

Review Article

Hypertension in India: Trends in Prevalence, Awareness, Treatment and Control

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ABSTRACT

Hypertension (HTN) is the attributable cause for 57% of stroke and 24% of coronary heart disease deaths in India. High prevalence of hypertension has been reported from various regions of the country. Recent studies have reported that shown that hypertension is present in 25-30% urban and 10-20% rural subjects in India. This translates into an approximate population burden of 100-110 million persons with high blood pressure (BP). Approximately half to two-thirds of these are stage I hypertension (systolic BP 140-159 and/or diastolic BP 90-99 mm Hg) and the rest have stage II-III disease. There is low awareness, treatment and control status of hypertension in India, more among the rural than in urban populations. Determinants of low hypertension treatment and control are rural locations, low socioeconomic and educational status and female gender. Public health strategies are important for creating awareness of hypertension and physician education is required for its better treatment and control. Use of non-physician community health workers and mHealth technology are promising tools for increasing rates of hypertension treatment and promote control and adherence to healthy lifestyles and medicines.

INTRODUCTION

Cardiovascular diseases (CVD) account for a large proportion of all deaths and disability worldwide.¹ India is the second most populous country in the world and emerging burden of CVD in countries here is alarming.¹ In 1990, CVD accounted for 20% of all deaths in this region.² Coronary heart disease (CHD) was responsible for 60% of these and 40% attributed to stroke.² This proportion has increased to 30% and currently almost 2 million deaths are annually caused by CVD in India.^{1,3,4} Escalating cardiovascular risk factors such as smoking, high blood pressure (BP), high low density lipoprotein (LDL) cholesterol, low high density lipoprotein (HDL) cholesterol, metabolic syndrome and diabetes are the major risk factors associated with the increasing CVD in India.³

Population-based epidemiological studies have reported

that all these risk factors have increased by two to five times in urban and rural regions over the last 50 years.⁵ Downward revision of the predicted increase in cardiovascular disease will require modification of risk factors with two characteristics.⁶ First, the risk factors must have high attributable risk, high prevalence, or both. Second, reversal of most or all of the risks must be cost-effective. High BP is a major risk factor for several types of cardiovascular disease, and the association of BP with cardiovascular risk is continuous. Large proportions of most populations have non-optimal BP values.⁶ Moreover, most or all BP-related risk can be significantly reduced within a few years using relatively inexpensive interventions. The Global Burden of Diseases study has reported that hypertension is the most important cardiovascular risk factor in this region and responsible for the largest burden of disease and mortality.^{1,7} Present estimates suggest that a 2 mm Hg population-wide decrease in systolic BP can lead to prevention of more than 151,000 stroke and 153,000 coronary heart disease deaths in India.⁷

RECENT STUDIES ON HYPERTENSION PREVALENCE IN INDIA

Both urban and rural areas in India have been surveyed to estimate the prevalence of hypertension and a number of reviews have highlighted escalating burden of hypertension in India.^{8,9,10,11} In the mid-1950s, Indian urban population based epidemiological studies used older World Health Organization (WHO) criteria for diagnosis (known hypertension or BP \geq 160 mm Hg systolic and/or 95 mm Hg diastolic) and reported hypertension prevalence of 1.2 to 4.0%.⁸ Since then prevalence of hypertension in Indian cities has been steadily increasing from 3.0-4.5% in early 1960's to 11.0 to 15.5% in mid 1990's.⁸ Although rural populations in India generally have lower prevalence of hypertension there has been a significant increase in these populations from less than 1% in early 1960's to 5-7% in late 1990's.⁸

Systolic BP \geq 140 mm Hg and/or diastolic BP \geq 90 mm Hg is the currently accepted diagnostic threshold for hypertension. Many prevalence studies of hypertension

defined by current criteria have been performed in late 20th and early 21st century in India as reviewed earlier.^{10,11} Studies have been performed in the urban (Table 1) as well as rural (Table 2) Indian populations.¹²⁻⁴⁵ Most of the studies are regional. There are only a few multicentric studies in the country.^{18,22,25,26,28,36,44,45}

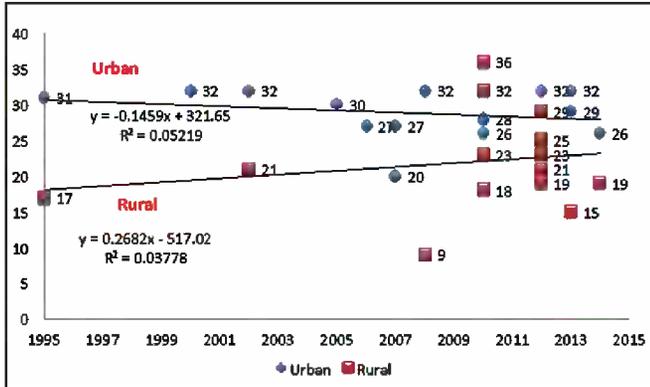


Figure 1: Convergence in prevalence of hypertension in urban and rural populations in India. Prevalence data from studies that have included subjects aged ≥ 20 years are included. Prevalence of hypertension in urban areas (black line) has stabilized while in rural areas (grey line) is increasing.

All these studies reveal a high prevalence of hypertension in Indian urban populations. It appears that hypertension is increasing more rapidly in the Indian rural populations and there is an urban rural convergence in hypertension prevalence (Figure 1).¹¹ These studies show that almost a third of adult Indian population has high BP. This is similar to other parts of the developing world and only slightly lower than the developed countries.⁴⁶

There are large regional differences in hypertension prevalence in India (Tables 1 and 2) and large trans-

national studies are needed. National Family Health Surveys and National Statistical Survey Organization surveys should focus on hypertension screening and referral. Government of India, under the National Program for Control of Cardiovascular Diseases, Stroke, Diabetes and Cancer has initiated a large project of opportunistic screening in India.⁴⁷ More than 50 million adults have been screened and it has been reported that 6.2% participants were suffering from diabetes while hypertension was in 5.5%.⁴⁷ These numbers are clearly an underestimate and much lower than the government sponsored (Indian Council of Medical Research) studies.⁴⁵ Improvement in measurement quality for diagnosis of hypertension and diabetes are required and it is recommended that a better quality program for universal screening for hypertension in India should be implemented. Also, required are population based prospective studies to identify causes and consequences of hypertension in the Indian population.

In India, an estimate regarding the absolute numbers of patients with hypertension that would be eligible for treatment can be made from epidemiological studies. Current studies have shown that hypertension is present in 25% of urban and 10% of rural subjects in India.¹¹ Because of a difference in the number of BP measurements (typically 1 in epidemiological studies and 3-4 over a time-period in clinical studies), it has been estimated that epidemiological studies over-diagnose hypertension by 20-25%.⁴⁸ If we discount this proportion, currently 20% adults in the urban and 10% in the rural areas of India would be eligible for antihypertensive therapies. Translating these proportions into numbers reveals a

Table 1: Recent Hypertension Prevalence Studies in Urban Populations

First Author	Ref.	Year Reported	Place	Age Group (years)	Sample Size (No)	Prevalence (%)
Gupta R	12	1995	Jaipur	>20	2212	30.9
Anand MP	13	2000	Mumbai	30-60	1662	34.0
Gupta R	14	2002	Jaipur	>20	1123	33.4
Shanthirani CS	15	2003	Chennai	>20	1262	21.1
Gupta PC	16	2004	Mumbai	>35	88653	47.9
Prabhakaran D	17	2005	Delhi	20-59	2935	30.0
Reddy KS	18	2006	National	20-69	19973	27.2
Mohan V	19	2007	Chennai	>20	2350	20.0
Kaur P	20	2007	Chennai	18-69	2262	27.2
Yadav S	21	2008	Lucknow	>30	1746	32.2
Gupta R	22	2012	National	>35	2616	48.2
Prince MJ	23	2012	Chennai	>60	1000	60.0
Gupta R	24	2012	Jaipur	>20	739	32.1
Joshi SR	25	2012	National	49(mean)	15662	46.0
Gupta R	26	2013	National	>20	6106	31.5
Bhagyalaxmi A	27	2013	Gujarat	15-64	1805	29.0
Bhansali A	28	2014	National	>20	14059	26.3

Table 2: Hypertension Prevalence Studies in Rural Populations

First Author	Ref.	Year Reported	Place	Age Group (years)	Sample Size (No)	Prevalence (%)
Gupta R	29	1994	Rajasthan	>20	3148	16.9
Kusuma	30	2004	Andhra	>20	1316	21.0
Hazarika NC	31	2004	Assam	>30	3180	33.3
Krishnan	32	2008	Haryana	15-64	2828	9.3
Todkar SS	33	2009	Maharashtra	>20	1297	7.2
Bhardwaj R	34	2010	Himachal	>18	1092	35.9
By Y	35	2010	Karnataka	>18	1900	18.3
Kinra S	36	2010	National	20-69	1983	20.0
Gupta R	22	2012	National	>35	4624	31.5
Prince MJ	23	2012	Tamilnadu	>65	1000	29.0
Kaur P	37	2012	Tamilnadu	25-64	10463	21.4
Kokiwar PR	38	2012	Tamilnadu	>30	924	19.0
Dutta A	39	2012	West Bengal	>18	1186	24.7
Borah PK	40	2012	Assam	>30	916	55.6
Haddad S	41	2012	Kerala	18-96	1660	23.5
Bansal SK	42	2012	Uttarakhand	>18	968	28.9
Meshram II	43	2012	Kerala	>20	4193	40.0
Bhagyalaxmi A	27	2013	Gujarat	15-64	1684	15.4

massive burden of this disease in India. According to the 2011 census there are 700 million adults (of the total 1.21 billion) in India, of whom 450 million are in rural and 250 million in urban areas. The absolute number of hypertensives in India, presently, would therefore be 45 million among rural and 50 million in urban subjects. This would translate into a total of about 95-100 million adults in India with hypertension.

HYPERTENSION AWARENESS, TREATMENT AND CONTROL

Although hypertension is highly prevalent in India, there is low awareness, treatment and control status in Indian urban as well as rural populations. Poor control of high BP has been attributed to a variety of socioeconomic factors including women, low educational status, poverty, rural residence as well as physiological factors, eg. obesity.⁹ Awareness status of hypertension has increased in the last 30 years in India but remains very low especially in rural populations.¹⁰ Hypertension awareness has increased from less than 30% in 1980's among urban populations to about 60% presently and from less than 10% in rural areas in 1980's to 35-40% presently.⁹ However, treatment and control status remain low at less than 30% in urban and 20% in rural areas.¹⁰

Anchala et al¹⁰ reviewed hypertension awareness, treatment and control status including all the recent studies in India. Overall estimates (95% confidence intervals) for awareness of hypertension in India was 41.9% (35.1–48.9) for urban and 25.1% (21.0–29.1) for rural populations. The awareness levels for hypertension

were consistently above 35% in almost all studies from urban areas. In urban populations the treatment and control status of those with known hypertension was 37.6% (24.0–51.2) and control in 20.2% (11.6–28.7). While in rural populations, the treatment status for those with known hypertension was 25.1% (17.0–33.1), and control status was in 10.7% (6.5–15.0) (Figure 2).

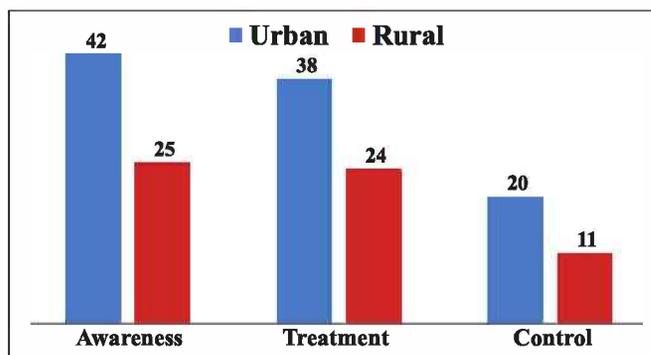


Figure 2: Meta-analysis of hypertension awareness, treatment and control in Indian urban and rural populations.

Treatment status varied by location in urban parts of India with for percentage treated for hypertension varying from a low of 19% to a high of 80%. The treated percentage among hypertensive patients showed greater variation in rural southern parts of India, ranging from 1 to 47% than in urban areas. Overall, close to 38% of urban Indians suffering from HTN are being treated. The BP control among both urban and rural parts of India has been very poor (range 11.6–28.7% in urban and 6.5–15% in rural).¹⁰ Jaipur Heart Watch (JHW) is the only prospective cross-sectional hypertension and other cardiovascular risk

Table 3: 22-year trends in age and sex-adjusted hypertension prevalence and awareness in among urban subjects in Jaipur Heart Watch studies

	JHW-1 (n=2212)¹²	JHW-2 (n=1123)¹⁴	JHW-3 (n=458)⁴⁹	JHW-4 (n=1127)⁵⁰	JHW-5 (n=739)²⁴	JHW-6 (n=1781)⁵¹
Years of study & reporting	1992-1994	1999-2001	2003-2004	2006-2007	2010-2011	2012-2014
Year of publication	1995	2002	2004	2007	2012	2015
Crude prevalence rate (known hypertension + BP >140/>90)	30.9	36.9	51.3	53.3	34.4	38.9
Age- and sex-adjusted prevalence	29.9	35.3	35.8	39.4	34.4	36.0
Hypertension awareness (% of total hypertensives)	13.2	43.8	49.1	38.1	49.2	56.1

factor epidemiology study in India.^{12,14,24, 49,50,51} In a series of cross-sectional studies in Jaipur (Rajasthan, India) we evaluated trends in hypertension awareness, treatment and control over a 22-year period (Table 3).

While the crude prevalence of hypertension has varied from 30-50% in these studies, awareness of hypertension has increased significantly (Table 3). The awareness of hypertension was 13% in early 1990's and has now increased to more than 56%. There is, however, a great need to increase diagnosis of hypertension through screening and its awareness in India so that we can reach the awareness levels of developed countries which are 70-80% in most countries.⁴ The reasons for greater awareness of hypertension in JHW studies are not clear, further studies are required. Better health literacy due to public health campaigns could be important factors. In another study we reported that the age-adjusted mean systolic BP has declined over this period. This shows that better awareness is associated with lower systolic BP, possibly due to better lifestyles or better treatments.⁵²

Table 4: Hypertension awareness, treatment and control in India Heart Watch Study (n=6198).

Age group (years)	Aware (%)	Treated (%)	Controlled (%)
20-29	23.2	8.7	15.9
30-39	34.4	20.0	18.4
40-49	53.3	38.3	25.5
50-59	60.6	46.4	28.3
60-69	65.4	55.4	27.5
70+	64.7	53.8	19.3
Age-adjusted	55.3	36.5	28.2

India Heart Watch study in urban populations reported prevalence of awareness, treatment, and control of hypertension middle class sites in 11 cities in India and enrolled more than 6000 subjects.²⁶ Hypertension awareness, treatment and control among the study subjects in different age groups is shown in Table 4. An

age-adjusted analysis showed that 53.8% of men and 57.3% of women were aware of hypertension. Among subjects with hypertension, 37.9% of the men and 34.5% of the women were receiving treatment for it. Controlled BP (systolic BP < 140 mm Hg and diastolic BP < 90 mm Hg) was found in 25.6% of the men and 31.6% of the women with hypertension (28.2% overall). Awareness of hypertension increased with age in both men and women, with less than a quarter of men and women under 30 years of age being aware of hypertension as opposed to two-thirds of those > 60 years of age. Treatment status also increased with age, with < 20% of those younger than age 40 years but > 50% of those over age 60 years receiving treatment. Hypertension control status did not change significantly with age. Among the subjects aware of having hypertension, 78.6% of men and 76.1% of women were receiving treatment. Among individuals treated for hypertension, less than half (41.5% of men and 41.6% of women) had controlled BP. This study showed that even among the urban middle class there is a low treatment and control status of hypertension. This study also reported that low educational status was associated with lower hypertension awareness, treatment and control.⁵³ Poor status of hypertension control, almost similar to Indian rural populations, was observed in this study (Figure 3).

There have been limited studies that determined determinants of hypertension awareness, treatment and control. Indian Women Health Study was conducted in low and low-middle socioeconomic status women at multiple urban and rural sites in India.²² Prevalence of known hypertension was low and only 56.8% urban and 24.6% rural women were aware of the condition. Of the aware hypertensive women only 38.6% were on drug therapy (rural 46.5%, urban 38.6%). Hypertension control defined by systolic BP <140 mm Hg and diastolic BP <90 mm Hg among those on treatment was extremely low and only 10.2% rural and 28.3% urban women had controlled BP values. Overall, of the 1672 hypertensive

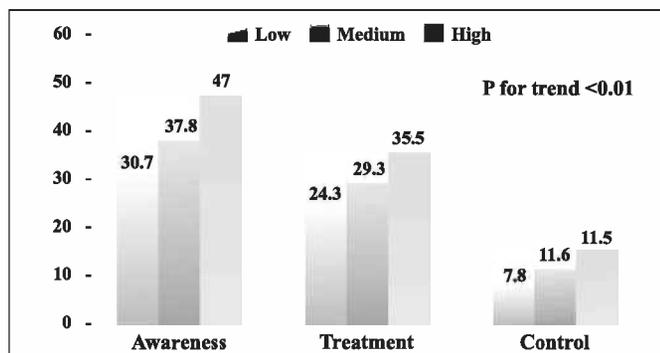


Figure 3: Educational status (low, medium and high) and hypertension awareness, treatment and control in urban middle-class participants in the India Heart Watch study.⁵³

women (rural 746, urban 926) only 18.3% were on treatment (rural 13.1%, urban 22.5%) and control to target achieved in 3.9% (rural 1.3%, urban 5.9%) ($p < 0.05$ for rural-urban difference). Significant lifestyle determinants of hypertension awareness, treatment and control showed that rural location is the most important risk factor for awareness (age-adjusted OR 3.13, CI 2.49-3.93), treatment (1.59, 1.18-2.13) as well as control (5.11, 2.22-11.74). Low educational level and spouse educational status has insignificant association respectively with

awareness (age and location adjusted OR and 95% CI 1.39, 0.92-2.09 and 1.14, 0.75-1.74), treatment (0.62, 0.38-1.03 and 1.74 (0.94-3.25) as well as control (0.55, 0.21-1.42 and 0.60, 0.20-1.80). In most developed countries, hypertension awareness, treatment and control is greater among women as compared to men.⁴⁶ This study showed that in India in both urban and rural women there is low awareness, treatment and control of hypertension and systematic strategies are required to improve blood pressure control.

IMPLICATIONS

There is an urgent need for public health and clinical interventions to prevent onset of hypertension and better hypertension control including long term management using standard public health approaches.⁵⁴ These interventions include policy-level, health system-level, population-level and clinic based individual-level interventions (Table 5). Policy and system level interventions should be focused on public education and screening, while population level interventions should focus on reduced intake of salt and alcohol, smoking cessation, promotion of healthy diet and facilitation of physical activity. Individual level interventions should be

Table 5: Public health and clinical measures for better hypertension treatment and control in India.⁵⁴

Strategy	Examples
Public education	<ul style="list-style-type: none"> Hypertension is a major cardiovascular risk factor and one of the most important cause of strokes and heart disease Hypertension is most often silent and so regular BP checks are essential in all adults (>35 yrs) Hypertension can be prevented and better controlled by adoption of prudent lifestyle combined with simple, safe and inexpensive drugs
Physician education	<ul style="list-style-type: none"> Greater focus on non-communicable diseases during undergraduate education. Focus on hypertension in public health curriculum. Hypertension as a primary care issue. Knowledge of proper management and long-term care. Physician inertia to be managed. Importance of home monitoring, ambulatory BP measurement, combination therapy and focus on vascular risk management.
Opportunistic screening	<ul style="list-style-type: none"> Screening for hypertension among all adults by physicians or other health care workers at every encounter at all levels of care (universal opportunistic screening). Measurement of BP in adults once a year by trained non-physician health care workers during home visits in rural and urban areas.
Lifestyle changes	<ul style="list-style-type: none"> Focus on reducing high salt in diet, reducing alcohol consumption, weight reduction, and greater physical activity. Smoking/tobacco use cessation for overall risk reduction.
Low dose combination pharmacotherapy	<ul style="list-style-type: none"> Use of low doses of two or more individual drug combination as initial therapy. Use of evidence based combinations.
Control of vascular risk factors	<ul style="list-style-type: none"> Focus on management of all vascular risk factors- smoking, high cholesterol, other lipids, diabetes- in every hypertensive. Polypharmacy approach in high risk persons
Patient empowerment	<ul style="list-style-type: none"> Lifelong commitment to lifestyle changes and anti-hypertensive therapy in patients with hypertension BP self monitoring

on better physician education who should promote individual lifestyle changes, appropriate pharmacotherapy and control of vascular risk factors along with efforts to improve adherence.

In conclusion, hypertension is an important public health problem in India.⁵⁵ Hypertension detection, awareness and its control are poor. Improved detection and management can prevent hundreds of thousands of premature deaths and avoid larger number of strokes and heart attacks every year. Innovative systems-based strategies outlined in Table 5, are required to increase hypertension awareness and for better management of hypertension. A combined approach to lowering risk with lifestyle changes and combined use of anti-hypertensive and lipid lowering therapy can reduce the cardiovascular risk by as much as 75 %. We need improved systems of healthcare for widespread screening for hypertension so that it can be detected. Once detected, effective BP control and reduced cardiovascular risk is best achieved by appropriate pharmacotherapy with good adherence. Such a public health approach shall lead to enormous changes in clinical outcomes of hypertension in India.

REFERENCES

1. Global Burden of Diseases 2013 Mortality and Causes of Death Collaborators. Global, regional, and national levels of age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet* 2015; 385: 117-171.
2. Moran AE, Forouzanfar MH, Roth GA, et al. Temporal trends in ischemic heart disease mortality in 21 world regions, 1980 to 2010: The Global Burden of Disease 2010 Study. *Circulation* 2014; 129:1483-1492.
3. Gupta R, Guptha S, Sharma KK, et al. Regional variations in cardiovascular risk factors in India: India Heart Watch. *World J Cardiol* 2012; 4:112-120.
4. Fuster V, Kelly BB, and Board for Global Health. Promoting cardiovascular health in developing world: a critical challenge to achieve global health. Washington. Institute of Medicine 2010.
5. Gupta R, Joshi PP, Mohan V, et al. Epidemiology and causation of coronary heart disease and stroke in India. *Heart* 2008; 94:16-26.
6. Rodgers A, Lawes C, MacMahon S. Reducing the global burden of blood pressure related cardiovascular disease. *J Hypertens* 2000; 18(Suppl. 1):S3-S6.
7. Patel V, Chatterji S, Chisholm D, et al. Chronic diseases and injuries in India. *Lancet* 2011; 377:413-428.
8. Gupta R, Al-Odat NA, Gupta VP. Hypertension epidemiology in India: Meta-analysis of fifty-year prevalence rates and blood pressure trends. *J Hum Hypertens* 1996; 10:465-472.
9. Gupta R. Trends in hypertension epidemiology in India. *J Hum Hypertens* 2004; 18:73-78.
10. Anchala R, Kannuri S, Pant H, et al. Hypertension in India: a systematic review and meta-analysis of prevalence, awareness, and control of hypertension *J Hypertens* 2014; 32:1170-1177.
11. Gupta R. Convergence of urban-rural prevalence of hypertension in India. *J Hum Hypertens* 2015 June; ePub. Doi:10.1038/jhh.2015.48.
12. Gupta R, Guptha S, Gupta VP, et al. Prevalence and determinants of hypertension in the urban population of Jaipur in Western India. *J Hypertens* 1995; 13:1193-1200.
13. Anand MP. Prevalence of hypertension amongst Mumbai executives. *J Assoc Physicians Ind* 2000; 48:1200-1201.
14. Gupta R, Gupta VP, Sarna M, et al. Prevalence of coronary heart disease and risk factors in an urban Indian population: Jaipur Heart Watch-2. *Indian Heart J* 2002; 54:59-66.
15. Shanthirani CS, Pradeepa R, Deepa R, et al. Prevalence and risk factors of hypertension in a selected South Indian population: the Chennai Urban Population Study. *J Assoc Physicians India* 2003; 51:20-27.
16. Gupta PC, Gupta R, Pendnekar M. Hypertension prevalence and blood pressure trends in 88,653 subjects in Mumbai, India. *J Hum Hypertens* 2004; 18:907-910.
17. Prabhakaran D, Shah P, Chaturvedi V, et al. Cardiovascular risk factor prevalence among men in a large industry of northern India. *Natl Med J India* 2005; 18:59-65.
18. Reddy KS, Prabhakaran D, Chaturvedi V, et al. Methods for establishing a system for cardiovascular diseases in Indian industrial populations. *Bull WHO* 2006; 84:461-469.
19. Mohan V, Deepa M, Farooq S, et al. Prevalence, awareness and control of hypertension in Chennai: The Chennai Urban Rural Epidemiology Study. *J Assoc Physicians India* 2007; 55:326-332.
20. Kaur P, Rao TV, Sankarasubbaiyan S, et al. Prevalence and distribution of cardiovascular risk factors in an urban industrial population in south India: a cross sectional study. *J Assoc Physicians India* 2007; 55:771-776.
21. Yadav S, Boddula R, Genitta G, et al. Prevalence of risk factors of prehypertension and hypertension in an affluent north Indian population. *Indian J Med Res* 2008; 128:712-720.
22. Gupta R, Pandey RM, Misra A, et al. High prevalence and low hypertension awareness, treatment and control in Asian Indian women. *J Hum Hypertens* 2012; 26:585-593.
23. Prince MJ, Ebrahim S, Acosta D, et al. Hypertension prevalence, awareness, treatment and control among older people of Latin America, India and China: a 10/66 cross sectional population based survey. *J Hypertens* 2012; 30:177-187.
24. Gupta R, Sharma KK, Gupta A, et al. Persistent high prevalence of cardiovascular risk factors in the urban middle-class in India: Jaipur Heart Watch-5. *J Assoc Physicians India* 2012; 60:11-16.
25. Joshi SR, Saboo B, Vadivale M, et al. Prevalence of diagnosed and undiagnosed diabetes and hypertension in India: results from the Screening India's Twin Epidemic

- (SITE) study. *Diabetes Technol Ther* 2012; 14:8-15.
26. Gupta R, Deedwania PC, Achari V, et al. Normotension, prehypertension and hypertension in Asian Indians: prevalence, determinants, awareness, treatment and control. *Am J Hypertens* 2013; 26:83-94.
 27. Bhagyalaxmi A, Atul T, Shikha J. Prevalence of risk factors of non-communicable diseases in a district of Gujarat, India. *J Health Popul Nutr* 2013; 31:78-85.
 28. Bhansali A, Dhandhanika VK, Mohan D, et al. Prevalence of and risk factors for hypertension in urban and rural India: the ICMR INDIAB study. *J Hum Hypertens* 2014; ePub.
 29. Gupta R, Sharma AK. Prevalence of hypertension and subtypes in an Indian rural population: Clinical and electrocardiographic correlates. *J Human Hypertens*. 1994; 8:823-829.
 30. Kusuma YS, Babu BV, Naidu JM. Prevalence of hypertension in some cross cultural populations of Vishakhapatnam district, South India. *Ethn Dis* 2004; 14:250-259.
 31. Hazarika NC, Narain K, Biswas D, et al. Hypertension in the native rural population of Assam. *Natl Med J India*. 2004; 17:300-304.
 32. Krishnan A, Shah B, Lal V, et al. Prevalence of risk factors for non-communicable disease on a rural area of Faridabad district of Haryana. *Indian J Public Health* 2008; 52:117-124.
 33. Todkar SS, Gujarathi VV, Tapare VS. Period prevalence and sociodemographic factors of hypertension in rural Maharashtra: a cross sectional study. *Indian J Comm Med* 2009; 34:183-187.
 34. Bhardwaj R, Kandori A, Marwah R, et al. Prevalence, awareness and control of hypertension in rural communities of Himachal Pradesh. *J Assoc Physicians India* 2010; 58:423-424.
 35. By Y, Mr NG, Ag U. Prevalence, awareness, treatment and control of hypertension in rural areas of Davengere. *Indian J Comm Med* 2010; 35:138-141.
 36. Kinra S, Bowen LJ, Lyngdoh T, et al. Sociodemographic patterning of non-communicable disease risk factors in rural India: a cross sectional study. *BMJ*. 2010; 341:c4974.
 37. Kaur P, Rao SRT, Radhakrishnan E, et al. Prevalence, awareness, treatment and control and risk factors for hypertension in a rural population in south India. *Int J Public Health*. 2012; 57:87-94.
 38. Kokiwar PR, Gupta SS, Durge PM. Prevalence of coronary risk factors in a rural community in Andhra Pradesh. *J Assoc Physicians India*. 2012; 60:26-29.
 39. Dutta A, Ray MR. Prevalence of hypertension and prehypertension in rural women: a report from the villages of West Bengal. A state in eastern part of India. *Aust J Rural Health*. 2012; 20:219-225.
 40. Borah PK, Shankrishan P, Hazarika NC, et al. Hypertension subtypes and angiotensin converting enzyme (ACE) gene polymorphism in Indina population. *J Assoc Physicians India* 2012; 60(11):15-17.
 41. Haddad S, Mohindra KS, Siekmans K, et al. Health divide between indigenous and non-indigenous populations in Kerala, India: population based study. *BMC Public Health* 2012; 12:390.
 42. Bansal SK, Saxena V, Kandpal SD, et al. The prevalence of hypertension and hypertension risk factors in a rural Indian community: a prospective door-to-door study. *J Cardiovasc Dis Res* 2012; 3:117-123
 43. Meshram II, Arlappa N, Balkrishnan N, et al. Prevalence of hypertension, its correlates and awareness among adult tribal population of Kerala state, India. *J Postgrad Med* 2012; 58:255-261.
 44. National Institute of Medical Statistics. Integrated Disease Surveillance Project: Non-Communicable Disease Risk Factors Survey. New Delhi. Indian Council of Medical Research 2009.
 45. Shah B, Mathur P. Surveillance of cardiovascular risk factors in India: the need and the scope. *Indian J Med Res* 2010; 132:634-642.
 46. World Health Organization. Global Status Report of Noncommunicable Diseases 2014. Geneva. World Health Organization. 2014.
 47. Ministry of Health and Family Welfare. National Programme For Prevention and Control of Cancer, Diabetes, Cardiovascular Disease and Stroke (NPCDCS). Available at: <http://mohfw.nic.in/index1.php?lang=1&level=3&sublinkid=3627&lid=2194>. Accessed 17th Dec 2014.
 48. WHO Expert Committee. Hypertension Control. WHO Technical Report Series 1996; 862:2-10.
 49. Gupta R, Sarna M, Thanvi J, Rastogi P, Kaul V, Gupta VP. High prevalence of multiple coronary risk factors in Punjabi Bhatia community: Jaipur Heart Watch-3. *Indian Heart J* 2004; 57:646-652.
 50. Gupta R, Kaul V, Bhagat N, Agrawal M, Gupta VP, Misra A, Vikram NK. Trends in prevalence of coronary risk factors in an urban Indian population: Jaipur Heart Watch-4. *Indian Heart J* 2007; 59:346-353.
 51. Dhabriya R, Agrawal M, Gupta R, et al. Cardiometabolic risk factors in the Agarwal business community in India: Jaipur Heart Watch-6. *Indian Heart J* 2015; ePub.
 52. Gupta R, Guptha S, Gupta VP, et al. Twenty year trends in cardiovascular risk factors in India and influence of educational status. *Eur J Prev Cardiology* 2012; 19:1258-1271.
 53. Gupta R, Sharma KK, Gupta BK, et al. Education status related disparities in awareness, treatment and control of cardiovascular risk factors in India. *Heart Asia* 2015; 7:1-7.
 54. Gupta R, Yusuf S. Towards better hypertension control in India. *Indian J Med Res* 2014; 139:657-660.
 55. Gupta R. Hypertension as a public health problem in India. *Hypertension J* 2015; 1:3-7.

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