Hypertension epidemiology in the 21st century India

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Abstract

South Asian Indians have one of the highest cardiovascular morbidity and mortality in the world. Studies have identified that multiple risk factors, such as hypertension, high low density lipoprotein cholesterol, low high density lipoprotein cholesterol, diabetes, smoking and tobacco use, and abnormal lifestyles are important causes of premature occurrence of cardiovascular diseases. Hypertension is the main cause contributing for 57% stroke deaths and 24% coronary heart disease deaths in India. High prevalence of hypertension is reported from various regions of India and among the migrant populations. Recent studies have reported that hypertension is present in 25–30% urban and 10–15% rural subjects in India and more than 40% adults among migrant Indians. Approximately, 70% of these are Stage I hypertension (systolic BP 140–159 and/or diastolic BP 90–99 mm Hg). There is low awareness, treatment and control status among urban and rural Indian populations. There are limited mechanistic studies for identification of unique genetic or pathophysiological pathways of hypertension in this group. Population based cost-effective hypertension control strategies should be developed. Salt intake is high in India and moderation of its intake is a contentious public health issue. Pharmaco dynamic and pharmacokinetic studies of various antihypertensive drugs are also not available. Clinical trials have reported that there are no significant differences in efficacy of various drugs in Indians/South Asians as compared to Caucasians. Identification of high risk individuals is important and aggressive risk factor control is required to achieve universal cardiovascular risk reduction.

Key Words
- Cardiovascular disease
- Hypertension
- Risk factors
- Prevention

Introduction

Cardiovascular diseases (CVD) account for a large proportion of all deaths and disability worldwide. South Asian region (India, Pakistan, Bangladesh, Nepal, and Sri Lanka) is the most populous in the world and emerging burden of CVD in countries of this region is alarming. In 1990, CVD accounted for 20% of all deaths in this region.1 Coronary heart disease (CHD) was responsible for 60% of these and 40% attributed to stroke. This proportion has increased to 30%, and currently almost 3 million deaths are annually caused by CVD in this region.2 Age-adjusted annual mortality from CVD in rural area varies from 250–260/100,000 and in urban area from 450–530 in males and 230–300 in females. These rates are much more than comparable rates in high income countries where these are 200–300/100,000 in men and 100–150/100,000 per year in women.3 Escalating cardiovascular risk factors, such as smoking, high blood pressure (BP), low high density lipoprotein (LDL) cholesterol, low high density lipoprotein (HDL) cholesterol, metabolic syndrome and diabetes are associated with the increasing CVD in India.3 Population–based epidemiological studies have reported that all these risk factors have increased by 2–5 times in urban and rural areas, over the last 50 years. Downward revision of the predicted increase in cardiovascular disease will require modification of risk factors with two characteristics

1. The risk factors must have high attributable risk, high prevalence, or both
2. Reversal of most or all of the risks must be cost-effective.

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.4 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.5 21st century estimates are that if a 2 mmHg population-wide decrease in systolic BP is achieved, more than 151,000 stroke and 153,000 coronary heart disease deaths could be prevented in India.4

Hypertension in India in 21st century

Both urban and rural areas in India have been surveyed to estimate the prevalence of hypertension.7 In the mid-1950s, Indian urban population studies used older World Health Organization (WHO) criteria for diagnosis (known hypertension or BP ≥160 mmHg systolic and/or 95 mmHg diastolic) reported hypertension prevalence of 1.2–4.0% in urban populations and also because of the current recommendations of the WHO and many Indian Consensus Groups, the criteria of systolic BP ≥140 mmHg and/or diastolic BP ≥90 mmHg is the currently accepted diagnostic threshold for hypertension. No prospective epidemiological studies exist among Indians; therefore, the level of BP at which the risk of cardiovascular events begins to increase is not well defined. Most studies from developing countries show a lower mean population BP as compared to developed countries.8 Therefore, the values above which high BP increases cardiovascular risk could be lower in these countries. However, in the absence of prospective data and also because of the current recommendations of the WHO and many Indian Consensus Groups, the criteria of systolic BP ≥140 and/or diastolic BP ≥90 mmHg is the currently accepted diagnostic threshold for hypertension.

Table 1: Recent Indian hypertension prevalence studies (BP ≥140/90 mmHg)9-19

<table>
<thead>
<tr>
<th>First author</th>
<th>Year reported</th>
<th>Place</th>
<th>Age group</th>
<th>Sample size</th>
<th>Prevalence (%)</th>
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<tbody>
<tr>
<td>Gupta R</td>
<td>1995</td>
<td>Jaipur</td>
<td>≥20</td>
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<tr>
<td>Anand MP</td>
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<td>Mumbai</td>
<td>30–60</td>
<td>1662</td>
<td>34.0</td>
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<td>Gupta R</td>
<td>2002</td>
<td>Jaipur</td>
<td>≥20</td>
<td>1123</td>
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<tr>
<td>Shanthirani CS</td>
<td>2003</td>
<td>Chennai</td>
<td>≥20</td>
<td>1282</td>
<td>21.1</td>
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<tr>
<td>Gupta PC</td>
<td>2004</td>
<td>Mumbai</td>
<td>≥35</td>
<td>88653</td>
<td>47.9</td>
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<tr>
<td>Prabhakaran D</td>
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<td>Delhi</td>
<td>20–59</td>
<td>2835</td>
<td>30.0</td>
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<tr>
<td>Reddy KS</td>
<td>2006</td>
<td>National</td>
<td>20–69</td>
<td>19973</td>
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<tr>
<td>Mohan V</td>
<td>2007</td>
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<td>≥20</td>
<td>2350</td>
<td>20.0</td>
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<tr>
<td>Kaur P</td>
<td>2007</td>
<td>Chennai</td>
<td>18–69</td>
<td>2262</td>
<td>27.2</td>
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<tr>
<td>Yadav S</td>
<td>2008</td>
<td>Lucknow</td>
<td>≥30</td>
<td>1746</td>
<td>32.2</td>
</tr>
</tbody>
</table>

Urban Populations

Rural Populations

Gupta R     | 1994          | Rajasthan | ≥20      | 3148        | 16.9           |
Kusuma      | 2004          | Andhra    | ≥20      | 1316        | 21.0           |
Hazareka NC | 2004          | Assam     | ≥30      | 3180        | 33.3           |
Krishnan    | 2008          | Haryana   | 15–64    | 2828        | 9.3            |
Todkar SS   | 2009          | Maharasthra | ≥20   | 1297        | 7.2            |
Bhardwaj R  | 2010          | Himachal  | ≥20      | 1092        | 35.9           |
By Y        | 2010          | Karnataka | ≥20      | 1900        | 18.3           |
Kurea S     | 2010          | National  | ≥20      | 1983        | 20.0           |

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Key Words
• Cardiovascular disease
• Hypertension
• Risk factors
• Prevention

Introduction
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1. The risk factors must have high attributable risk, high risk effect, or both
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Hypertension in India in 21st century
Both urban and rural areas in India have been surveyed to estimate the prevalence of hypertension. In the mid-1950s, Indian urban population studies used older World Health Organization (WHO) criteria for diagnosis (known hypertension or BP >160 mmHg systolic and/or 95 mmHg diastolic) reported hypertension prevalence of 1.2–4.0% in 1950s. Since then prevalence of hypertension in Indian cities has been steadily increasing from 3.4–5.5% in early 1960’s to 11–15.5% in mid 1990s. 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 1990s.

Systolic BP >140 mmHg and/or diastolic BP >90 mmHg is the currently accepted diagnostic threshold for hypertension. No prospective epidemiological studies exist among Indians; therefore, the level of BP at which the risk of cardiovascular events begins to increase is not well defined. Most studies from developing countries show a lower mean population BP as compared to developed countries. Therefore, the values above which high BP increases cardiovascular risk could be lower in these countr-tries. However, in the absence of prospective data and also because of the current recommendations of the WHO and many Indian Consensus Groups, the criteria of...
Table 2: 20 trends in age and sex-adjusted prevalence of selected cardiometabolic risk factors in urban subjects in India (JHW Jaipur Heart Watch studies) 33

<table>
<thead>
<tr>
<th>First author</th>
<th>JHW-1 (n = 712)</th>
<th>JHW-2 (n = 558)</th>
<th>JHW-3 (n = 374)</th>
<th>JHW-4 (n = 887)</th>
<th>JHW-5 (n = 537)</th>
<th>X2 test for trend p value</th>
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</thead>
<tbody>
<tr>
<td>Overweight (BMI &gt; 25.0 kg/m2)</td>
<td>143 (20.4)</td>
<td>287 (51.4)</td>
<td>166 (44.5)</td>
<td>460 (53.0)</td>
<td>248 (46.8)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hypertension (history/awareness)</td>
<td>39 (5.5)</td>
<td>103 (18.5)</td>
<td>64 (17.2)</td>
<td>161 (18.2)</td>
<td>105 (19.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hypertension</td>
<td>212 (29.9)</td>
<td>197 (35.3)</td>
<td>133 (35.8)</td>
<td>286 (39.4)</td>
<td>150 (28.1)</td>
<td>0.829</td>
</tr>
<tr>
<td>Cholesterol &lt; 200 mg/dl</td>
<td>136 (25.2)</td>
<td>95 (25.6)</td>
<td>129 (25.9)</td>
<td>164 (30.5)</td>
<td>160 (30.5)</td>
<td>0.086</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>44 (8.1)</td>
<td>28 (7.5)</td>
<td>59 (10.7)</td>
<td>42 (8.8)</td>
<td>42 (8.8)</td>
<td>0.091</td>
</tr>
</tbody>
</table>

**Hypertension risk factors**

Although the precise reasons for the increase in hypertension prevalence among Indians have not been established, the rapid increase in BP in unacculturated societies is generally lower and do not increase with age. 34 In non-Westernized Indian rural populations, there is only a small increase in the prevalence of hypertension (Table 2). 35

Current studies have shown that hypertension is present in 25% of urban and 10% of rural subjects in India. 36 Because of a difference in the number of BP measurements (typically 1 in epidemiological studies and 2–3 over a time period in clinical studies), it has been estimated that epidemiological studies over-diagnose hypertension by 20–25%. 37 If we discount this proportion, currently 19% adults in the urban and 7.5% in the rural areas of India would be eligible for antihypertensive therapies. Translating these proportions into numbers reveals a massive burden of this disease in India. According to the 2011 census, there are 700 million adults in India, of whom 500 million are in rural and 200 million in urban areas. The absolute number of hypertensive patients in India in the early 21st century would therefore be 38 million among rural and a similar number in urban subjects, for a total of 74–78 million subjects with hypertension. 38

In India, an estimate regarding the absolute number of patients with hypertension that would be eligible for treatment can be made from epidemiological studies. No data on hypertension in India have been published in the last 30 years, and the prevalence of hypertension has increased sharply in India and other countries of this region.

Hypertension in the 21st century India

The prevalence of hypertension is increasing in the urban Indian population has high BP. This is similar to other parts of the developing world and slightly lower than the developed countries where high BP is present in 40–50% of adults. 39 Some surveys have found that hypertension prevalence in Indian urban populations and excluding hypertension in rural populations. It is now obvious that almost a third of adult Indian population has high BP. This is similar to other parts of the developing world and slightly lower than the developed countries where high BP is present in 40–50% of adults. 39

According to the WHO, in adults aged 40–55 years, BP levels were the highest among Indian men, as compared to those of 20 other developing countries. 40 Population-based survey results show that hypertension is more prevalent in middle and lower socioeconomic groups and lower in rural and higher in urban areas. 41

In Bangladesh hypertension was reported in less than 5% of rural subjects. 42 High prevalence of hypertension has been reported from urban as well as rural populations in Pakistan. 43 However, there are large regional differences in prevalence in India and other large countries of the South Asian region, and large trans-national studies are needed. Also required are population-based prospective studies to identify causes, and consequences of hypertension in this population which has a high prevalence of multiple cardiovascular risk factors.

In India, an estimate regarding the absolute number of patients with hypertension that would be eligible for treatment can be made from epidemiological studies. For example, if 20% of the adult population in India has hypertension, one can estimate that there are approximately 100 million hypertensive patients in India. This estimate is based on the assumption that the prevalence of hypertension in India is similar to that in other developing countries with similar socioeconomic conditions. However, this estimate is likely to be an underestimate, as many hypertensive patients in India may not seek medical care or may be misdiagnosed. Furthermore, the prevalence of hypertension is likely to increase in the future due to the increasing burden of non-communicable diseases and lifestyle changes in India.

In summary, the prevalence of hypertension in India is high, and the burden of the disease is expected to increase in the future. Therefore, it is crucial to develop effective strategies for the prevention and management of hypertension in India. Such strategies should be based on evidence from epidemiological studies and clinical trials, and should be adapted to the local context. This will require multidisciplinary approaches involving researchers, healthcare providers, policymakers, and the general public.
patients with hypertension that would be eligible for factors.

Regional differences in hypertension prevalence in India populations in Pakistan. However, there are large differences between regions, with hypertension being treated. The consequences of this situation are significant because of the high prevalence of multiple cardiovascular risk factors. In India, the prevalence of hypertension is higher than in most other developing countries. Furthermore, the prevalence of hypertension has been increasing rapidly in recent years and correlates with the increase in the prevalence of hypertension. Per capita fat and oil consumption has increased significantly during the last 40 years. It was 5.79 kg/person/year in 1961, 5.85 in 1971, 6.48 in 1981 and 6.96 in 1987, and increasing. According to Indian National Nutrition Monitoring Bureau the salt consumption was 10.7 g/person/day in 1971 and increased to 13.0 in 1981, 15.8 in 1991 and 16.9 in 1994 and is maintained at this level over the last 15 years. Summation of these socio demographic and lifestyle factors may be accelerating the hypertension epidemic, currently sweeping India and other countries of this region.

High salt intake is possibly the most important reversible hypertension risk factor. Intake of salt (sodium chloride) varies from 8–15 g/day, more than the rural populations. This is compounded by false perception among the healthcare professionals that it is a passive salt loss due to hot weather conditions. Recent meta-analyses have clearly shown harms of excessive salt intake and guidelines recommend intake less than 6 g/day among general population.

Sub-national and regional epidemiological studies have reported that important correlates of hypertension in Indian populations are increasing socioeconomic status and obesity. In Indian middle socioeconomic status subjects, Jaipur Heart Watch Studies reported 20-year trend in hypertension awareness and prevalence (refer Table 2). Increasing awareness of hypertension was noted over this period. Prevalence of hypertension did not increase significantly in the non-obese population. Whether a reversal in socioeconomic gradient in prevalence of hypertension, with greater hypertension in poorer subjects as is present in most developed countries, can be maintained at this level over the long term is uncertain.

Whether a reversal in socioeconomic gradient in prevalence of hypertension, with greater hypertension in poorer subjects as is present in most developed countries, can be maintained at this level over the long term is uncertain. In the Treatment of Mild Hypertension Study (TOMHS) lifestyle modifications plus drug treatment in individuals with mildly raised BP (Stage I hypertension: systolic 140–159 mmHg and/or diastolic 90–95 mmHg, average 142±91 mm Hg) was associated with improved outcomes compared to those who received placebo plus lifestyle modifications. In 1992, Sander recommended an average population systolic BP of 110 mmHg as a realistic goal. Reports from the Seven Countries Study and Framingham Heart Study51 showed that what was termed “high normal” BP (systolic BP 130–139 mmHg and/or diastolic BP 85–89 mmHg) and Stage I hypertension carry a significant cardiovascular risk, and there is need to reduce this BP. Pharmacological therapies for these individuals will be expensive, and needs more studies, although TOMHS demonstrated that drug therapy reduces cardiovascular end-points. For BP higher than Stage I, almost all guidelines recommend pharmacological therapy. This translates into 20–25 million persons in India, who would require regular antihypertensive medications. This carries a huge economic burden on already over-stressed economies of these poor countries. Studies that examine cost-effective approaches to optimally control BP among these populations are urgently needed.

<table>
<thead>
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Hypertension risk factors

Although the precise reasons for the increase in hypertension prevalence among Indians have not been established, high salt intake is one of the major risk factors. In unacculturated societies it is generally lower and do not increase with age. In non-Westernized Indian rural populations, there is only a small increase in prevalence in urbanization over the last 30 years. There is epidemiological evidence that population-based prospective studies to identify causes, and consequences of hypertension in this population which has a high prevalence of multiple cardiovascular risk factors. In India, an estimate regarding the absolute number of patients with hypertension that would be eligible for treatment can be made from epidemiological studies.
Stop Hypertension (DASH) in USA have reported usefulness of comprehensive dietary changes. This approach leads to decrease of high BP along with multifactorial cardiovascular risk factor control. Similar studies are required in this region, although observational studies report benefit of low-fat Indian vegetarian diets in controlling high BP and vascular risk.

There are ethnic differences in therapeutic response to antihypertensive drug treatment. The African-Americans respond less well to drugs that suppress the renin-angiotensin system (e.g., beta blockers and angiotensin-converting enzyme inhibitors) as compared to other drugs (diuretics and calcium channel blockers). No trials of efficacy of different antihypertensive agents are available in Indians or other South Asian groups. However, as there is a greater prevalence of diabetes, insulin resistance, and metabolic syndrome among this population, drugs that improve insulin sensitivity and provide vasculoprotective effects such as angiotensin-converting enzyme inhibitors or angiotensin receptor blockers could be considered first-line options. Prospective studies in India are required that address influence of different anti-hypertensive agents on cardiovascular events and other hard end points.

Results

Hypertension is highly prevalent in the 21st century. This is a manifestation of demographic and epidemiological transition, changing lifestyles (increase in the consumption of fruits and vegetables and low physical activity) and increasing obesity and central obesity. There is low awareness, treatment and control status in Indian urban as well as rural populations. Hypertension carries a huge economic burden on already overstressed economy of India. Poor control of high BP has been attributed to various socioeconomic factors. There are limited data on economic burden on already overstressed economy of India. Poor control of high BP has been attributed to various socioeconomic factors. There are limited data on economic burden on already overstressed economy of India. Poor control of high BP has been attributed to various socioeconomic factors. There are limited data on economic burden on already overstressed economy of India. Poor control of high BP has been attributed to various socioeconomic factors. There are limited data on economic burden on already overstressed economy of India. Poor control of high BP has been attributed to various socioeconomic factors. There are limited data on economic burden on already overstressed economy of India. Poor control of high BP has been attributed to various socioeconomic factors. There are limited data on economic burden on already overstressed economy of India. Poor control of high BP has been attributed to various socioeconomic factors. There are limited data on economic burden on already overstressed economy of India. Poor control of high BP has been attributed to various socioeconomic factors. There are limited data on economic burden on already overstressed economy of India. Poor control of high BP has been attributed to various socioeconomic factors. There are limited data on economic burden on already overstressed economy of India. Poor control of high BP has been attributed to various socioeconomic factors. There are limited data on economic burden on already overstressed economy of India. Poor control of high BP has been attributed to various socioeconomic factors. There are limited data on...
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