Original Article

Trends of Hypertension and Neurological Diseases in India: A Nationwide Survey Reporting the Distribution Across Geographical Areas

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Sriloy Mohanty[1], Raghuram Nagarathna[2], Kashinath Metri[3], Suchitra Patil[4], Sanjay Kumar[5], Amit Singh[4] and Hongasandra R Nagendra[4]

Abstract

Background: Hypertension has remained an imperative risk factor for cardiovascular and cerebrovascular diseases, increasing the national burden of premature deaths over the decades.

Purpose: There is limited data on the prevalence of hypertension and its distribution across all geographic regions in India. This nationwide survey was conducted in 2017 to assess the prevalence of hypertension and prehypertension among the Indian adults.

Methods: A multilevel stratified cluster sampling technique, with a random selection among the urban and rural populations, was adopted to achieve a sample of 70,031 adults from 24 states and 4 union territories. Blood pressure was measured twice using automated oscillometric machines with a minimum of 3-min gap, and the average was recorded. This was later categorized into prehypertension (elevated blood pressure) and hypertension subgroups as defined by the new 2017 American Heart Association guidelines.

Results: The prevalence of prehypertension and hypertension in our study population across all ages was found to be 18.2% and 24%, respectively. Prehypertension was common at a younger age, whereas the prevalence of hypertension was higher in the older age groups. The urban population (24.4%) and males (24.7%) were positively associated with prehypertension and hypertension. The western zone had the highest prevalence of hypertension, whereas the eastern population had the lowest.

Conclusion: Our study revealed an alarmingly high prevalence of hypertension, accounting up to one hypertensive in every four adults in India. There is a need for more robust national strategies for identifying and treating hypertension to reduce the national and the global burden of hypertension by 25% before 2025.

Keywords

Nationwide survey, Prevalence, Hypertension, Prehypertension

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Introduction

The global action plan endorsed by the World Health Assembly for the prevention and control of noncommunicable diseases (NCDs) in 2013 aimed at a 25% relative reduction in the prevalence of raised blood pressure (BP) to reduce the global burden of premature deaths by 25% before 2025.[1] Hypertension has emerged as the most imperative risk factor for the global disease burden and estimated to contribute to more than 12% of the global deaths.[2] Hypertension is directly responsible for 57% and 24% of mortality because of stroke and coronary heart disease, respectively, in India.[3] India alone accounts for one-fifth of the global premature deaths related

[1] Centre of Integrative Medicine and Research, All India Institute of Medical Sciences, New Delhi, India
[2] Arogyadhama, Vivekananda Yoga Anusandhana Samsthana, Bangalore, Karnataka, India
[3] Department of Yoga, Central University of Rajasthan, Kishangarh, Rajasthan, India
[4] Department of Life Science, Swami Vivekananda Yoga Anusandhana Samsthana, Bangalore, Karnataka, India
[5] Department of Health, Vivekananda Yoga Anusandhana Samsthana, Bangalore, Karanataka, India

Corresponding author:
Sriloy Mohanty, Centre for Integrative Medicine and Research, All India Institute of Medical Sciences, Ansari Nagar, New Delhi 110029, India.
E-mail: sriloy21@gmail.com

to cardiovascular diseases (CVDs).[4] Furthermore, the Indian population tends to develop CVDs a decade earlier in life than the European population.[5] Therefore, the global reduction of cardiovascular and cerebrovascular morbidity and mortality depends significantly on India.[6] Sensing the global pressure and overviewing the larger portion of CVDs contributing to the national NCD burden, the national health policy has earmarked for a 25% reduction of the premature mortality related to CVDs and 80% screening and treatment of hypertension by 2025.[7]

Despite rigorous nationwide health awareness and health approaches, the recent upward trend in hypertension and other CVDs in India has raised a concern regarding the achievement of the sustainable development goals as formulated by the United Nations.[8] Although multiple studies report the prevalence of hypertension about a particular age, gender, or region of the country,[9–12] India still lacks in studies reporting a nationwide systemic evaluation for the prevalence of hypertension. The "global burden of hypertension" study also highlighted the need for national studies representing the hypertension's prevalence in India.[13] The national family health survey was aimed to evaluate the prevalence of hypertension among young and middle-aged men and women using a representative sampling from all over the country. The study reported an overall prevalence of hypertension as 13.6% and 8.8% in men and women, respectively, between the ages of 15 and 59 years. The study also reported a significantly greater prevalence in the urban populations in comparison to the rural.[12] Another study by Geldsetzer et al.. pooled and reported the data from District Level Household Survey-4 and Annual Health Survey.[14] This study also reported an unadjusted prevalence of hypertension as 25.3% (CI [25.0, 25.6]), with a higher prevalence in men as compared to women (23.6%, CI [23.3, 23.8] vs. 27.4%, CI [27.0, 27.7]; $P < .001$). The "great Indian hypertension" survey by Ramakrishnan et al.. reported an overall unadjusted prevalence of hypertension to be 30.7% (CI [30.5, 30.9]) and the one adjusted for the World Health Organization (WHO) reference population to be 32.8%.[15] This alarming rise in the prevalence trend may be attributed to cardiometabolic risk factors of hypertension that are the resultant of the unequal distribution of rapid economic growth and urbanization in India over the past two decades. Understanding this rapid economic growth and rate of urbanization and its impact on the prevalence of hypertension particularly, we premeditated the current survey using the *Niyantrita Madhumeha Bharata Abhiyaan*—India's largest politico-scientific enterprise.[16,17]

Methodology

Study Design and Setting

The current study was a nationwide cross-sectional survey conducted in 2017 using a multilevel stratified cluster sampling technique, with a random selection among the urban and rural populations covering all states and union territories (UTs). The Indian Yoga Association provided the ethical approval to the study, and written consent was obtained before enrolling the subjects for the survey. The detailed methodology has previously been published.[18]

Participants

The study included all men and women above 20 years of age, covering a population of 4,000 per district (50% rural and 50% urban) in the sampling area. Sampling was done at four levels: zones, states, districts, and villages (rural) or towns (urban). To factor the cultural heterogeneity, the country was stratified into seven zones, and within each zone, individual states were considered. A total of 24 most populous states and 4 UTs were included in the survey after excluding the remote or smaller states/UTs for operational reasons. To ensure that district samples within a state were not clustered, we grouped the state into geographical regions and chose a district from each region. Later, from the selected districts, villages with an adult population of about 500 (100 to 175 households) were listed and grouped geographically into north, south, east, and west.

Similarly, the list of urban clusters (towns/cities) in the selected district as per Census 2011 was grouped into four geographic locations. Randomly, urban and rural clusters were included, and all households within the cluster were surveyed. Using the census location map, each sampling unit (villages or census enumeration blocks), and a mapping, a household listing operation was carried out, and consecutive unique numbers were assigned to every household.

The execution of the study was done in two steps. In the first step, information regarding demographic and health status by door-to-door surveys was acquired using a mobile app (*Niyantrita Madhumeha Bharata Abhiyaan*: https://goo.gl/7zBCw1), and in the second step, individuals having hypertension or with a high risk were invited to camps for health checkups.

Blood Pressure Measurement

After collecting demographic details and self-reported health status from the subjects and obtaining their consent, each subject was asked to be seated for at least 10 min. After this, their BP was measured twice by the research staff, using automated oscillometric machines. The average of the two BP measurements was recorded. The new 2017 hypertension classification guideline, as postulated by the American Heart Association, was used to define prehypertension (elevated BP) and hypertension subgroups.

Statistical Analysis

The statistical analysis was carried out using the SPSS statistics 23.0 software to analyze the mean, standard

deviations, and proportions. The distribution of BP across the five classifications [normal, prehypertension (elevated BP; 120 to 129/<80 mmHg), stage 1 hypertension (130 to 139/80 to 89 mmHg), stage 2 hypertension (>140/>90 mmHg), and hypertension crisis (>180/>120 mmHg)], as per the 2017 American Heart Association guidelines,[19] was calculated across different zones, genders, age groups (18 to 34, 35 to 44, 45 to 64, and ≥65 years), body mass index (BMI) categories (18 to 24.9, 25 to 29.9, >30 kg/m^2), and three socioeconomic status groups (low, middle, and high as per the Kuppuswamy scale[20] for the year 2014). A chi-square test was applied to calculate the association of these factors with the hypertension burden. A *P*-value < .05 was considered as significant. A weighted prevalence in overall and subgroups was checked by using the nonresponse rate. An odds ratio (OR) was calculated by using the multinomial logistic regression.

Results

A total of 70,031 subjects (51.9% females, 51.6% urban population) with a mean age of 41.39 ± 13.76 years were surveyed. The mean systolic and diastolic BP were found to be 128.9 ± 19.07 and 84.2 ± 13.33, respectively. Demographic details including age, sex, BMI, mean systolic, and diastolic BP have been tabulated in Table 1. There were statistical differences between the urban and rural populations in all characters. Among males and females, there were similar trends.

Prevalence of Hypertension and Prehypertension

The prevalence of prehypertension and hypertension in our population across all ages was 18.2% and 24%, respectively. There were significant differences in the prevalence of hypertension and prehypertension between males and females (hypertension, 24.77% vs. 23.5%, $P < .001$; prehypertension, 18.7% vs. 17.7%, $P < .001$; Table 2). The prevalence between the rural and urban populations was also statistically different (hypertension, 23.6% vs. 24.4%, $P < .001$; prehypertension, 18.2% vs. 18.2%, $P < .001$).

Table 1. Characteristics of the Study Participants

Characteristics	Rural	Urban	Male	Female	Total	*P*-Value for Area	*P*-Value for Gender
N (%)	33,873 (48.4)	36,158 (51.6)	33,668 (48.0)	36,363 (51.9)	70,031		
Mean age	41.1 ± 13.7	41.6 ± 13.8	42.3 ± 14.1	40.5 ± 13.4	41.3 ± 13.7	< .001	< .001
Mean BMI	24.1 ± 4.66	25.8 ± 4.81	24.4 ± 4.43	24.7 ± 5.04	24.6 ± 4.76	< .001	< .001
BMI (18.5–24.9)	60.8%	51.4%	58.0%	54.1%	55.9%	< .001	< .001
BMI (25–29.9)	27.9%	33.5%	30.9%	30.7%	30.8%		
BMI >30	11.3%	15.1%	11.1%	15.2%	13.2%		
Mean SBP	128.4 ± 19.96	129.3 ± 18.17	130.4 ± 18.46	127.5 ± 19.50	128.9 ± 19.07	<.001	< .001
Mean DBP	83.6 ± 19.34	84.7 ± 13.50	85.1 ± 13.35)	83.38 ± 11.36	84.2 ± 13.33	< .001	.56

Notes: Data as a mean ± standard deviation.

Abbreviations: BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure.

Table 2. Weighted Prevalence of Prehypertension and Hypertension

Categories	Normal	Prehypertension	Hypertension Stage 1	Hypertension Stage 2	Hypertension Crisis	Hypertension Prevalence	*P*-Value
Overall	57.8%	18.2%	9.4%	14.6%	0.2%	24.0%	
Rural	58.2%	18.2%	9.1%	14.6%	0.2%	23.6%	< .001
Urban	57.3%	18.2%	9.8%	14.6%	0.2%	24.4%	
Male	56.6%	18.7%	9.8%	14.9%	0.2%	24.7%	< .001
Female	58.8%	17.7%	9.2%	14.3%	0.2%	23.5%	
Age (18–34)	62.8%	21.1%	8.3%	7.8%	0.1%	16.1%	< .001
Age (35–44)	58.4%	17.9%	9.6%	14.1%	0.2%	23.7%	
Age (45–64)	53.2%	15.9%	10.7%	20.2%	0.4%	30.9%	
Age >65	54.1%	12.8%	9.4%	23.7%	0.3%	33.1%	

(*Table 2 continued*)

(*Table 2 continued*)

Categories	Normal	Prehypertension	Hypertension Stage 1	Hypertension Stage 2	Hypertension Crisis	Hypertension Prevalence	*P*-Value
BMI (18.5–24.9)	57.6%	19.5%	9.6%	13.3%	0.1%	22.9%	< .001
BMI (25–29.9)	56.0%	18.3%	10.2%	15.5%	0.2%	25.7%	
BMI >30	56.0%	18.8%	9.4%	15.7%	0.3%	25.1%	
Lower SES	58.1%	18.8%	9.0%	14.0%	0.2%	23.1%	< .001
Middle SES	59.5%	17.3%	9.3%	13.9%	0.2%	23.2%	
Upper SES	64.1%	5.4%	4.2%	26.3%	0.3%	30.2%	
Central	46.8%	30.4%	9.8%	12.9%	0.1%	22.7%	< .001
East	57.2%	22.9%	10.7%	9.1%	0.1%	19.8%	
J&K	53.2%	21.7%	11.1%	14.1%	0.0%	25.2%	
North	65.6%	9.8%	8.3%	16.3%	0.3%	24.6%	
Northeast	57.2%	18.8%	7.8%	16.2%	0.3%	24.0%	
South	62.2%	13.3%	8.3%	16.2%	0.4%	24.5%	
West	57.0%	15.1%	10.4%	17.5%	0.3%	27.9%	

Notes: Data are represented as percentages unless otherwise indicated.

Abbreviations: BMI: body mass index; SES: socioeconomic status.

Table 3. Associations Between Categories of Hypertension With Characteristics of the Study Population

				95% Confidence Interval	
BP Categories		Sig.	Odds Ratio	Lower Bound	Upper Bound
Pre hypertension	Urban	0.13	1.042	0.988	1.098
	Male	0.27	1.030	0.977	1.085
	Age (35–44)	<0.001	3.295	2.936	3.699
	Age (45–64)	<0.001	2.076	1.846	2.334
	Age >65	<0.001	1.429	1.275	1.601
	BMI (25–29.9)	<0.001	0.884	0.814	0.961
	BMI >30	<0.001	0.882	0.808	0.963
Hypertension	Urban	0.64	1.010	0.968	1.053
	Male	<0.001	0.942	0.903	0.983
	Age (35–44)	<0.001	2.309	2.125	2.509
	Age (45–64)	<0.001	1.542	1.419	1.677
	Age >65	<0.001	1.117	1.032	1.209
	BMI (25–29.9)	0.55	0.980	0.917	1.048
	BMI >30	0.07	0.939	0.875	1.007

The prevalence of prehypertension was higher in the early adulthood, i.e., between the ages of 18 and 34 years, which gradually lowered with increasing age; however, the prevalence of hypertension was contrasting to that of prehypertension. Surprisingly, the prehypertension prevalence was higher in individuals with a BMI of less than 25 kg/m^2; however, the prevalence of hypertension was lowest in these adults. The central zone population had the highest prehypertension prevalence, which was more than three times higher than that in the north zone population of India, which has the lowest prevalence (30.4% vs. 9.8%). The eastern population represented the lowest prevalence of hypertension, and the western showed the highest (19.8% vs. 27.9%).

In the regression analysis, men were significantly associated with hypertension (OR = 0.942, CI [0.903, 0.983], $P < .005$). Subjects with age ≥ 35 years were highly associated with prehypertension (OR = 3.295, CI [2.936, 3.699], $P < .001$) and hypertension (OR = 2.309, CI [2.125, 2.509], $P < .001$). Participants with a BMI of more than 25 kg/m^2 had a higher association with prehypertension (between 25.0 to 29.9 kg/m^2, OR = 0.884, CI [0.814, 0.961], $P < .004$ and >30 kg/m^2, OR = 0.882, CI [0.808, 0.963], $P < .005$) (Table 3).

Discussion

The results of this nationwide cross-sectional survey highlighted the higher prevalence of prehypertension and hypertension in India. Prior to the initiation of the survey, we assumed a higher prevalence of hypertension to be around 42% among non-Hispanic blacks as the impact of the new 2017 American Heart Association guidelines[19] for the diagnosis and treatment of hypertension in India.[21] The prevalence of prehypertension was 18.2% and the prevalence of hypertension was 24.0%. Compared to the other studies,[15,22] our study had a lower prevalence of hypertension in India, and the reason for the same can be attributed to multiple factors. First, there was an equal distribution of males and females and urban and rural representatives in the study population. Second, about 57.6% of the subjects had a BMI below 25 kg/m^2. Our data were in concurrence with the District Level Household Survey-4 and the second update of the Annual Health Survey.[14] A study conducted at All India Institute of Medical Sciences, New Delhi reported a 65% prevalence of hypertension among consecutive stroke patients who were admitted between the years 2012 and 2014.[23] In a country with a population of 1.3 billion, one-sixth of the world population, these numbers in India represent a considerable burden of prehypertensives and hypertensives.[24] This study is the first study to use the new 2017 hypertension classification guidelines among the Indian adults as postulated by the American Heart Association,[19] which may attribute to the lower prehypertension (elevated BP) prevalence in our study. As premeditated, the urban population had a higher disease burden, but the rural areas were not far behind.

Male participants had a higher prevalence of both hypertension and prehypertension than female participants, which is similar to that reported by Ramakrishnan et al..,[15] but the prevalence in male subjects in our study was lower than their report. We also observed a higher prevalence with the higher age categories, which is in line with the previous literature.[15] The elderly had more than double the prevalence of hypertension when compared to the early adulthood population. Simultaneously, the prevalence of prehypertension was lower in the elderly and highest in the young adults. The regression analysis revealed that the urban population had a higher association with prehypertension, the reason being the sedentary lifestyle, high-fat diet, and lack of physical activity. Particularly males showed a higher association with hypertension than females; however, there was no association between males and prehypertension in the regression analysis.

The mean BMI was 24.6 ± 4.76 kg/m^2 in the overall study population, as 60.8% of the Indian population had the ideal body weight as per the WHO guidelines. This population had a lower disease burden than the overweight and obese population; however, the prehypertension was highest in this population. Obesity was strongly associated with the prevalence of prehypertension. The higher socioeconomic population had a lower prevalence of prehypertension, with the highest prevalence of hypertension.

In the current survey, to factor the cultural heterogeneity, the country was stratified into seven zones. All states except the eastern zone had a similar trend in the prevalence of hypertension. The eastern zone had the lowest (19.8%) and the western zone (28%) had the highest prevalence of hypertension when compared to other parts of the country. The higher prevalence of hypertension in the northern region may be attributed to the rapid urbanization of the rural population with consequent lifestyle changes, including the high-fat diet and sedentariness. Similarly, the prevalence of prehypertension was lower in the north and south zone populations, which is in contrast to the previous study reporting the highest prevalence in India.[14,25] Jammu and Kashmir showed a higher prevalence of hypertension as well as prehypertension.

Homogeneous data collection, equal representation from genders and urban and rural populations, prevalence based on different zones, age groups, and BMI are some of the strengths of this survey. Our study was the first study to report the prevalence of prehypertension and hypertension in the Jammu and Kashmir region.

This study had several limitations too. First, dietary salt consumption, psychological stress, physical activity, smoking status, and family history of hypertension were not incorporated in the current analysis. Animal models and alternate models should be tested and confirmed for new hypertensives and its effectiveness.[26–46] Second, most of the study participants, who consented to participate in the survey, were with ideal body weight, which may have limited the population's actual prevalence. Third, in the current study, we have not taken into account the population below the age of 19 years, which can add to the disease burden. Fourth, we have used a standard cut off while measuring the BP for all groups of subjects, which may be a limitation of the current survey.

Conclusion

This study revealed that the prevalence of both prehypertension and hypertension is alarmingly high across various zones in India. Prehypertension was common at a younger age, whereas the prevalence of hypertension was higher in the older age groups. The urban population and males were positively associated with both prehypertension and hypertension. However, there is a need for more robust national strategies for identifying and treating hypertension to reduce the national and global burden of hypertension by 25% before 2025. India may follow the WHO global action plan for the prevention of NCDs, which has advocated for harnessing the potential of traditional and complementary therapies because of their potentially lower costs and greater cultural acceptability.[37]

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Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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ORCID iD

Sriloy Mohanty https://orcid.org/0000-0001-6981-9178

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