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Epidemiology of Hypertension in India

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Abstract

Hypertension is one of the modifiable major risk factors contributing to premature mortality from cardiovascular and cerebro-vascular diseases. Over the years it has emerged as an important public health problem in India. Studies carried out globally have established the risk factors of hypertension. These risk factors operate in different combinations in different parts of the world. Review of literature suggests that predictive risk factors for hypertension in Indian population are age (>50 years), male gender, socioeconomic group, anthropometric parameters like body weight especially truncal obesity, increased insulin levels, metabolic syndrome, and lifestyle conditions such as alcohol consumption. The high risk strategy of early detection and treatment does not appear to be a practical strategy; however, clinic visits can be utilized for detection and treatment. As the prevalence of risk factors are on the rise in India, focus on population strategies to keep the distribution of risk factors at lower level in the entire population is the most appropriate preventive strategy at this stage.

Key words: Epidemiology, hypertension, risk factors, prevention, India

Introduction

Raised blood pressure has emerged as an important public health problem in India as there is a direct relationship between cardiovascular risk and blood pressure. Although various operational definitions for hypertension have evolved over the years, defining hypertension has been a challenge. Sir George Pickering in 1968 stated that

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"essential hypertension is not hitherto recognized in medicine in which the defect is quantitative and not qualitative" (1). Evans and Rose high-lighted the concerns of physicians and suggested that hypertension is at that level of blood pressure at which detection and treatment do more good than harm (2). As a consequence the dividing line between hypertension and normotension can only be defined in an operational way. Nevertheless, it is one of the modifiable major risk factors contributing to premature mortality from cardiovascular and cerebro-vascular diseases. It is ranked third as a cause of disability-adjusted life-years (DALYs) losses in the world (3). Estimates for global burden of disease attributable to high blood pressure shows about 80% of the attributable disease burden occurs in low income and middle income countries like India, and over half occur in people aged 45-69 years (4). Many other risk factors tend to accompany hypertension including glucose intolerance, obesity, left ventricular hypertrophy and dyslipidemia. Control of hypertension is a complex and multidimensional process. A further understanding of its epidemiology in Indian context is needed in order to design and plan better interventions for its prevention and control.

Indian Scenario

According to World Health Report 2002, cardiovascular diseases (CVDs) will be the largest cause of death and disability in India by 2020 (5). Hypertension is directly responsible for 57% of all stroke deaths and 24% of all coronary heart disease deaths in India (6). Peculiarly mortalities associated with hypertension related disorders in developing countries like India occur before the age of 70 years compared with 23% in established market economies (7,8). Recent reviews have shown that hypertension is on the rise in India, from 5% in 1960s to 12-15% in 1990s. Pooling of epidemiological studies shows that hypertension is present in 25% urban and 10% rural subjects in India (9). Studies carried out globally to determine the risk factors for hypertension have reported that the increased risk of hypertension is mainly due to alcohol intake, lack of physical activity, nutritional factors like high fat intake, anthropometric parameters like body weight, waist to hip ratio, and metabolic disorders like diabetes mellitus. However, review of literature suggests that risk factors operate in different combinations in different parts of the world (10,11,12,13). This paper aims to review the predictive risk factors

for hypertension in Indian population and the control strategies in the light of emerging body of evidence worldwide.

Risk factors

Non-modifiable risk factors

Age

Cross sectional surveys and longitudinal studies worldwide have shown a positive relation between age and blood pressure rise in populations with diverse geographical, cultural and socioeconomic settings (14). Various epidemiological studies in India have shown age (>50 years) to be a predictor variable for hypertension (13,15,16). Experts feel that age probably represents an accumulation of environmental influences and the effect of genetic senescence in the body system. However, it has been observed that in some isolated populations in the world this rise is not evident (Yanamamo Indians in Brazil and Kenyan nomads) (14,17). When unacculturated societies adopt mainstream lifestyles, they acquire a predisposition to age related increase in blood pressure, indicating an environmental influence. Thus, there is reason to believe that age related rise in blood pressure is neither an inevitable nor a normal biological accompaniment of the ageing process (18).

Sex

There is little evidence of difference in blood pressure early in life. Beginning at adolescence, women tend to have lower blood pressure than age matched men. This difference is most apparent in young and middle aged adults. Later in life the difference narrows and may even be reversed (14). Compared to premenopausal women, postmenopausal women tend to have higher blood pressure, suggesting ovarian hormones may modulate blood pressure (19). Animal studies have provided evidence that estriol is an antihypertensive while testosterone is a prohypertensive (19). Epidemiological studies carried out in India have shown male gender to be a predictor of hypertension (13,20). However, whether sex hormones are responsible for observed gender associated differences in arterial blood pressure and whether ovarian hormones account for differences in blood pressure in premenopausal vs postmenopausal remains unclear.

Socio-economic status

In countries, that are in the post transitional stage of economic and epidemiological change, consistently higher levels of blood pressure and a higher prevalence of hypertension is noted in the lower socioeconomic

groups. However, in societies that are in transitional and pre transitional stage, higher level of blood pressure and a higher prevalence of hypertension are noted in the upper socioeconomic groups (18). This is highlighted by an ecological study of inter population difference on prevalence of hypertension in Asia, who found higher social class to be a risk factor for hypertension in India, China, Philippines, Thailand, Sri Lanka, Iran, Pakistan and Nepal as compared to the developed richer nations of the world such as Australia, New Zealand, and Japan (8). This factor is supported by other population based studies conducted in India (15,21). However, certain other studies conducted on predictors of hypertension in India have negated the impact of affluence and family size and suggest that hypertension is equally prevalent in rich and poor (13,22).

Heredity and genetic factors

A family history of elevated blood pressure is one of the strongest risk factors for future development of blood pressure in individuals. The blood pressure of first order adults relatives (parents, siblings) corrected for age and sex have been shown to aggregate at all levels of blood pressure, with a regression coefficient of 0.2-0.3 (18).

The genetic basis of hypertension is well documented in experimental models. Genetic variations interact with environ-mental exposures and achieve significance through cumulative interaction of lifetime experiences (23,24). Hypertension is regarded to be polygenic associated with angiotensin II converting enzyme (ACE II) and angiotensinogen gene polymorphisms and susceptibility imparted by any single gene is modest and quantitative (25). Whitfield et al found associations of various polymorphisms of ACE to hypertension and support the association of hypertension to the A allele of ACE4 (26). Several phenotypic characteristics have been implicated for development of hypertension such as familial dyslipidemia, metabolic syndrome, insulin resistance, body fat distribution, sodium sensitivity, non modulation of aldosterone and renal blood flow and abnormal cellular ion transport systems (Na, Li, K, H transport systems) (18). The nature of genetic contribution to development of hypertension amongst Indians need further research (27).

Modifiable risk factors

Body weight

Various cross sectional and prospective observational studies worldwide have shown a consistent association between development of hypertension and body weight. The

INTERSALT epidemiological study involving 32 countries found an independent and significant relation between BMI and blood pressure of individuals. Pooled data from all the sites showed correlation coefficient of SBP per unit BMI to be +0.775 (28). Results from the trials of hypertension prevention (TOHP), a randomized controlled multicentre trial showed a weight loss of 3.9 kg producing a decrease in SBP of 2.9 mm Hg ($p<0.01$) (29). The proportion of hypertension attributable to obesity has been estimated to be 30-65% in the western population (18). Epidemiological studies conducted in India support the association between weight and development of hypertension and can be considered as a strong predictor of its risk of development (15,21,22,30,31,32).

Central obesity and metabolic syndrome

Central obesity or truncal obesity indicated by increase in waist : hip ratio along with other components of metabolic syndrome such as insulin resistance, glucose intolerance and dyslipidemia are also associated with hypertension (33, 34, 35). The enhanced BP reactivity to dietary salt observed in subjects with the metabolic syndrome, may determine the increased BP levels commonly associated with the syndrome (36). Some investigations have revealed that South Asians are likely to have more abdominal visceral fat for any degree of BMI compared with Eupropean population (37). Several studies have noted the association of increased insulin levels with high blood pressure, in both obese and non obese individuals. This pattern has also being noticed amongst Indian population by epidemiological studies (38).

Nutritional factors

Sodium chloride: Various animal models as well as observational and interventional studies have shown an association between sodium chloride and hypertension. Experiments conducted in species closest to homosapiens, the chimpanzees showed lower sodium intake was associated with lower systolic, diastolic, and mean arterial blood pressures (39). An overview of within-population epidemiological studies with correction for regression dilution, gave a pooled (simple) regression estimate that 100 mmol lower sodium was associated with BP lower by 4.5 mm Hg systolic and 2.5 mm Hg diastolic (40). In INTERSALT study across 52 centres, average sodium excretion was significantly related to slope of BP with age, such that 100 mmol

lower sodium was associated with 2.17 mm Hg lower rise in SBP. The quantitative estimates derived from INTERSALT study were low as compared to the others due to methodological reasons (41). The DASH interventional trial showed that participants consuming control diet, a 77 mmol/d lower sodium intake (64 mmol/d vs 141 mmol/d) had reduced BP by an average of 6.7/3.5 mm Hg (42). Epidemiological studies conducted in India show that certain communities are more susceptible to habitual high salt intake and thus high blood pressure (43, 44).

Potassium: The INTERSALT and CARDIAC studies showed a significant inverse association with blood pressure of individuals. It was estimated that sodium-potassium ratio of 1.00 along with 100 mmol lower sodium intake would lower the systolic blood pressure by 3.4 mm Hg in the INTERSALT study (41).

Other micronutrients: The role of magnesium and calcium in lowering blood pressure has been studied in various intervention trials. In a review of 19 randomized trials of calcium supplementation, Cutler and Brittain reported pooled differences of -1.8/-0.7 mm Hg, but with wide confidence limits. More studies are required in potentially susceptible subgroups, such as those with low dietary calcium and high dietary sodium intake (45). Although there is considerable literature on an inverse association between water hardness and cardiovascular mortality, review of specific studies of magnesium intake and BP changes give inconsistent results (46).

Protein intake

Observational and clinical studies have shown that high protein intake, particularly plant protein reduce blood pressure (47, 48). The role of animal protein in reducing blood pressure has so far shown inconsistent results. The exact mechanism(s) linking plant or total protein to BP are still unclear. Further research is needed to confirm the association and to elucidate the exact mechanism.

Alcohol

Many studies have demonstrated a positive relation between alcohol consumption and blood pressure (49). The INTERSALT study also concluded that heavy and binge drinking were associated with higher blood pressures, thus exhibiting that both the amount of alcohol as well as the pattern of consumption have an effect on blood

pressure (50). Anand et al. found a high prevalence of alcohol consumption (29%) in a prevalence study conducted to find the risk factors of non-communicable diseases in urban Haryana (51). Similar findings were reported by Malhotra et al. in their study in rural Haryana (15). Various other epidemiological studies conducted in India have shown an association between prevalence of hypertension and alcohol consumption (21,22,30,31,32).

Stress

There is evidence that various forms of acute mental stress increase blood pressure independent of other confounding variables. A systematic review conducted to assess the effect of psychological stress on blood pressure increase showed individuals who had stronger responses to stressor tasks were 21% more likely to develop blood pressure increase when compared to those with less strong responses (OR: 1.21; 95% CI: 1.14-1.28; p <0.001). Although the magnitude of effect was relatively small, results suggest the relevance of the control of psychological stress to the non-therapeutic management of high blood pressure (52). However, the body of evidence so far is inconsistent and inconclusive on the mode of causality and further research is needed in this area (29).

Tobacco smoking

Cigarette smoking causes various adverse cardiovascular events synergistically with hypertension and dyslipidemia. Smoking causes an acute increase in blood pressure (BP) and heart rate and has been found to be associated with malignant hypertension. Nicotine acts as an adrenergic agonist, mediating local and systemic catecholamine release and possibly the release of vasopressin. Paradoxically, several epidemiological studies have found that BP levels among cigarette smokers were the same as or lower than those of nonsmokers (53, 54). Examination of the annual health survey data of England (1994-1996) to investigate the association between blood pressure and hypertension revealed that independent chronic association of smoking on blood pressure are small and association of hypertension with smoking is a complex interaction of smoking, alcohol intake and BMI.

Control measures

Prevention of hypertension is a challenge for India. Our society is in a state of economic transition, with deleterious changes in lifestyle accompanying economic development. Global projections have shown that over 80% of the attributable disease burden

caused by hypertension will be faced by low and middle income countries such as India (4). Prevention of hypertension requires two strategies: identifying individuals with high blood pressure who are at increased risk of developing complications (high risk strategy) and reducing the risk of developing high blood pressure in the population as a whole (population strategy) (56).

So far, preventive measures have largely focused on the high risk strategy with early detection (of those at the top end of BP distribution) and treatment as the mainstay of preventive efforts. However, this does not entirely eliminate the risk of morbidity and mortality as interventions may not be completely adhered to or may occur late in the natural history of the disease and may not completely eliminate the risk of complications. The MRFIT screening cohort follow up data clearly highlights this fact that even under optimal conditions (which are seldom achieved), the treatment and control of hypertension will influence no more than 70% of the cardiovascular disease related to blood pressure in the community (57).

Another essentially fundamental fact ignored by the high risk strategy is that a large number of people exposed to a low risk is likely to produce more cases than a small number of people exposed to a high risk (56). Therefore, the effect of high risk strategy may be more limited than we imagine, as the community benefit depends not only on the benefit each individual receives but also on the prevalence of the risk factor. The prevalence of risk factors for hypertension such as tobacco, alcohol, sedentary lifestyle is on a rise in our society as exemplified by the globalization of the production and marketing campaigns of tobacco and alcohol industries and lifestyles associated with these. Hence a more aggressive population strategy with an ambitious endeavour to lower the whole distribution of the risk factors associated with hypertension by some measure in which all participate is the only ultimate answer to the control of hypertension.

Conclusion

The clinical importance of elevated blood pressure has been known since ancient times. However, with rapid changes in lifestyle patterns, hypertension has increasingly attained public health importance in India. Recent studies have shown changes in epidemiological pattern of hypertension with lifestyle diseases like hypertension contributing to nearly half of the total cardiovascular disease burden and an

ever decreasing gap in sex and rural urban divide. There is a pressing need for initiating actions to control this problem. While prevention of complications through good management of established cases as well as early diagnosis is essential, primary prevention through population strategies is critically important. Strong advocacy is required in India for appropriate policy responses for population strategies from the government.

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