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REVIEW ARTICLE

Hypertension and stroke in Asia: prevalence, control and strategies in developing countries for prevention

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Reliable statistics related to the prevalence, incidence and mortality of hypertension and stroke are not available from Asia. The data may be in national or institutional reports or journals published in the local language only. The mortality rate for stroke has been on the decline since the mid 1960s in the developed countries of Asia, such as Australia, New Zealand, and Japan, with some improvement in Singapore, Taiwan and Hong Kong, some areas of China and Malaysia about 15 years later. In India, China, Phillippines, Thailand, Sri Lanka, Iran, Pakistan, Nepal, there has been a rapid increase in stroke mortality and prevalence of hypertension. The prevalence of hypertension according to new criteria (>140/90 mm Hg) varies between 15–35% in urban adult populations of Asia. In rural populations, the prevalence is two to three times lower than in urban subjects. Hypertension and stroke occur at a relatively younger age in Asians and the risk of hypertension increases at lower levels of body mass index of 23–25 kg/m^2. Overweight, sedentary behaviour, alcohol, higher social class, salt intake, diabetes mellitus and smoking are risk factors for hypertension in most of the countries of Asia. In Australia, New Zealand and Japan, lower social class is a risk factor for hypertension and stroke. Population-based long-term follow-up studies are urgently needed to demonstrate the association of risk factors with hypertension in Asia. However prevention programmes should be started based on cross-sectional surveys and case studies without waiting for the cohort studies.
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Introduction

In Bhagwatgita (5000 BC), it is mentioned that 'the foods which are bitter, acid, salted and burnt give rise to pain, stress and diseases'. About 2000 years ago, Confucius taught his students in China, 'The higher the quality of foods, the better, and never rely upon the delicacy of cooking.' So, in the earliest medical classics in China, a dietary guideline based on experience was given as 'cereals—the basic, fruits—the subsidiary, meat—the beneficial, and vegetable—the supplementary.' However, in Indian classics, fruits, vegetables, nuts, milk and ghee and cereals were advised for good health.

In the ancient treatise Sushrit Samhita (600 BC),[1] blood pressure has been described as 'Raktachapa'. Thus high blood pressure as a clinical problem was known to the ancient physician. There is an old Sanskrit proverb that 'there are six good flavours of food of which salt is the greatest' which may be the cause of hypertension. In China, the presence of hypertension was suggested by hardening of arteries due to excess of salt in 2700 BC. In the year 1913, Janeway reported[2] that patients with high blood pressure tend to die prematurely. Weises and Ellis in 1930[3] recognised the widespread prevalence of hypertension and mentioned the lack of treatment. Hay[4] in Britain, observed that high blood pressure is a common problem which is more serious when it develops between the ages of 40–50 years. In India, Chopra[5] studied the prevalence of hypertension in 1942 and showed that mean blood pressure was lower in Indians compared to Europeans and the overall prevalence of hypertension was lower. Later in 1949, Vakil[6] conducted a trial of an Indian herb, Ranwolfia serpentina in the treatment of hypertension. Reserpine was isolated from this and is still used in many countries, including India.

In the last decade, WHO experts[7] reviewed the

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problem of hypertension (<160/95 mm Hg) in developing countries. They reported that in adults aged 40–55 years, blood pressure levels were the highest among Indian men as compared to those of 20 other developing countries. It is possible that south Asians appear to be predisposed to high blood pressure as well as an increased susceptibility to coronary artery disease (CAD) possibly due to insulin resistance.[8–10] Hypertension as a risk factor for stroke and CAD has been recognised in developed countries[11] since 1950. It is now also considered important in the pathogenesis of cardiovascular disease (CVD) in developing countries.[12–23] While prevalence and mortality due to CVD is rapidly declining in most developed countries, it is in sharp contrast rising in the developing countries. Hypertension is the major cause of stroke which may be associated with cerebral infarction or haemorrhage. The majority of patients with hypertension either die due to stroke or CAD and heart failure.

Nutritional and epidemiological transition

In most societies of the world, economic development is associated with the improvement in food supply, better nutritional status and an increase in life expectancy. Almost two thirds of the total world population (6 billion) live in Asia, mostly in India and China. There are rapid changes in diet and lifestyle in most Asian countries due to economic development in the last 2–3 decades. With these changes have come the problems of diet-related chronic diseases which typically occur in middle and later adult life, and counteract the gains in life expectancy attributable to a better food supply. The life expectancy in most Asian countries was about 40 years in the 1950s which has risen to >60 years in the 1990s.

The stage at which hypertension, diabetes, CAD and cancer emerge as significant causes of death corresponds to a life expectancy level between 50–60 years, and at this level cardiovascular disease mortality accounts for 15–25% of all deaths. Cardiovascular diseases were on average already becoming a significant cause of death in developing countries between 1970 and 1975, whereas the corresponding period in developed countries was 50 years earlier, in the 1920s. Recent studies[13–22] indicate that CVD has become a major cause of morbidity and mortality by the year 2000.

Burkit and Trowell as well as Singh and Niaz,[24–26] after reviewing descriptive epidemiological studies from many developed and developing countries, concluded that there is usually a sequence in the emergence of chronic diseases as the diet of the developing country becomes more westernised (Figure 1). Overweight, central obesity and hyperinsulinemia come first, then appendicitis, diabetes and hypertension tend to occur early, followed after several decades by coronary heart disease, insulin resistance syndrome and gall stones, then cancer of the large bowel and finally various chronic disorders of the gastrointestinal tract and bone and joint diseases and renal diseases. Such changes have occurred more obviously in countries or population

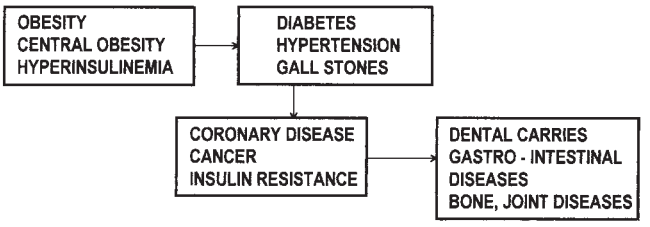

Figure 1 Sequence of emergence of chronic diseases of affluence due to interaction of gene and environment (modified from Burkitt and Trowell).[24,25]

groups undergoing rapid transition between different cultural stages. This analysis reflects cross-sectional data from different countries but the pattern has been confirmed by longitudinal studies of the evolving pattern of diseases and life expectancy in many developed and developing countries.

The dietary staple in southern China, southern India and in most Asian countries has been rice for many centuries. In north India and north China, Pakistan, Afganistan, Iran, Nepal, the main staple is wheat or corn. Traditionally fat and sugar consumption have been low and animal protein consumption especially low. The salt consumption in China and Japan was 10–20 g/day and in India it varied between 5–20 g/day. However the diet is rapidly changing in the cities to resemble that of the more affluent countries, which has been associated with marked increase in overweight, hypertension, diabetes and CAD. Such trends have been reported in most of the countries of Asia.[27–83]

The global availability of inexpensive vegetable fat has resulted in greatly increased fat consumption among low income countries such as India, China, Thailand, Philippines as well as in newly industrialised countries such as Taiwan, Hong Kong, Singapore, Korea etc. The transition has occurred at lower levels of gross national product than previously and is further accelerated by rapid urbanisation and industrialisation. In China, the proportion of upper-income persons who were consuming a relatively high fat diet (>30% en/day) rose from 22.8% to 66.6% between 1989 and 1993.[27,28] The lower and middle income classes also showed a rise from 19% to 36.4% in the former and 19.1% to 51.0% in the latter.[27,28] In India, in a recent study,[29] the intake of fruits and vegetables showed no significant difference in higher and lower social classes but the consumption of visible fat was three-fold greater in social classes 1 and 2 than social classes 3–5 (Table 1). Higher social classes also have higher risk of CVD. In Japan, there is a three-fold increase in dietary fat from 1955 when Japanese were supposed to have undernutrition. Undernutrition was fully controlled by 1965 in Japan without any increase in CAD, although dietary fat intake (14.8%) was doubled from 1955 (Table 2).[83]

According to the World Development Report,[27] in which affluence was measured by evaluation of per capita net domestic product, growth of production and the human development index (in which longevity, income and knowledge were measured), showed significant increase in almost all the Asian countries from 1960 to the 1990s. There has been a

Table 1 Social class and food intakes in Indian women

Social classes	*Coronary disease (%)*	*Total fruit vegetable (g/day)*	*Total visible fat (g/day)*	*FV/visible fat ratio*
		mean ± s.d.		
Social classes 1–2 (n = 1776)	10.1	186 ± 65	40.1 ± 16	4.63 ± 1.5
Social classes 3–5 (n = 1482)	3.5	189 ± 61	16.1 ± 5	11.73 ± 3.2

Singh *et al. Lancet*, 1999.[29]

Table 2 Percentage of nutrient intake per day by Japanese between 1955–1994

Year	*Protein*	*Fat*	*Carbohydrate*	*Energy*
1955	13.3	8.7	78.0	–
1965	13.1	14.8	72.1	–
1975	14.5	22.3	63.1	2226
1980	14.9	23.6	61.5	2119
1985	15.1	24.5	60.4	2088
1989	15.6	25.7	58.7	–
1990	15.5	25.3	59.2	2026
1994	15.8	25.8	58.4	2023

Health and Welfare Statistics Association. Data of National Nutrition Survey (Kohsci-no-Shiyyo) 1970–1997, vol 17–44.[83]

marked increase in the consumption of salt, fat and tobacco and an increase in sedentary behaviour (due to the common use of automobiles) in the last three decades of development in Asia. These developments and changes in diet and lifestyle were associated with a marked increase in the prevalence of hypertension (>160/95 mm Hg), from 2–3% in 1960 to 15–20% in 1990 in different Asian countries.

Burden of cardiovascular disease in Asia

It has been estimated that during the period of 1965–1990, cardiovascular mortality fell by 50% in Australia and by 60% in Japan.[30–32] The decline in stroke mortality has been more marked especially in Japan where there was a nonsignificant increase in coronary mortality in 1985 in some areas. The discordant trend of rising CVD mortality rates in India, China and other parts of Asia, however is in sharp contrast to the decline in the western rim of Asia. The emergence of the CVD epidemic in the developing nations of Asia during the past 2–3 decades has attracted least attention and poor public health response even within these countries.[21,22] It is not widely realised that the developing Asian countries contribute a greater share to the global burden of CVD than the developed countries of the world (Table 3). It has been estimated that 5.3 million deaths attributable to CVD occurred in the developed countries in 1990, whereas the corresponding figure for the developing nations of Asia was 6.3 million.[33] It is possible that the cause-specific mortality ascertainment methods currently used in Asia call for cautious interpretations of these estimates.[30–32,34] In a recent multinational assessment,[34] stroke ranks as the second or third leading cause of death in Hong Kong, Taiwan, South Korea and Singapore. Malaysia, Thailand, Philippines and Indonesia are countries with moderate hospital-based data on stroke. India is the only country among three-country assessment, to have some data on stroke prevalence.[34]

The conservative assumptions made by the experts suggest that the absolute burden of stroke mortality is indeed likely to be greater in developing Asia. China, Taiwan and Japan rank highest in terms of stroke mortality in the region. The mortality rates for cerebrovascular disease in these countries stand close to a hundred or higher per 100 000 population for men and women for all ages. In China,[35] stroke is the leading cause of death, while in Taiwan it currently ranks second, next to cancer, after being the main cause of death for almost 20 years from 1963 to 1982.[35] The major type of stroke in Taiwan is cerebral infarction while for Japan and China, it is cerebral haemorrhage.[36,37] In Japan twice as many men (2.1) and women (2.6) die from stroke as from CAD. Chonghna *et al*[38] found that the incidence of stroke is four times that of acute myocardial infarction in some areas of China. There are about 5 million surviving stroke patients and some 1.3 million new cases occur each year. However, in New Zealand and Australia, stroke to CAD mortality ratio was only 0.3 for men and 0.6 for women. In Japan, workers in agriculture, sales, transportation and service industries have higher rates of stroke than those in business.[39]

New Zealand, Australia, Singapore and Hong Kong have a low stroke mortality of between 50–100 per 100 000 population. Their stroke mortality rates for men in 1991/92 ranged from 39 per 100 000 population in Australia and 72 for Singapore and among women, the rates ranged from 34 per 100 000 population for Australia to 68 for Singapore.[30,31,39]

The trends of stroke mortality indicate that Japan has undergone the most substantial decline since 1970 for both men and women. The decline in Japan was 20.1% for men and 22% for women in the 1980s. Taiwan[40] has also experienced a reduction in its stroke death rate, albeit less rapidly than Japan during about the same period. Its decrease was 17.5% for men and 18.5% for women between 1972 and 1983, as compared to 43.6% and 42.4% for men and women respectively for Japan between 1970–74 and 1980–84. The magnitude of the decline in stroke mortality in Australia and New Zealand was also very rapid. In China there is mild decline in stroke mortality in some areas but in Singapore, the decline is impressive.

Table 3 Regional differences in burden of cardiovascular disease and contribution to mortality (1990)[30]

Country	*Population (millions)*	*CVD mortality (thousands)*	*Cerebrovascular mortality (thousands)*	*CVD (%) mortality*	*All causes (%) mortality*
India	849.5	2385.9	619.2	19	17
China	1133.7	2566.2	1271.1	18	18
Other Asian countries and islands	682.5	1351.6	350.4	11	9
Total	2665.7	6303.7	2240.7	–	–

Values are given as a percentage of world total mortality.

One of the most important causes of concern is the early age of CVD deaths, risk of hypertension and CAD in the developing Asian countries, particularly among south Asians[41] compared with Japan, Australia and other developed countries. In 1990, the proportion of CVD deaths occurring below the age of 70 years was 26.5% in the developed countries compared with 46.7% in the developing countries. For example, in a large developing country like India, deaths below 70 years were 52.2%.[22] It is possible that impaired fetal nutrition may have an inverse relation with CVD which may occur relatively early in life.[42,43] Adverse intrauterine influences such as poor maternal nutrition lead to impaired fetal growth, resulting in low birth weight, short birth length and small head circumference.[43] It is possible that poor nutrition in the fetus may be associated with molecular and physiological adaptations to facilitate survival. These adaptations may lead to disordered responses to environmental challenges as the child grows, due to interaction of genes and environment.[22] Only a modest increase in dietary fat and salt intake with a sedentary behaviour results in central obesity, overweight, glucose intolerance, hyperinsulinemia, dyslipidemia activation of renin-angiotensin aldosterone system and premature hypertension and CAD in early adult life in south Asians.

Prevalence of hypertension

The prevalence of hypertension in countries of Asia was as low as 2% in rural areas to 24% in urban areas.[7] According to new criteria of the WHO-ISH[23] subcommittee (>140/90 mm Hg), the prevalence appears to be 5–35% in different countries of Asia (Tables 4 and 5). The prevalence of hypertension and mean systolic and diastolic blood pressures varied from one country to another country and from one community to another community in the same country depending upon the economic development and affluence.[7,14–24]

In one meta-analysis, performed by Gupta, studies of trends in blood pressure levels and the prevalence of hypertension at various places in India were described.[14] Identification of studies was done by using computer search manual retrieval and personal records. To qualify, the study had to be population-based using well-defined randomisation techniques, with a sufficiently large sample size and reported prevalence of hypertension using standard criteria. In the MEDLINE database search, key words were hypertension, prevalence, epidemiology and human. A total of 51 articles were located, in which only 34 met the selection criteria. Most studies from India have used WHO criteria for the diagnosis of hypertension published in 1959. According to these criteria, hypertension is defined as systolic BP $\geqslant$160 mm Hg and/or diastolic BP $\geqslant$95 mm Hg, or the individual is on medical treatment for hypertension. More liberal criteria for the diagnosis of hypertension have been suggested by several investigators and initially applied to population data by the fourth US Joint National Committee (JNC-IV). According to this committee, hypertension was diagnosed when systolic blood pressure is 140 mm Hg or more and/or diastolic blood pressure is 90 mm Hg or more, or the subject is on treatment for hypertension. The fifth US Joint National Committee for detection, evaluation and treatment of hypertension in adults (JNC-V), the British Hypertension Society and the WHO-International Society of Hypertension have also adopted these guidelines.[4,23] However, only a few studies have used these guidelines in Asia.

Table 6 shows studies on the prevalence of hypertension in India performed since 1942. This table also shows population type (urban, rural or tribal), the age group studied, criteria for the diagnosis of hypertension, total sample, gender distribution of the sample and percentage prevalence of hypertension in both sexes. It is clear that both urban and rural areas in various parts of India were studied and the diagnostic criteria were initially different in various studies.[14] The age distribution of the populations studied in almost similar. The blood pressure measurement was performed at a work site, dispensary or at home, using a standardised mercury sphygmomanometer, in a sitting position.

Studies published from 1958 which used WHO criteria for diagnosis of hypertension have shown a steadily increasing trend in the prevalence of hypertension (Tables 4–6).[5,15–18,44–74] Studies from the cities of Ludhiana,[60] Bombay,[55] Jaipur[73] and Moradabad[17] showed a prevalence of more than 10%. Statistical analysis of this trend in comparable surveys showed a significant increase demonstrated by non-parametric analysis (Mantel–Haenzel $\chi^2 = 6.11$ $P < 0.01$). The prevalence of hypertension by WHO/ISH criteria also showed a steep increase from 6.2% in 1959 to 25.6% in 1998 (Table 5). According to old WHO guidelines, the prevalence of hypertension in rural populations also showed an increase (Table 6). Shah in Mumbai[49] reported a prevalence

Table 4 Population studies on prevalence of hypertension in India

First author	*Year*	*Rural/urban*	*Age group (years)*	*Criteria (⩾)*	*Total*	*Sample (No.)*		*Hypertension (%)*		
						M	*F*	*Total (n)*	*M(n)*	*F(n)*
Chopra RN[5]	1942	Urban	18–70	130/?	10000	*	*	21.40	*	*
Dotto BB[44]	1949	Urban	18–50	?	2500	2500	nil	1.24	1.24	–
Dubey VD[45]	1954	Urban	18–60	?/95	2262	2262	nil	4.24	4.244	–
Padmavati S[96]	1958	Urban	20–75	160/95	1052	708	344	1.99	1.84	2.33
Shah VV[49]	1959	Rural	30–60	160/95	5996	5996	nil	0.52	0.52	–
Padmavati S[47]	1959	Rural	20–75	140/90	648	267	381	2.93	*	*
Padmavati S[46]	1959	Urban	20–75	10/90	679	659	20	6.19	*	*
Sathe RV[48]	1959	Urban	20–80	160/95	4120	2362	1758	3.03	2.03	4.38
Mathur KS[50]	1963	Urban	20–80	160/95	1634	1408	226	4.35	3.98	6.64
Malhotra SL[51]	1971	Urban	20–58	160/95	4232	4232	nil	9.24	9.24	–
Gupta SP[53]	1977	Rural	20–69	160/95	2045	1184	891	3.57	3.55	3.59
Gupta SP[54]	1978	Urban	20–69	160/95	2023	1151	872	6.43	5.99	6.99
Dalal PM[55]	1980	Urban	20–80	160/95	5723	3148	2575	15.52	15.63	15.38
Wasir HS[57]	1983	Rural	20–69	160/95	905	464	441	5.41	3.20	7.50
Verma BL[56]	1983	Rural	30–70	160/95	3332	1523	1809	0.36	0.20	0.49
Wasir HS[57]	1984	Urban	20–60	160/95	2455	1767	688	3.18	3.85	1.45
				140/90	2455	1767	688	6.15	7.42	2.90
Baldwa VS[59]	1984	Rural	21–60	160/95	912	447	465	7.89	6.93	8.81
Sharma BK[60]	1985	Rural	20–75	160/95	3340	3340	nil	2.63	2.63	–
Sharma BK[60]	1985	Urban	20–75	160/95	1008	803	205	14.08	15.44	8.78
Dash SC[61]	1986	Tribal	20–70	160/95	4523	2870	1653	0.44	0.45	0.42
Puri DS[62]	1986	Tribal	15–82	160/95	3103	1592	1511	2.42	2.45	2.38
Hussain SA[63]	1988	Rural	20–70	140/90	5142	2887	2255	6.67	6.17	7.32
Kumar V[64]	1991	Rural	21–70	160/95	6840	3742	3098	3.83	4.01	3.62
Joshi PP[65]	1993	Rural	16–60	160/95	448	227	221	4.02	4.85	3.17
Jajoo UN[66]	1993	Rural	20–69	160/95	4045	2247	1798	3.41	2.89	4.06
Kutty VR[67]	1993	Rural	25–69	160/95	1130	*	*	17.88	*	*
Dash SC[68]	1994	Tribal	20–70	160/95	935	515	420	2.56	2.71	2.14
Gilberts EC[69]	1994	Rural	20–70	160/95	1027	456	571	12.46	*	*
Agarwal AK[70]	1994	Rural	20–70	160/95	3760	*	*	1.57	*	*
Gupta R[71]	1994	Rural	20–80	160/95	3148	1982	1166	7.08	7.60	6.20
				140/90	3148	1982	116	21.19	23.71	16.89
Singh RB[72]	1995	Urban	26–65	150/95	152	80	72	16.45	17.50	15.10
Begom R[72]	1995	Urban	26–65	150/95	460	235	225	16.96	18.60	15.20
Gupta R[73]	1995	Urban	20–80	160/95	2212	1415	797	10.99	10.32	12.17
				140/90	2212	1415	797	30.92	29.47	33.50
Begum R[15]	1995	Urban	25–64	160/95	1497	737	760	18.4	19.6	18.1
Babu BV[74]	1996	Tribal	20–60	140/90	398	217	181	9.05	3.69	15.47
Singh RB[17a]	1997	Urban	26–65	140/90	152	80	72	32.8	*	*
		Rural	26–65	140/90	162	86	76	12.9	*	*
				160/95	162	86	76	4.3	*	*
Singh RB[18]	1997	Rural	25–64	160/95	1769	894	875	4.2	4.7	3.6
				140/90	1769	894	874	17.3	17.4	17.2
Singh RB[17]	1997	Urban	25–64	160/95	1806	904	902	13.4	13.8	12.9
				140/90	1806	904	902	25.9	25.0	22.3
Singh RB[16]	1998	Urban	25–64	160/95	3212	*	3212	14.8	*	14.8
				140/90	3212	*	3212	25.6	*	25.6

M: male; F: female; ⩾ either systolic or diastolic or diastolic blood pressure equal to or more than; *not mentioned.

of 0.52 ± 0.1% and Gupta in Haryana[53] reported a prevalence of 3.6 ± 0.4%. However, in north India, recent studies have reported a high prevalence of 7.08 ± 0.5% in Rajasthan[71] and 4.3 ± 0.4% in Uttar Pradesh.[18] In south India, Kerala[67] the prevalence was as high as 17.8 ± 1.1% in a suburban village. It seems that there is a significant increase in the prevalence of hypertension in the last few decades in India (Mantel–Haenzel $\chi^2 = 5.93$, $P < 0.01$). There was also a substantial increase in mean blood pressures from the 1960s to 1998 (Table 7).

Since hypertension is the major cause of CAD and stroke, it is clear that one of the biggest challenges facing public health authorities and medical practioners is the control of hypertension, both in individual patients and at the population level. It affects 50 million people. Americans contribute to more than half a million strokes and 1.25 million coronary attacks per year in the United States alone. A few international studies have reported trends over time in the prevalence and control of hypertension. No such studies are available from developing Asian nations. The Framingham Heart Study[75] has reported the prevalence of long-term sustained hypertension in a US cohort. In this study, cohorts of men and women aged 50–59 years were analysed in 1950, 1960 and 1970. The prevalence of established hypertension in men (>160/95) increased from 16.1% in 1950 to 17.8% in 1960 and 18.7% in 1970 but the trend was not significant (Mantel–Haenzel test, $P = 0.66$). In women, there was a significant decrease in the prevalence of hypertension from 26.3% in 1950 to 21.9% in 1960 and 15.4% in 1970 ($P < 0.00$). The reduction in hypertension

Table 5 Comparable studies in urban populations

First author	*Year*	*Age group (years)*	*Place*	*Sample size*	*HTN (% ± s.e.)*
Hypertension >160/95 mm Hg					
Dotto BB[44]	1949	18–50	Calcutta	2500	1.24 ± 0.2
Dubey VD[45]	1954	18–60	Kanpur	2262	4.23 ± 0.4
Sathe RV[48]	1959	20–80	Bombay	4120	3.03 ± 0.3
Mathur KS[50]	1963	20–80	Agra	1634	4.35 ± 0.5
Malhotra SL[51]	1971	20–58	Railways	4232	9.24 ± 0.4
Gupta SP[54]	1978	20–69	Rohtak	2023	6.43 ± 0.5
Dalal PM[55]	1980	20–80	Bombay	5723	15.52 ± 0.5
Wasir HS[58]	1984	20–60	Delhi	2455	3.18 ± 0.4
Sharma BK[60]	1985	20–75	Ludhiana	1008	14.08 ± 1.1
Gupta R[73]	1995	20–80	Jaipur	2212	10.99 ± 0.7
Begum[15]	1995	25–64	Kerala	1497	18.4 ± 0.8
Singh[17]	1997	25–64	UP	1806	13.4 ± 0.7
Singh[16]	1998	25–64	Five City	3212	14.8 ± 0.7
		Mantel–Haenzel χ^2 for trend = 6.11; P = <0.01			
Hypertension >140/90 mm Hg					
Padmavati S[46]	1959	20–75	Delhi	679	6.19 ± 0.9
Wasir HS[58]	1984	20–60	Delhi	2455	6.15 ± 0.5
Gupta R[73]	1995	20–20	Jaipur	2212	30.92 ± 1.0
Singh[17a]	1997	20–65	UP	152	32.8 ± 1.1
Singh[17]	1997	25–64	UP	1806	25.9 ± 1.0
Singh[16]	1998	–	UP	3212	25.6 ± 0.9

HTN: hypertension.

Table 6 Comparable studies in rural populations

First author	*Year*	*Age group (years)*	*Place*	*Sample size*	*HTN (% ± s.e.)*
Hypertension >160/95 mm Hg					
Padmavati S[47]	1958	20–75	Delhi	1052	1.99 ± 0.4
Shah VV[49]	1959	30–60	Bombay	5996	0.52 + 0.1
Gupta SP[53]	1977	20–69	Haryana	2045	3.57 + 0.4
Verma BL[56]	1983	30–70	UP	3332	0.36 + 0.1
Wasir HS[57]	1983	20–69	Haryana	905	5.41 + 0.8
Baldwa VS[59]	1984	21–60	Rajasthan	912	5.59 + 0.8
Sharma BK[60]	1985	20–75	Punjab	3340	2.63 + 0.3
Kumar V[64]	1991	21–70	Rajasthan	6840	3.83 + 0.2
Joshi PP[65]	1993	16–60	Maharashtra	448	4.02 + 0.9
Jajoo UN[66]	1993	20–69	Maharashtra	4045	3.41 + 0.3
Kutty VR[67]	1993	25–69	Kerala	1130	17.88 + 1.1
Gilberts EC[69]	1994	20–70	Kerala	1027	12.46 + 1.0
Agarwal AK[70]	1994	20–70	UP	3760	1.57 + 0.2
Gupta R[71]	1994	20–80	Rajasthan	3148	7.08 + 0.1
Singh[17a]	1997	26–65	UP	162	4.3 + 0.4
Singh[18]	1997	25–64	UP	1769	4.2 + 0.5
		Mantel–Haenszel χ^2 for trend = 5.93; P = 0.01			
Tribal populations					
Dash SC[61]	1986	20–70	Orissa	4523	0.44 + 0.1
Puri DS[62]	1986	15–82	Himachal	3103	2.42 + 0.3
Dash SC[68]	1994	20–70	Orissa	935	2.56 + 0.5
		Mantel–Haenszel χ^2 for trend = 1.60; P = 0.21			
Hypertension >140/90 mm Hg					
Padmavati S[47]	1959	20–75	Delhi	648	2.93 + 0.7
Hussain SA[63]	1988	20–70	Rajasthan	5142	6.67 + 0.3
Gupta R[71]	1994	20–80	Rajasthan	3148	21.19 + 0.7
Singh[17a]	1997	20–65	UP	162	12.9 + 0.8
Singh[18]	1997	25–64	UP	1702	17.3 + 0.9

Table 7 Mean blood pressure in urban men 40–49 years from 1942 to 1995

Year	*First author*	*Systolic BP*	*Diastolic BP*
1942	Chopra RN[5]	120.4	73.2
1949	Dotto BB[44]	121.6	82.0
1954	Dubey VD[45]	123.5	82.5
1959	Padmavati S[46]	123.4 ± 11	86.9 ± 12
1963	Mathur KS[50]	125.2 ± 19	81.9 ± 16
1971	Malhotra SL[51]	126.2 ± 13	79.4 ± 7
1978	Gupta SP[54]	125.0 ± 15	82.0 ± 11
1985	Sharma BK[60]	128.7 ± 18	84.2 ± 15
1995	Gupta R[73]	128.8 ± 17	83.2 ± 10
1997	Singh RB[17]	130 ± 16	84 ± 11
Correlation coefficient		0.98 ($P < 0.001$)	0.46 ($P = 0.212$)

prevalence has been ascribed to a reduction in mean body mass index (BMI) and the prevalence of obesity. The Seven Country Study[76] also reported time trends in the prevalence of hypertension and changes in systolic and diastolic blood pressure. The Minnesota Heart Health Program reported that during the period 1981–1990, the prevalence of hypertension decreased by 1% every year in men and by 0.27% every year in women, with a decrease in mean systolic blood pressure. The Italian and Greek cohorts of the seven countries study showed that there was a decrease in systolic blood pressure while it increased in Yugoslavian cohorts. The prevalence of hypertension increased in Japanese cohorts and no change was seen in Dutch and Finnish cohorts. Our analysis of Indian studies shows an increasing trend in the prevalence of hypertension as well as mean blood pressures (Tables 4–7).

The International Clinical Epidemiology Network (INCLEN)[12] study, using WHO criteria showed that the prevalence of hypertension was more than 20% among six of 12 communities in various parts of Asia and Latin America. The WHO reported that hypertension is an important public health problem in developing countries and in adults aged 40–55 years, blood pressure levels were the highest among Indian men as compared to those of 20 other developing countries.[7] In the INCLEN[77] each centre (three in Thailand, two each in China, Chile and Brazil and one each in Philippines, Indonesia and Colombia) examined approximately 200 men aged 35–65 years, drawn at random from a population within their locality. Risk factors included in the study were BMI, blood pressure, blood cholesterol, and smoking of tobacco. Education, occupation, and current income were grouped into ordinal categories of socioeconomic status according to standard protocol guidelines and comparisons were made between risk factor levels within each of these categories. For blood pressure and cigarette smoking, the associations with socioeconomic status tended to be negative, more in line with the direction of association seen in the developed world, whereas for BMI, there were a number of centres which showed positive associations in China or urban and rural Thailand, Indonesia and Philippines.[77] However, the criteria of social class were not well defined in this study. Further analysis of data from the same study[78] showed that BMI was a mean 22.2 (s.d. 3.24) in the four Asian urban populations and 21.4 (s.d. 3.33) in the three Asian rural populations, which were lower than BMI (25.3 (3.7)) in the five Latin American populations. Despite the differences in mean BMI levels, statistically significant positive relationships of a similar magnitude were seen between BMI and blood pressure levels in both Asia and Latin America. The similarities of the associations between BMI and blood pressure in the two groups suggest that efforts to reduce BMI in all populations is likely to be important in reducing the risk of hypertension even in populations with BMI which is considered normal.

Table 8 Blood pressure levels in various age groups[10]

Age group	*Subjects (n)*	*Systolic*	*Diastolic*
Moradabad (north)			
25–34	354	117 (13)	74 (8)
35–44	254	121 (14)	77 (10)
45–54	171	124 (16)	80 (11)
55–64	123	132 (18)	84 (13)
Total	902	124 (17)	81 (12)
Trivandrum (south)			
25–34	285	121 (11)	78 (10)
35–44	190	124 (13)	80 (11)
45–54	154	127 (16)	82 (13)
55–64	131	134 (18)	84 (14)
Total	760	128 (17)	84 (13)
Calcutta (east)			
25–34	104	118 (13)	75 (6)
35–44	105	120 (14)	77 (6)
45–54	92	122 (14)	79 (7)
55–64	64	126 (15)	81 (8)
Total	365	122 (16)	78 (9)
Nagpur (central)			
25–34	130	120 (10)	80 (9)
35–44	108	122 (11)	83 (9)
45–54	98	130 (13)	86 (10)
55–64	69	134 (14)	86 (10)
Total	405	125 (16)	83 (9)
Bombay (west)			
25–34	189	120 (13)	80 (8)
35–44	237	124 (14)	82 (9)
45–54	211	128 (14)	84 (9)
55–64	143	131 (15)	84 (10)
Total	780	126 (16)	83 (10)
Total of the five cities			
25–34	1062	119 (12)	77 (8)
35–44	894	122 (13)	80 (9)
45–54	726	126 (14)	82 (10)
55–64	530	131 (16)	84 (10)
Total	3212	125 (17)	82 (11)
Pearson's *r* value		0.45	0.19
Regression coefficient		6.12	3.22
Kendal's *r* value		0.376	0.306

Values are given as the mean (standard deviation).
$P < 0.01$ for all differences.

The Five City Study[10] was a cross-sectional survey among 3257 women, aged 25–64 years from the cities of Moradabad ($n = 902$), Trivandrum ($n = 760$), Calcutta ($n = 410$), Nagpur ($n = 405$), and Mumbai ($n = 780$) (Tables 8–12). All subjects after pooling of data were divided into social class 1 ($n = 985$), social

class 2 ($n = 790$), social class 3 ($n = 674$), social class 4 ($n = 602$) and social class 5 ($n = 206$) based on five different attributes of socioeconomic status (Table 1). The prevalence of hypertension, obesity, and central obesity, diabetes mellitus, and sedentary lifestyle were significantly associated with higher social classes. Mean age, body weight, body mass index, waist-hip ratio, systolic and diastolic blood pressure, total cholesterol and 2-h blood glucose were significantly positively correlated with social class. Higher social classes 1–3 were more common in Trivandrum and Bombay than Moradabad. The prevalence of hypertension and overweight were also more common in Trivandrum, south India and Bombay, west India compared to Moradabad in north India.[16] The prevalence of hypertension and mean systolic and diastolic blood pressure showed a significant increase with age in all the cities (Tables 8 and 9). Risk factors such as mean age, body weight, body mass index, overweight (>23 kg/k^2), sedentary lifestyle and salt intake (>6 g/day) showed significant association with hypertension (Tables 10 and 12) than non-hypertensive subjects.[16] Undernutrition was more common in populations with a lower prevalence of hypertension.[10] The Framingham study classification of hypertension[10] (>140/90 mm Hg) in the total population from five cities showed that women who were known hypertensives obtained drugs at various centres.[16] The prevalence of hypertension according to this classification revealed that isolated diastolic hypertension was

Table 9 Prevalence of hypertension in different age groups in five cities

Age groups	*Subjects (n)*	*>140/90 mm Hg*	*>160/95 mm Hg*
Moradabad			
25–34	354	33 (9.3)	17 (4.8)
35–44	254	65 (25.6)	28 (11)
45–54	171	64 (37.4)	44 (25.7)
55–64	123	40 (32.5)	28 (22.8)
Total	902	202 (22.3)	117 (12.9)
Trivandrum			
25–34	285	35 (12.3)	18 (6.3)
35–44	190	60 (31.5)	25 (13.1)
45–54	154	74 (48.0)	54 (35.0)
55–64	131	65 (49.6)	41 (31.2)
Total	760	234 (30.7)	138 (18.1)
Calcutta			
25–34	104	10 (9.1)	6 (5.5)
35–44	105	21 (20.0)	14 (13.3)
45–54	92	24 (26.0)	15 (16.3)
55–64	64	15 (25.4)	8 (13.5)
Total	365	70 (19.1)	43 (11.8)
Nagpur			
25–34	130	16 (12.3)	4 (3.1)
35–44	108	28 (25.9)	10 (9.2)
45–54	98	36 (36.7)	24 (24.5)
55–64	69	18 (26.0)	12 (17.4)
Total	405	98 (24.2)	50 (12.3)
Bombay			
25–34	189	17 (9.2)	10 (5.3)
35–44	237	41 (17.3)	27 (11.3)
45–54	211	103 (48.8)	60 (28.5)
55–64	143	58 (40.8)	36 (25.4)
Total	780	219 (28.0)	133 (17.0)
Total for the five cities			
25–34	1062	111 (10.4)	55 (5.2)
35–44	894	215 (24.0)	104 (11.6)
45–54	726	301 (41.4)	197 (27.1)
55–64	530	196 (36.9)	125 (23.6)
Total	3212	823 (25.6)	481 (14.8)
χ^2 for trend		218.6	216.7
P values		<0.002	<0.005

Values are expressed as percentages.

Table 10 Clinical characteristics of subjects with hypertension and normotension in five cities

Risk factors	*Hypertensives (>140/90 mm Hg)*	*Normotensives*
Moradabad	*n* = 202	*n* = 700
Mean age (years)	45.4 ± 14[a]	35.5 ± 11
Body weight (kg)	53.6 ± 13[a]	50.0 ± 8
Body mass index (kg/m^2)	23.6 ± 2.6[a]	21.2 ± 2.0
Overweight (BMI >23 kg/m^2)	162 (80.1)[b]	232 (36.0)
Sedentary lifestyle	190 (94.0)[b]	345 (49.2)
Salt intake (>6 g/day)	181 (89.6)[b]	152 (21.7)
Trivandrum	*n* = 234	*n* = 526
Mean age (years)	42.5 ± 15[a]	34.6 ± 10
Body weight (kg)	58.1 ± 14[a]	52.8 ± 12
Body mass index (kg/m^2)	24.0 ± 3.0[a]	22.0 ± 3
Overweight (BMI >23 kg/m^2)	210 (89.7)[b]	206 (39.1)[b]
Sedentary lifestyle	212 (90.6)[b]	235 (44.6)
Salt intake (>6 g/day)	195 (83.3)[a]	306 (58.1)
Calcutta	*n* = 70	*n* = 295
Mean age (years)	46.6 ± 12	37.5 ± 10
Body weight (kg)	58.2 ± 13	54.2 ± 12
Body mass index (kg/m^2)	24.6 ± 2.8[a]	23.1 ± 2.4
Overweight (BMI >23 kg/m^2)	63 (90.0)[a]	110 (37.3)
Sedentary lifestyle	52 (74.2)	152 (51.5)
Salt intake (>6 g/day)	58 (82.5)	155 (52.5)
Nagpur	*n* = 98	*n* = 307
Mean age (years)	43.5 ± 10[a]	36.5 ± 8
Body weight (kg)	50.5 ± 12[a]	46.0 ± 10
Body mass index (kg/m^2)	24.6 ± 2.5[a]	22.0 ± 2.2
Overweight (BMI >23 kg/m^2)	82 (83.6)[a]	122 (39.7)
Sedentary lifestyle	86 (87.7)	118 (38.4)
Salt intake (>6 g/day)	88 (89.7)	182 (59.3)
Bombay	*n* = 219	*n* = 561
Mean age (years)	44.5 ± 11[a]	40.2 ± 10
Body weight (kg)	57.2 ± 12	51.5 ± 11
Body mass index (kg/m^2)	24.2 ± 2.5[a]	22.7 ± 2.3
Overweight (BMI >23 kg/m^2)	199 (90.9)[b]	233 (41.6)
Sedentary lifestyle	193 (88.3)[b]	257 (45.9)
Salt intake (>6 g/day)	202 (92.2)	346 (61.6)

Overweight is defined as a body mass index >23 kg/m^2. The numbers in parentheses are percentages. [a]$P < 0.05$; [b]$P < 0.01$.

Table 11 Framingham study classification of hypertension (>140/90 mm Hg) in the total population from five cities

Subtypes of hypertension	*Women (n = 3212)*
Borderline isolated systolic hypertension	481 (14.9)
Definite isolated systolic hypertension	96 (2.9)
Isolated diastolic hypertension	1622 (50.5)
Definite or established hypertension	605 (18.8)

more common than other subtypes of hypertension (Table 11). In another study by Gupta *et al*,[3,7] isolated diastolic hypertension was highly prevalent, being common in both sexes. Borderline isolated systolic hypertension was also significantly prevalent, although its overall prevalence was less than that in the Framingham data.[79] The prevalence of definite isolated systolic hypertension was low, in contrast to studies from industrialised western populations in which definite isolated systolic hypertension is an important subtype of hypertension especially in the elderly.[3,80] A lower prevalence of isolated systolic hypertension among Indians might be due to there being fewer elderly people in India on account of lower life expectancy of Indians (61.5 years) compared to western populations (>75 years). Bulpitt has termed this phenomenon an exhaustion of susceptibles.[80]

There are a very few studies from Asia, which have reported electrocardiographic changes in patients with hypertension in the population-based studies.[17,71,73] A low prevalence of electrocardiographic Q waves has been observed in two Indian studies which have reported on this finding indicating a lower incidence of arteriosclerosis.[17,73] It is possible that south Asian immigrants to developed countries may have a greater incidence of electrocardiographic changes, due to their increased susceptibility to insulin resistance[8,81] which may be decreased by a diet rich in n-3 fatty acids.[82] Higher body mass index in association with hypertension and a higher fat diet has been observed in Japan. WHO reported that hypertension is the most important public health problem in developing countries.[7] It was also emphasised that in adults aged 40–55 years, blood pressure levels were the highest among Indian men as compared to those of 20 other developing countries.[83–90] The prevalence of hypertension was also greater in Tibet and Nepal (Table 13). In subjects aged 50–59 years, the prevalence of hypertension was greater in all the countries of Asia than in subjects 10 years younger (Table 4). Mean systolic and diastolic blood pressures also showed a significant increase in the last few decades (Table 13) in India. The prevalence of overweight (BMI >25 kg/m^2) and hypertension was reported in several studies from Asia (Table 14). The prevalence of overweight and hypertension was most common in New Zealand, Australia and Japan followed by Iran, urban India, Singapore, urban Sri Lanka and urban Philippines (Table 14).[10,16,19,20,78,89–98]

Table 12 Risk factors among hypertensives and normotensives in all of the women studied in the Five Cities Study

Risk total	*Hypertensives (>140/90 mm Hg) (n = 823)*	*Normotensives (n = 2389)*
Mean age (years)	44.2 ± 15[b]	36.8 ± 12
Body weight (kg)	55.7 ± 14[a]	50.9 ± 12
Body mass index	24.2 ± 2.7[a]	22.2 ± 2.7
Overweight (BMI >23 kg/m^2)	716 (86.9)[a]	978 (40.9)
Sedentary lifestyle	733 (89.8)[b]	1008 (42.2)
Salt intake (>6 g/day)	724 (87.9)[a]	1142 (47.8)

Numbers in parentheses are percentages.
BMI = body mass index.
[a]$P < 0.01$; [b]$P < 0.01$.

Epidemiologic studies in the eastern Mediterranean region report the prevalence of hypertension up to 30% among adults in urban areas. In one cross-sectional survey, Sarraf-Zadigan and Aminiknik studied 8639 men (n = 2505) and women (n = 3413) aged 19–70 years from Isfahan city (n = 7857) and surrounding rural areas (total n = 782, men = 178, women = 436).[19] The prevalence of hypertension by new criteria (21 *vs* 7%, $P < 0.01$) as well as by old WHO criteria (27 *vs* 10, $P < 0.01$) were significantly greater in urban than rural subjects. Mean systolic and diastolic blood pressures for various age groups were also significantly greater in urban than in rural subjects (Tables 13 and 14). In a more recent cross-sectional survey among 2200 subjects (1000 men and 1200 women) from Isfahan city,[20] aged 19–70 years, the prevalence of hypertension (>160/95 mm Hg) was 16.8% in men and 19.4% in women. According to new criteria (>140/90 mm Hg), the prevalence of hypertension was 28.3% in women and 28.0 in men. Sedentary behaviour was more common in women than men (60.3 *vs* 45.9%). Obesity (BMI >30 kg/m^2) was also more common in women than men (22.7 *vs* 9.8%). However, the prevalence of hypertriglyceridemia (>4.4 mmol/L) was more common in men than women (11.4 *vs* 6.4).

In Sri Lanka[89] in one cross-sectional survey,[14] the prevalence of hypertension and CAD was studied in 975 men, aged 35–59 years. The prevalence of hypertension by WHO criteria (>160/95) was 17% and median systolic blood pressure was 120 mm Hg and diastolic blood pressure 88 mm Hg. About half (57.9%) of the subjects were current smokers, 18.4% had a BMI of >24 kg/m^2. These risk factors are similar to data from developed countries.[99–101]

In Pakistan,[102] more than 5.5 million men and 5.3 million women suffer from hypertension, which includes 17% of adults over the age of 15 years as hypertensive. The prevalence of hypertension showed an increase with age ranging from a low of 3% in urban females aged 15–24 years to 58% for urban females aged 65 years and over. Prevalence of hypertension for females is lower than that for males at a younger age and then crosses over and exceeds that for males after the ages of 35–44 years. Overall urban subjects also have a higher prevalence than rural subjects (21.5 *vs* 16.2%, $P < 0.05$). The urban population also has higher prevalence of hyperten-

Table 13 Mean blood pressure (mm Hg) and prevalence of hypertension in Asia

Country	*Population*	*Year*	*Age*	*Males*			*Females*		
				n	*Blood pressure*	*Prevalence*	*n*	*Blood pressure*	*Prevalence*
Nepal[84]	Rural	–	41–50	(109)	–	7	(155)	–	3
			51–60	(91)	–	9	(86)	–	12
China[85]	Beijing	1975	35–44	(791)	–	4	(1237)	–	5
	Urban		45–54	(880)	–	9	(995)	–	10
Tibet[86]	Rural	1979	35–44	(2652)	–	7	(3392)	–	9
			45–54	(2981)	–	18	(3241)	–	20
Shanghai[87]		1979–1982	40–49	(3490)	–	5	(952)	–	4
			50–59	(1754)	–	16	(217)	–	12
Japan[88]		–	40–49	(171)	133/79	17	(221)	128/75	10
			50–59	(186)	139/81	21	(257)	137/79	19
Republic of		–	40–49	(266)	123/82	14	(425)	122/79	10
Korea[88]	Rural	–	50–59	(116)	131/85	24	(227)	128/82	18
Philippines[88]	Urban	1976	40–49	(82)	122/82	15	(147)	116/76	8
Quezon			50–59	(82)	128/84	22	(98)	126/80	13
India[53]	Rural		35–44	(470)	–	5	(395)	–	4
			45–54	(316)	–	8	(220)	–	13
Sharma[60]	Urban		40–45	(339)	129/84	6	–	–	–
			50–59	(170)	136/91	7	–	–	–
Iran[19]	Urban		40–49	(204)	123/80	21.8	(340)	124/80	26.4
			50–59	(181)	128/82	27.9	(276)	129/81	46.4
India[17]	Urban		35–44	(290)	124/80	11.4	(254)	121/77	11.0
			45–54	(182)	130/84	25.3	(171)	124/80	25.7

sion at most age groups for men and women and it is also more common in higher social classes.

The Philippine Lipid Society and Philippine Society of Hypertension in collaboration with the Food and Nutrition Research Institute conducted a nationwide survey in 1998–1999.[103] The prevalence of hypertension (>140/90) (21%), smoking (46.6%), fasting hyperglycemia (>125 mg/dl) (41%), hypercholesterolemia (>200 mg/dl) (16%) or higher LDL cholesterol (>130 mg/dl) (22%), hypertriglyceridemia (>150 mg/dl) (18%) and low HDL (<35 mg/dl) (65%) were quite common in the population of 4541 subjects aged 20 years and above. Mean blood pressure was 124/79 mm Hg and mean blood glucose 88 mg/dl. Mean values for total cholesterol were 159 mg/dl, LDL-C 107 mg/dl. Triglycerides were 116 mg whereas HDL-C was 30 mg/dl, indicating that low HDL-C may be an important problem in the Philippines.

In Korea, disease patterns have changed from infectious disease to non-infectious disease in the 1970s. Since then, stroke has been the leading cause of death. National mortality data based on vital registration have been available since 1981. In 1998, stroke mortality per 100 000 population was 70.7 and 77.3 in males and females, respectively.[104] During 1985–1998, age-adjusted stroke mortality rates showed a decreasing trend for both sexes.[105] The decrease in the death rate was more prominent in males than in females. For males, it decreased 41% (from 70.7/100 000 to 41.6/100 000) and, for females, it decreased 30% (from 61.6/100 000 to 42.8/100 000).

In Korea, there were two nationwide blood pressure surveys which were performed in 1980 and 1990. During 1980–1990, mean systolic and diastolic blood pressure decreased significantly in men and women.[106] In 1990 prevalence of hypertension (140/90 mm Hg or more) among adults aged 30 years or more was 20.7% in males and 19.9% in females.[107] There was no significant differences in blood pressure levels between rural and urban areas. The proportion of hypertensives who were aware of hypertension was 27%, and among hypertensives, 28% treated their hypertension in 1990.[107]

Coronary artery disease has been the leading cause of mortality in Malaysia since the early 1980s.[108,109] This is partly a reflection of the increasing prevalence of risk factors for coronary artery disease in the country over the same period. Surveys done in the 1980s revealed that the prevalence of hypertension (defined as >160/95 mm Hg) was 14% in the state of Selangor[110] and 14.4% in a nationwide survey (First National Health and Morbidity Survey Report, 1986). Meanwhile a survey done in the state of Kelantan in the mid 1990s showed that the prevalence of hypertension (>160/90 mm Hg) increased from 10.1% in those with normal weight to 13.1% in the overweight and 23.3% in the obese population.[111] A Second National Health and Morbidity Survey completed in 1996[112] meanwhile revealed that hypertension (>140/90 mm Hg) was present in 29.9% in adults age 30 years and above. The same survey also showed that 8.3% of Malaysians above 30 years old are diabetics (compared to 6.3% in 1986), 30.6% above the age of 18 had ever

Table 14 Prevalence of overweight and hypertension in Asians

Study	*Overweight (body mass index >25 kg/m²)*		*Hypertension (>160/95 mm Hg)*	
	Men	*Women*	*Men*	*Women*
New Zealand, Mann *et al*, 1991[91]	55.0	38.0	23.2	14.6
Australia, NHF-RFPS, 1989[39]	50.0	34.9	19.8	15.6
Taiwan, Lyu *et al*, 1994[92,93]	–	–	22.0	22.0
Malaysia, UPM-IMR, 1992–93[39]	22.3	30.8	6.3	9.0
Japan, Okayama *et al*, 1993[94]	23.0	22.6	27.7	22.5
Kikkawa *et al*, 1992[95]				
Philippines INCLEN 1992[78]	24.0	–	–	–
Indonesia Monica-Jakarta-	22.6	23.6	19–23	11–18
Thailand INCLEN, 1992[78]	19.0	–	21.0	–
China, Folsom *et al*, 1994[97]				
Urban	–	–	9.0	11.0
Rural	–	–	12.0	6.0
Ge *et al*, 1994[98]				
Urban	–	12	–	–
Rural	–	7.5	–	–
Sri Lanka Mendis *et al*, 1994[89]				
Urban	22.5	–	17.2	–
Rural	11.9	–	16.7	–
India, Singh *et al* 1998, 1999[10,16]				
Urban		36.5	–	14.8
Singh *et al* 1997[17a]				
Rural	8.1	10.5	4.8	3.4
Urban	37.5	52.7	16.4	16.4
Iran, Sarraf *et al* 1999[20]				
Urban	47.9	62.5	16.8	19.4

smoked (24.8% being current smokers) while only 11.6% were considered to have exercised adequately. Hyperlipidaemia (>5.2 mmol/L) meanwhile was present in 55% and an increased body mass index (BMI >25) was found in 26.5%.[111]

Awareness and control

Awareness of hypertension among hypertensives has not been studied in the majority of the studies. Only 46 (11%) of men and 44 (16%) of women hypertensives were aware of their condition in a study by Gupta *et al*[73] from Rajasthan, India. The Five City Study showed that the awareness was significantly less at Moradabad and Nagpur compared to Calcutta (12% and 14% *vs* 22%, $P < 0.05$) where it was comparable with Bombay (24%) and Trivandrum (26%).[16] Only half of the women who were known hypertensives were receiving drug therapy at various centres. In a recent study by Singh *et al*, only 50 patients were known hypertensives (32 men, 18 women) and of these, two-thirds were taking regular treatment.[17] In another study[90] among 7630 employees in a town, the prevalence of hypertension was 33.2% of 2535 hypertensives, only 559 (22.0%) were aware of their hypertension. The aware hypertensives were predominantly symptomatic, overweight and had higher age and blood pressure than the unaware hypertensives. In Pakistan 70% of the hypertensives were not aware of their hypertension.[102]

In international studies,[99–101] the prevalence of unaware hypertensives among total patients of hypertension was 49% and 31% in the National Health and Nutrition Examination Survey I and III respectively.[100] The prevalence of unaware hypertensives amongst the elderly was higher than that found in a Munich blood pressure study (27%).[100,101] However, it was lower than that reported by Sharma *et al*[60] in industrial workers (87.5%) and professionals (78.8%) in Ludhiana. The prevalence of unaware hypertensives in the <35 years age group was lower than a similar age group in urban Delhi, which was comparable with Gupta *et al* in Shimla.[90] WHO also reported on the level of awareness among hypertensives from Bangladesh,[113] China,[87] India,[53,60] Philippines,[114] Sri Lanka[115] compared to Finland in 1988[116] based on earlier published studies.[7] At the beginning of 1980, the same proportion of Chinese industrial workers[87] knew about their hypertension as did men in Finland in 1972 (39%). Awareness has increased among Finnish patients of both sexes over the period of 1972–82 to 67% in men and 87% in women.[116] In a recent study, 27% of hypertensives were aware of their hypertension in the Philippines.[107]

It seems that the presence of symptoms and health education of the patient bring him to the doctor for a check-up, resulting in a diagnosis of hypertension. However, asymptomatic subjects in lower social classes remain undiagnosed hypertensives. A prevention programme for the control of cardiovascular disease in developing Asia is therefore linked to a policy relevant research agenda. Long-term cohort studies followed by intervention trials to initially identify and later modify risk factors appear to be time consuming for developing countries and are likely to be impeded by financial constraints.[117–119]

Table 15 Lifestyle guidelines and desirable level of risk factors for Asians

Factors	*Desirable values*
Energy (kcalories/day)	1900–2300
Total carbohydrate (% kcalories/day)	65.0
Complex carbohydrate (% kcalories/day)	55.0
Total fat (% kcalories/day)	21.0
Saturated fatty acids (% kcalories/day)	7.0
Polyunsaturated fatty acids (% kcalories/day)	7.0
Polyunsaturated/saturated fat ratio	1.0
n-6/n-3 fatty acid ratio	<5.0
Dietary cholesterol (mg/day)	100
Cereals (wheat, rice, millets) (g/day)	400
Fruit, vegetable and legume (g/day)	
Primary prevention	400
Secondary prevention	600
Salt (g/day)	<6.0
Body mass index (kg/m^2)	
Range (19–23 for south Asians)	19–25
Average	21.0–22.0
Waist-hip girth ratio:	
Male	<0.88
Female	<0.85
Serum total cholesterol (mg/dl) (4.42 mmol/L)	<170
Mild hypercholesterolemia (mg/dl) (4.42–5.20 mmol/L)	170–200
Hypercholesterolemia (mg/dl) (>5.20 mmol/L)	>200
Low density lipoprotein cholesterol (mg/dl) (2.32 mmol/L)	<90
Borderline high (mg/dl) (2.32–2.84 mmol/L)	90–110
High (mg/dl) (2.84 mmol/L)	>110
Triglycerides (mg/dl) (1.7 mmol/L)	<150
High density lipoprotein cholesterol (mg/dl) (0.9 mmol/L)	>35
Blood pressure (mm Hg)	<140/90
Physical activity (brisk walking or jogging (km/day))	>3
Alcohol intake (30–60 ml whisky or 1–2 glasses of red wine)	Alternate day
Meditation or prayer (min/day)	30

Modified from Indian Consensus Group, *J Nutr Environ Med*, 1996.[120]

Prevention of hypertension in Asia

Hypertension in Asian countries in relatively younger populations appears to be due to interaction of genes and environment and to nutritional inadequacies in early life. Therefore, the dynamics of the prevention effort may differ from those witnessed in the developed countries. Programmes for CVD prevention in developed countries started when the epidemic of CVD was close to its peak and the community had become aware and alarmed by its impact. Counselling for lifestyle modification to decrease the risk of disease is more readily accepted by such populations. However, developing Asian countries suffer from the double burden of pretransitional and post-transitional diseases and community awareness of the dangers of CVD is not high.[10] The transition towards becoming an industrial market is unleashing consumer aspirations that impatiently seek an affluent and indulgent lifestyle. There are new five star hospitals developing in every developing country of Asia with no clinical epidemiology department or health promotion unit. The voters in democratic countries of developing Asia, due to their ignorance, are demanding hospitals and high technology medical care without any welcome for messages of moderation. Countries with single party government such as China are therefore more successful in adopting prevention strategies which have completed a few cohort studies.[117] The task of prevention of hypertension and stroke in Asia therefore appears to be more complex than that in the developed countries.

The relatively lower levels of risk factors and low prevalence of hypertension and stroke in rural segments of the developing Asian countries, do offer a window of opportunity for early and effective control of the epidemic. Smaller body frame size, and the development of central obesity at relatively lower body mass index of 23–25 kg/m^2 especially in south Asians indicate that special guidelines for desirable levels of risk factors may be necessary for prevention of hypertension in Asia (Table 15).[120] Newer strategies for child and mother health education to prevent the acquisition or augmentation of cardiovascular risk factors in these developing communities should be combined with programmes to reverse and reduce the risk factors observed in urban communities and in the higher social classes[10] for primordial and primary prevention of CVD respectively.

There is a clear necessity and utility for cost-effective pharmacological management of high risk subjects and manifest disease with aspirin, ACE inhibitors[121] and fish oil[118] for the prevention of CAD and stroke. These low-cost life-saving interventions should be widely available and adopted by health professionals in primary and secondary care settings. Rapid growth of tertiary care hospitals should be allowed in the private sector provided they are equipped with a clinical epidemiology unit devoted to prevention. National and worldwide efforts by the World Health Organization, World Heart Federation, the International College of Nutrition,[108] International College of Cardiology, and the Asian Pacific Society of Atherosclerosis and Vascular Disease must be coordinated to recognise the epidemic of hypertension in Asia.

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