

Review Article

Hypertension Epidemiology in India in the Global Context

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ABSTRACT

Hypertension has emerged as the most important cause of death and disability in India as well globally. According to Global Burden of Diseases study, in the year 2017, it led to 1.54 million deaths in India and 10.4 million deaths globally. It also led to 38.1 million disability adjusted life years lost in India and 220.0 million globally. The global burden of hypertension has increased from 594 million patients in 1975 to 1.13 billion in 2015. In the past decades, hypertension burden has shifted from high- and upper-middle income countries to lower-middle income and low-income countries in South Asia and Africa. Hypertension prevalence in South Asian countries ranges from 20-25%. Representative Indian studies have reported hypertension in 25.3% adults, more in men (27.4%) compared to women (20.0%) which translates to 200 million hypertensives in the country. Hypertension awareness, treatment, and control rates are low and less than half of patients with hypertension are on treatment and 10% controlled to target. Policy level and health-system level interventions to prevent and manage hypertension and clinical interventions focused on treatment to targets and adherence to lifestyle and drug therapies is crucial to reduce hypertension related cardiovascular disease burden.

Keywords: Epidemiology, High Blood Pressure, Hypertension, Hypertension control.

INTRODUCTION

Successive Global Burden of Diseases (GBD) and World Health Organization (WHO) reports have identified that cardiovascular diseases (CVD) are the most important cause of mortality as well as disease burden in the world.^{1,2} The GBD study reported that in the year 2017, CVD caused 17.8 million deaths worldwide, loss of 330 million years of

disability adjusted life years (DALY), and 35.6 million years lived with disability (YLD).¹ GBD study has also reported that hypertension or raised systolic blood pressure (BP) is the most important risk factor for global mortality as well disease burden.³⁻⁵ Prospective Urban Rural Epidemiology (PURE) study has reported that about a dozen well known risk factors explain 90% of incident cardiovascular disease in low-, middle, and high-income countries.⁶ It has also established that hypertension (defined as BP ≥ 140 and/or ≥ 90 mmHg or known hypertension on treatment) is the most important CVD risk factor and confers the highest population attributable risk.⁶

In this article, we review epidemiology of hypertension in terms of mortality and disease burden (DALYs) at global, regional, and national levels using data from Global Burden of Diseases study.^{7,8} We then compare secular trends in mean BP and hypertension prevalence across the globe, in South Asia, and in India using data from WHO and other resources.⁹ State-level burden of hypertension in India is then reported using collated data from two national surveys: District Level Health Survey-4 (DLHS-4)/Annual Health Survey (AHS) and National Family Health Survey-4 (NFHS-4).¹⁰⁻¹² We also summarize recent data on hypertension awareness, treatment, and control,^{13,14} and suggest strategies for prevention and control of this epidemic.

GLOBAL BURDEN OF HYPERTENSION

GBD study has estimated mortality and disease burden (DALYs) from high BP in almost all countries of the globe,¹ while Non-communicable Disease Risk Factor Collaboration (NCDRisk) and WHO⁹ have reported prevalence of hypertension estimated from national and regional hypertension epidemiological studies. GBD study

has reported that in 2017, raised systolic BP led to 10.4 million deaths and 220.0 million DALYs. Raised systolic BP is responsible for 18.7% of global all-cause deaths and 25.4% of global non-communicable disease deaths and 8.7% of global all-cause DALYs and 14.1% of global non-communicable disease DALYs.⁷

Hypertension associated mortality and disease burden:

Hypertension associated deaths and DALYs (absolute values and rates/100,000 persons) in the 20 most populous countries have been obtained from GBD website,^{7,8} and are shown in table 1. Also shown is hypertension burden in countries as various levels of socioeconomic development estimated as socio-demographic development index (SDI). The highest absolute burden is in large countries, China and India while the burden/100,000 population is more in more developed countries Russia and Germany. Upper-middle, middle, and lower-middle SDI countries have the largest burden of hypertension related deaths and disability.

Trends in hypertension related mortality from the year

2000 to 2017 are also available in GBD study website.⁷ It has been reported that the highest age-adjusted mortality rate is in Russia. It is also observed that while hypertension related mortality is declining in high-income countries (Russia, USA), it is increasing in middle- and lower-middle income countries (China, India, Brazil, Pakistan, etc.). The mortality rates are low in low-income countries such as Nigeria and Bangladesh. Declining hypertension related mortality and disease burden in high- and upper-middle income countries is due to lower hypertension prevalence in these countries associated with greater hypertension awareness and better treatment and control.¹⁵ On the other hand hypertension prevalence is high and control is poor in most low and lower-middle income countries.^{16,17}

Hypertension prevalence: Hypertension is conventionally defined by systolic BP >140 mm Hg and/or diastolic BP >90 mm Hg according to recent European and British guidelines.^{18,19} The US guidelines have suggested a lower BP cut-off point for diagnosis but the measurement

Table 1: Hypertension (high systolic blood pressure) related mortality and disease burden (DALYs) in 20 most populous countries: Global Burden of Diseases study 2017

Country	Hypertension related deaths		Hypertension related DALYs	
	Annual Deaths	Deaths/100,000	Annual DALYs	DALYs/100,000
China	2542365	180.0	50599426	3582.3
India	1544920	111.9	38100178	2759.8
USA	454347	139.9	8035161	2473.6
Indonesia	427217	165.5	10488195	4063.1
Brazil	230454	108.8	5107773	2411.5
Pakistan	226594	105.7	5651972	2637.6
Nigeria	79219	38.4	1891688	917.9
Bangladesh	157571	100.4	3695323	2353.9
Russia	562933	385.1	10559630	7223.2
Mexico	116441	92.0	2449869	1935.6
Japan	197006	153.5	3054035	2379.2
Philippines	137091	132.5	3446516	3330.9
Ethiopia	34120	33.2	815063	792.2
Egypt	145833	151.1	3767470	3904.8
Vietnam	128963	134.4	2759127	2869.9
Congo	54568	67.5	1360061	1681.5
Germany	204630	245.7	2761696	3315.6
Iran	96839	117.8	1909900	2324.2
Turkey	90629	112.6	1859911	2311.7
France	79550	121.1	1157580	1761.6
High SDI countries	1721808	151.0	27394070	2403.4
Upper-mid SDI countries	2838257	204.6	55496291	4000.2
Middle SDI countries	3041736	145.5	65570914	3137.0
Lower-mid SDI countries	1886365	110.7	45793630	2686.3
Low SDI countries	903826	70.1	22718826	1761.3

DALY: disability adjusted life years; SDI: sociodemographic index

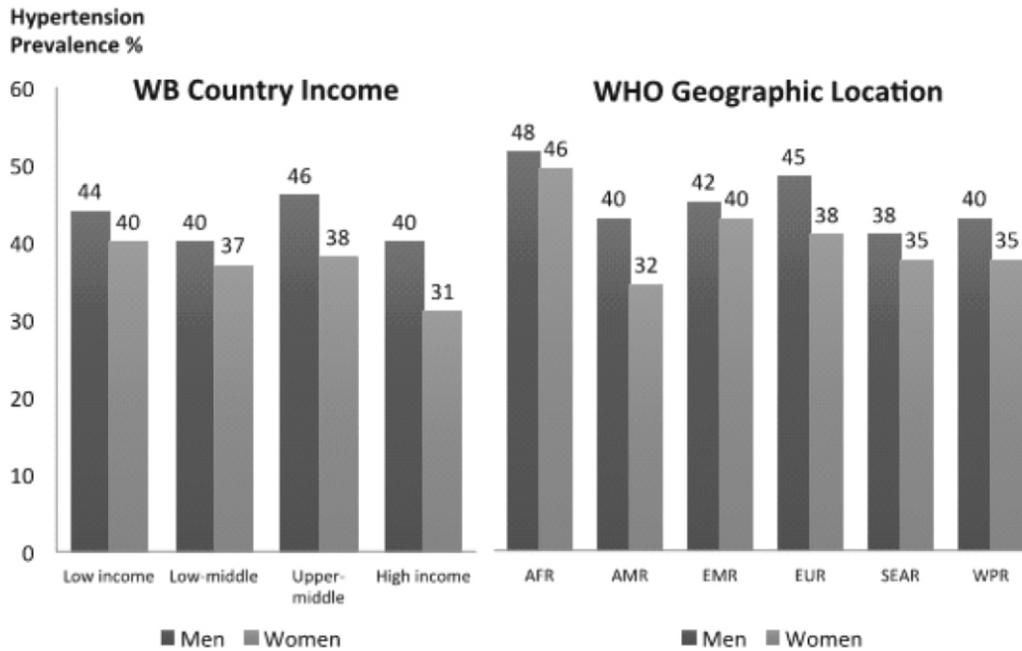


Figure 1: Hypertension prevalence in various countries according to World Bank (WB) income groups and World Health Organization (WHO) geographic regions.²¹

methodology is different.²⁰ Using the conventional criteria, WHO has reported that hypertension prevalence is the highest in low-income countries of Sub-Saharan Africa.²¹ Overall also hypertension is more prevalent in low-income and lower-middle income countries (Figure 1). It is also more prevalent in geographic regions of Africa, Europe (mainly eastern Europe), and Western Pacific region. The greater and increasing prevalence of hypertension in low-income and lower-middle income countries is multifactorial and both- social determinants and individual level risk factors are important.²²

International difference in prevalence of hypertension has also been reported by the PURE study.²³ Cross-sectional data from the study reported that among the 142,042 participants, 35-70 years of age, hypertension was in 57,840 (crude prevalence 40.8%) while age and sex-standardized prevalence of hypertension was 27.7%. Crude prevalence of hypertension was significantly greater in high-income (40.7%), upper-middle income (49.7%), and lower-middle income (39.9%) countries compared to low-income (32.2%) countries. However, prevalence of hypertension adjusted for age, sex, and rural/urban locations was not very dissimilar across high-income (29.7%), upper-middle income (35.8%), lower-middle income (31.7%), and low-income (30.5%) countries.²³ In

the PURE study, low income countries were India, Pakistan, Bangladesh, and Zimbabwe. Less representation of low-income African populations in this study may be a reason for lower prevalence of hypertension in this group compared to the WHO data.²¹

NCD-RisC has reported trends in mean BP and hypertension prevalence using a Bayesian hierarchical model using data from thousands of national and sub-national hypertension prevalence studies.^{24,25} In the 2017 report, national, subnational, or community population-based studies that had measured BP in adults were pooled.²⁵ Trends were estimated from 1975 to 2015 in mean systolic and diastolic BP along with prevalence of hypertension for 200 countries. It was observed that the global age-standardized prevalence of hypertension was 24.1% (95% confidence intervals, CI=21.4-27.1%) in men and 20.1% (CI=17.8-22.5%) in women in 2015. Mean systolic and diastolic BP decreased substantially from 1975 to 2015 in high-income western and Asia Pacific countries, moving these countries from having some of the highest worldwide BP in 1975 to the lowest in 2015. Mean BP also decreased in women in Central and Eastern Europe, Latin America and the Caribbean, and lately in Central Asia, Middle East, and North Africa. By contrast, mean BP increased in East and South-east Asia, South Asia, Oceania, and Sub-

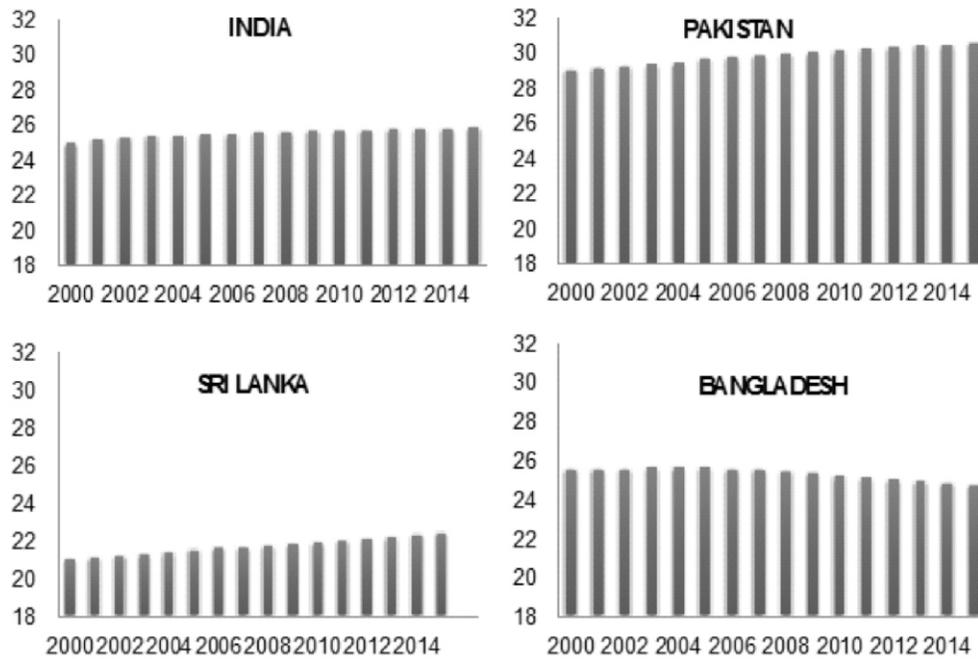


Figure 2: Secular trends in hypertension prevalence (%) in South Asian countries from 2000 to 2015 (Data Source: WHO Global Health Observatory).⁹

Saharan Africa. In 2015, Central and Eastern Europe, Sub-Saharan Africa, and South Asia had the highest BP levels. It was also observed that the prevalence of hypertension decreased in high-income and some middle-income countries while it remained unchanged elsewhere. The number of adults with raised BP increased from 594 million in 1975 to 1.13 billion in 2015, with the increase largely in low-income and middle-income countries. It was concluded that during the past four decades, the highest worldwide BP levels have shifted from high-income countries to low-income countries in South Asia and Sub-Saharan Africa due to epidemiological and other transitions, while BP has been persistently high in Central and Eastern Europe.

HYPERTENSION IN SOUTH ASIA AND INDIA

Indian State Level Disease Burden Initiative,²⁶ as well as Million Death Study in India,²⁷ have identified that cardiovascular diseases are the most important cause of non-communicable disease mortality and disease burden in India. Reviews have reported that hypertension is the most important risk factor.²⁸

Hypertension-related disease burden: Hypertension is highly prevalent in South Asian countries and leads to

considerable hypertension related mortality and morbidity (Table 1). The GBD studies have estimated importance of various risk factors for disease incidence in this region including India. Estimates in the GBD 2017 have reported that annual hypertension related deaths are high in this region with majority of deaths occurring in India (1,544,920), Pakistan (226,594), and Bangladesh (157,571). The disease burden (DALYs) is also high (Table 1). It has also been reported that hypertension related mortality and morbidity is increasing in this region.²⁹ The increasing trends in hypertension related mortality and disease burden is similar to other lower-middle and middle-income countries.

Hypertension prevalence: Hypertension prevalence has been studied in a number of national and regional studies and the data have been collated by WHO. We obtained hypertension related data from WHO-Global Health observatory site.⁹ Prevalence of hypertension and secular trends in South Asian countries is shown in figure 2. A high prevalence is observed in all the countries of this region and rate varies from 25-30%. A high prevalence of hypertension was also reported for South Asia in PURE study.²³

Hypertension in India: Epidemiology of hypertension has been widely studied in India.^{11,12} Initial studies were

Table 2: Hypertension prevalence in India among young and middle age (NFHS-4) and at all age groups (DLHS-4/AHS) as reported in nationwide studies

State (alphabetic)	Hypertension (known or BP>140/90 mmHg) in NFHS-433			Hypertension (known or BP>140/90 mmHg) in DLHS-4/AHS10		
	Men	Women	Total	Men	Women	Total
Andaman&Nicobar	27.9	9.0	18.5	37.2	26.3	32.1
Andhra Pradesh	16.2	10.0	13.1	28.3	20.7	24.5
Arunachal	21.6	15.0	18.3	27.7	21.4	24.7
Assam	19.6	16.0	17.8	21.3	16.8	19.1
Bihar	9.4	5.9	7.7	20.2	20.8	20.5
Chandigarh	13.5	9.3	11.4	41.8	31.3	37.0
Chhattisgarh	12.7	8.8	10.8	17.1	13.5	15.3
Delhi	4.2	7.6	5.9	27.9	22.4	25.4
Goa	13.2	8.5	10.9	32.9	26.4	29.7
Gujarat	13.0	9.7	11.4	--	--	--
Haryana	16.8	9.2	13.0	28.1	20.3	24.5
Himachal	21.9	12.1	17.5	38.5	30.8	34.7
Jammu/Kashmir	13.7	11.6	12.7	--	--	--
Jharkhand	12.2	7.8	10	24.7	18.8	21.8
Karnataka	15.4	9.7	12.6	25.5	21	23.3
Kerala	9.5	6.8	8.2	41.4	33.0	37.0
Madhya Pradesh	10.9	7.9	9.4	19.9	16.7	18.3
Maharashtra	15.9	9.1	12.5	28.2	21.8	25.1
Manipur	20.4	11.4	15.9	25.7	17.6	21.7
Meghalaya	10.4	9.9	10.2	22.9	18.3	20.6
Mizoram	17.9	9.8	13.9	24.5	14.8	19.7
Nagaland	23.1	16.0	19.6	39.6	31.8	35.8
Odisha	12.5	9.0	10.8	17.2	15.6	16.4
Punjab	21.8	13.2	17.5	41.4	29.4	35.7
Pondicherry	15.1	9.1	12.1	27.3	17.6	22.4
Rajasthan	12.4	6.9	9.7	23.7	16.5	20.2
Sikkim	27.3	16.5	21.9	36.2	30.4	33.5
Tamilnadu	15.5	8.3	11.9	27.7	18.8	23.3
Telangana	18.2	10.1	14.2	26.5	19.6	23.1
Tripura	13.6	12.6	13.1	22.4	18.8	20.6
Uttarakhand	17.2	9.6	13.4	32.2	22.3	27.4
Uttar Pradesh	10.1	7.6	8.9	20.5	18.2	19.4
West Bengal	12.4	10.3	11.4	22.6	21.0	21.8

performed more than 80 years ago and reported wide variability with greater hypertension prevalence in urban locations.³⁰ These studies also reported an increasing prevalence of hypertension in both urban and rural locations.³¹ Studies from 1990 onwards have reported persistent increase in hypertension in the country, and recent studies have reported greater increase in hypertension in rural areas and an urban-rural convergence.³²

Two large community-based nationally representative surveys have been conducted in the last decade. NFHS-4 evaluated hypertension prevalence in men 15-54 years of age and women 15-49 years of age and reported a low prevalence of hypertension (Table 2).³³ However, this is an epidemiological outlier, as hypertension prevalence has not been studied among the older individuals, among

whom the hypertension prevalence is greater as reported by DLHS-4/AHS (Table 2).¹⁰

Geldsetzer et al¹⁰ used data from pan-India Fourth District-level health survey (DLHS-4) and Annual Health Survey (AHS) obtained during 2012-2014.¹⁰ This study employed district level health data to estimate important cardiovascular risk factors (overweight, obesity, hypertension, diabetes) in all states of the country. In this program, a standardized measurement of BP and data on hypertension prevalence were obtained from 2012-2014. The investigators pooled data from DLHS-4 and AHS with representative data at district level with participation of 29 states. In this study, among 1,320,555 adults (46.9% men, 53.1% women) the unadjusted prevalence of hypertension was 25.3% (CI 25.0-25.6%) with greater prevalence in men

(27.4%, CI 27.0-27.7%) compared to women (23.6%, CI 23.3-23.8%) ($p < 0.001$). Age-standardized prevalence was also significantly greater in men (24.5%, CI 24.2-24.9%) as compared to women (20.0%, CI 19.7-20.3%). Hypertension prevalence in different states is shown in table 2 and ranges from a low of 13.5% among women in Chhattisgarh to a high of 43.5% among men in Daman and Diu. This study concluded that there was a high prevalence of hypertension in all the states across all socioeconomic groups in India. The prevalence of hypertension was high even among the young age individuals. The study also reported a large regional variation as shown in table 2.

TRENDS IN HYPERTENSION AWARENESS, TREATMENT, AND CONTROL IN INDIA

Although hypertension is highly prevalent in India and other South Asian countries, there is low level of awareness, treatment, and control. Studies have reported that awareness status has increased in the last 30 years, but it remains low especially in rural populations. Awareness increased from $<30\%$ in 1980's among urban populations to about 60% presently and from $<10\%$ in rural areas in 1980's to 35-40% presently.¹⁴ South Asian cohorts in PURE study reported similar low rate of hypertension awareness, treatment and control, respectively, in urban (46%, 38% and 15%) as well as rural (33%, 24% and 9%) locations.⁹

Anchala et al¹³ reviewed hypertension awareness, treatment and control status including all the major studies in India. This meta-analysis reported that awareness of hypertension in India was 42% (CI 35-49%) for urban and 25% (CI 21-29%) for rural populations. The awareness levels for hypertension were consistently above 35% in almost all the studies from urban areas. In urban populations, the treatment and control status of those with known hypertension was 38% (95% CI 24-51%) and control in 20% (CI 12-29%). While in rural populations, the treatment status for those with known hypertension was 25% (CI=17-33%), and control status was in 11% (CI=6-15%). Treatment status varied by location and in urban parts of India the percent-age treated for hypertension varied from a low of 19% to high of 80%. The treated percentage among hypertensive patients showed greater variation in rural parts of India, ranging from 1% to 47%. Overall, only 38% of urban Indians suffering from hypertension are being treated. The BP control among both urban and rural parts of

India was poor ranging from 12-29% in urban and 6-15% in rural populations.

Hypertension awareness, treatment, and control has not¹⁶ been reported in the DLHS-4/AHS study. Geldsetzer et al¹⁶ reported status of hypertension care in 44 low-income and middle-income countries with individual level data from 1.1 million individuals. In Southeast Asia and Western Pacific cohort that included Bangladesh, Bhutan, China, India, Indonesia, Mongolia, Nepal and Timor-Leste, out of 100 patients with hypertension, BP was ever measured in 65%, diagnosed hypertension was in 38%, treatment in 22%, and control in 5-6%. In India, a low prevalence of hypertension treatment and control has been reported among the younger participants in NFHS-4.³³ In this study hypertension prevalence was 18.1%. Among those with hypertension, 44.7% were aware of the diagnosis, 13.3% were treated and controlled BP was in 7.9%. The May Measurement Month 2017 study used opportunistic BP measurement among 240,376 individuals in India, validated BP readings were available in 122,685 screenees.³⁴ 31.8% had hypertension and among those receiving treatment, BP control was in 17.4%. In another multisite study, Great India Blood Pressure Survey, conducted in 24 states and multiple sites, BP was recorded in 180,335 participants.³⁵ Prevalence of hypertension was in 30.7%. Hypertension awareness was in 51.7%, treatment in 41.7% (81.1% of those aware), and control was in 24.5% (58.4% of treated). The study was conducted in secondary care clinics and high treatment and control rates among those aware of hypertension in this study could be an outlier. In various multisite studies in the country, hypertension treatment and control rates vary from 30-40% and 10-20% in urban locations.¹² Jaipur Heart Watch study reported that over a 25 year period there has been a slow increase in BP control rates in an urban Indian population.³⁶ This and other studies have highlighted a need for clinicians in India to focus on BP control in every patient with hypertension. This can be achieved using standard guidelines and other prevention strategies.¹⁸⁻²⁰

STRATEGIES FOR BETTER HYPERTENSION MANAGEMENT

There are multiple risk factors for hypertension and for its proper control multilevel strategies at population-level, healthcare systems-level, and at individual-level are

needed.³⁷ Many of these hypertension determinants and risk factors can be controlled by policy and clinical interventions. The World Health Organization has suggested number of measures to achieve reduction in prevalence of hypertension.²¹ These include:

- Implementation of public health policies to reduce the incidence of hypertension with focus on behavioral risk factors- harmful use of alcohol, overweight and obesity, and promoting physical activity;
- Establishment of integrated health programs for treating hypertension, diabetes, and other risk factors in primary care;
- Promotion of policies and programs that educate and encourage adherence to drug treatment and measures to reduce risk factors; and
- Promotion of workplace wellness programs and focus on individual risk behaviors- tobacco use, unhealthy diet, and others.

We believe that focus on social determinants of health with interventions using a health-in-all-policies (HIAP) approach suggested by WHO is important for prevention of hypertension in India.³⁸ It is also important to focus on improving medical education among physicians and paramedical professionals.³⁸ Ultimately, universal high-quality literacy along with suitable health literacy shall lead to improvement in hypertension control as is currently being observed in many high-income countries.

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