobacco use, alcohol consumption and smoking.

Table 3: Major possible associated factors of Hypertension in the previous studies.

Associated Factors	Percentage of Studies
Age	67.64
Body Mass Index	38.23
Tobacco Consumption	38.23
Alcohol Consumption	29.41
Overweight and Obesity	26.47
Education	23.53
Family History	23.53
Salt Intake	23.53
Gender	20.58
Smoking	20.58
Diabetes	11.76
SES	11.76

DISCUSSION

The present review summarized the prevalence of HTN among adult individuals of different states and UTs in India for a period of five years (2020 - 2025). Based on 53 community- and institution-based studies encompassing 45,646 individuals from diverse geographical regions and population groups, the pooled prevalence of hypertension was estimated at 31.02% using a random-effects model. The I^2 (98.76%) value indicates that there was a large variation of hypertension in the data set ranging from 8.0% to 69.4%. Similar regional heterogeneity has been documented in the Global Burden of Disease study, which highlighted marked interstate differences in cardiovascular risk factors across India.[62] The present pooled study explores that individuals of higher age group and lifestyle factors like consumer of tobacco, alcohol and smokers were more likely to be hypertensive. Gender disparity causes high prevalence of hypertension; few studies reported men with higher prevalence of hypertension compared to women.[8,28,31,37] Uncontrolled HTN was found to be associated with various adverse health outcomes and increased health care utilization, resulting in a substantial economic burden for individual as well as healthcare system.[51] However, some studies from southern India and urban settings reported comparable or higher prevalence among women, possibly reflecting increasing obesity, physical inactivity, and post-menopausal risk among females.[29,43]

Prevalence of HTN

Both Low and very high prevalence of HTN were reported by previous researches from various parts of India.[13,14,16,17,24,25,29,35,36,37,44,51,56,59,60] A systematic review and meta-analysis from India in 2014[63] among the adult with data from 1950-2013 reported an overall prevalence of 29.8% (95% CI, 26.7%-33.0%), which is less to our findings. Another systematic review and meta-analysis in SAARC countries found a prevalence of 27.0%.[64] A recent systematic review and meta-analysis from India by in 2025 reported a pooled prevalence of 27.2% (23.2%-31.3%).[65] Another recent systematic review and meta-analysis on trends in HTN in Nepal using data between 2000-2025, revealed a pooled prevalence of 32% (95% CI; 23.0%-40.0%) which is comparable to our population.[66] However, these close similarities in prevalence among this region may be due to the genetic similarities as well as modern lifestyle transition.

Regional Variations

Present review used the last five years secondary data (2020-2025) to analyze the pooled prevalence of HTN. Though from this review zone-wise specific prevalence estimation could not be done. Out of these 53 studies 12 studies (22.64%) conducted on rural and 8 (15.09%) studies on urban settings respectively. Six studies (11.32%) were from both urban and rural or urban and semi-urban combination. There were 15 studies (28.30%) conducted on tribal population from both rural and urban perspective. There were 5 studies (9.43%) reported from tertiary care centers, 2 (3.77%) were not specified and 5 (9.43%) were from others category mentioned in table 1. As per the findings the north zone is represented by Punjab, Rajasthan and Kashmir comprises a total of 8 studies, and the highest prevalence was from Rajasthan (55.3%).[60] The south zone is represented by the following states and UTs: Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Telengana and the UT Puducherry respectively, comprises a total of 16 studies fitted for this review and the highest prevalence of HTN (63.1%) was found among the adults of Puducherry.[44] The central zone is represented by Madhya Pradesh, Chhattisgarh, Uttar Pradesh and Uttarakhand comprises a total of seven studies out of the 53 studies included. In this zone the highest prevalence (69.4%) was found by[24] from Uttar Pradesh. The east zone is represented by the states Bihar, Jharkhand, Odisha, West Bengal and one UT Andaman and Nicobar. Most studies were found from West Bengal followed by Bihar, and only one study was reported for other three areas of this zone. The highest prevalence was reported[46] from West Bengal (36.8%) from east zone. The western zone represented a total of 4 studies (3 from Gujarat and 1 from Maharashtra) and the highest prevalence (60.2%) was reported from Gujarat.[51] From the north-east zone, only 6 studies met the criteria from Arunachal Pradesh, Assam, Manipur, Meghalaya and Nagaland. Highest prevalence (34.9%) was reported from Manipur.[58] In case of rural-urban disparities,

highest prevalence of HTN was reported from urban Puducherry (63.1%)[44] followed by rural Tamil Nadu (62.0%).[29] However, the difference is not much significant. The same percentage of HTN prevalence (62.0%) was reported from Punjab.[59] in respect of rural and urban context. A total of 15 studies reported the prevalence of HTN from the tribal communities of India from both the rural and urban area of different states. The highest prevalence of HTN among the tribal adult was reported from Rajasthan [60] and the lowest prevalence was found from Bihar.[13]

Associated Factors

Though the selected studies found almost similar results but some differences also observed. The key findings suggest the major possible associated factors such as age, BMI, tobacco consumption, alcohol consumption, overweight and obesity, education, salt intake, family history of HTN, smoking, gender, diabetes and socio-economic status (SES) (Table 3). Age emerged as the most important non-modifiable risk factor, consistent with physiological changes such as arterial stiffness and cumulative exposure to risk factors.[18,19,20,23,27,37,38,56] Lifestyle factors including tobacco and alcohol use remain major contributors, particularly among men. The association of obesity, high BMI, and salt intake with hypertension highlights the growing impact of nutrition transition and reduced physical activity. Gender also found as an important associated factor for HTN among the Indian adult population. This may be due to the differences in male and female body mechanism because of physiological differences, psychological factors and hormones.[67] Both smoking and smokeless tobacco use were found to increase HTN risk, particularly in rural and tribal populations where tobacco consumption is culturally embedded beside this modernization and market influence also responsible for smoking and tobacco consumption. Studies reported the association between HTN with tobacco use.[4,12,16,19,23,24,25,26,27,28,30,38,40] Regular alcohol intake has been shown to raise blood pressure through increased sympathetic activity. The association between alcohol use and HTN was particularly strong among men and urban residents, reflecting changing social norms and lifestyle patterns. Studies also reported association between HTN with alcohol consumption.[7,8,19,24,26,27,29,30,37,38,49] High dietary salt intake emerged as an important modifiable risk factor. Several studies highlighted the widespread practice of adding extra salt during meals, particularly in rural areas of Indian states.[2,4,7,14,16,28,37,45,49]

Anthropometric factors such as high BMI, obesity, and central adiposity were consistently associated with HTN across studies. Nearly 30% of the studies reported BMI as a significant predictor, while obesity was identified in about one-quarter of the studies. These findings reflect the growing burden of overweight and obesity in India due to nutrition transition, sedentary lifestyles, and increased consumption of processed foods.[30,43] Central obesity, measured using waist circumference and waist–hip ratio, was found to be a particularly strong predictor of hypertension in several studies.[10,23] Most of the studies indicated BMI was a crucial associated factor for HTN.[2,10,12,25,27,30,43,49,55,56] Studies reveals obesity influence the rate of HTN[1,4,7,8,23,24,29,30,40] among adults. The coexistence of obesity and HTN possess a significant challenge for NCD prevention programs, as it increases the risk of cardiovascular morbidity and mortality. Studies reveals HTN among adults and its awareness highly influenced by educational status.[18,19,27,30,31,39,40,41,49] Individuals with a positive family history may have inherited susceptibility as well as shared environmental and behavioural risk factors.[2,8] Family history of hypertensive individual has higher risk of being hypertensive.[12,38,45,49,55,57] Diabetes and HTN are closely interlinked conditions that significantly amplify cardiovascular risk when they coexist, the high prevalence of their co-morbidity observed across Indian population was reported by various regions.[29,30,43,45,56] Few studies observed that SES has significant impact on HTN.[19,31,38,49]

Strengths and Limitations

The findings have important public health implications. The high burden of HTN calls for strengthening population-based screening, early detection, and lifestyle modification strategies under national programs such as the National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS). The present finding highlights HTN as a major public health challenge in India, affecting nearly one in three adults, and underscores the urgent need for strengthened prevention, early detection, and control strategies among the adult Indian population. There are some limitations such as: this review includes findings based on available data from some particular databases; hence studies published in other databases may be overlooked. The pooled prevalence cannot be interpreted as a national average. Also, the inclusion criteria included only cross-sectional studies.

CONCLUSION

This meta-analysis provides updated and comprehensive evidence on the burden of HTN among the adult population in India, demonstrating that nearly one-third of adults are affected by the condition. This systematic review found that the pooled prevalence of HTN among the adult based on last five years data was higher (31%) than the targeted reduction in prevalence of HTN (25%) in India by 2025. The findings reflect the combined influence of demographic transition, urbanization, lifestyle changes, and socioeconomic disparities on the rising burden of HTN. It affects nearly one-third of the adult population in India, with marked variation across regions and population groups. The findings emphasize the urgent need for comprehensive, culturally sensitive, and region-specific prevention and control strategies focusing on lifestyle modification, early diagnosis, and effective management to curb the growing burden of

HTN in India. The insights from present review will help the policymakers in designing targeted interventions, especially for the high-burden regions, comparison of treatment and control rates, also in long-term planning for controlling HTN among the Indian adults.

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