

INTRODUCTION

Hypertension, also known as high or raised blood pressure, is a global public health issue. It is one of the most common lifestyle diseases today, prevalent in every third person and contributes to the burden of heart disease, stroke, kidney failure, premature mortality and disability. It is reported to be the fourth contributor to premature death in developed countries and the seventh in developing countries (WHO, 2013).

According to Indian hypertensive guidelines hypertension in adults aged 18 years and older is defined as Systolic Blood Pressure (SBP) of 140 mmHg or greater and/or Diastolic Blood Pressure (DBP) of 90 mmHg or greater or any level of blood pressure in patients taking antihypertensive medication (Shah *et al.*, 2013).

Hypertension may be classified by aetiology into two groups: essential (or primary) hypertension and secondary hypertension. Essential hypertension is diagnosed when no identifiable cause can be found and accounts for 95 per cent of all cases of hypertension. Secondary hypertension, where a cause can be identified, accounts for less than 5 per cent of cases. Essential hypertension is now recognised as a heterogeneous condition. In classical essential hypertension both the systolic and diastolic blood pressures are high, but isolated systolic and isolated diastolic hypertension are also seen. Malignant or accelerated hypertension is associated with a rapid rise in arterial pressure and, if untreated, results in rapid end-organ damage and death (Warrel *et al.*, 2015).

The Global Burden of Disease (GBD) study 2010 states that high blood pressure ranked as the leading single risk factor for global burden of disease. Looking back at findings from the GBD study 1990, the GBD 2010 study identifies a shift from communicable diseases in childhood to non-communicable disease in adulthood. This is most notable in regions such as sub-Saharan Africa and South

Asia, where a substantial proportion of the world's population resides and where high blood pressure has have an especially large effect on disease burden (Bromfield and Muntner, 2013).

Number of studies demonstrates that individuals with blood pressure >120/80 mm Hg, but <140/90 mm Hg, termed as prehypertension by WHO, have an increased risk of hypertension, cardiovascular disease and early death from cardiovascular causes. A survey conducted in nine states of India by the National Nutrition Monitoring Bureau (NNMB) reports the pooled estimate of prehypertension is in the range of 40-60 per cent, a precursor condition with high likelihood of converting into hypertension if left unaddressed (Ray *et al.*, 2011).

There is a misconception among the general public that high blood pressure affects only the old people and youngsters need not have to worry until they reach at least 40 years old. Contrary to this popular belief, statistics have proven high blood pressure does not discriminate based on age, and both young and old are equally affected by this disease. The sad part is that most people who have this disease are not aware of it because it has practically no symptoms, but the consequences are deadly. Since it has no symptoms, it can remain undetected for many years. If undetected and not treated properly, it can lead to death, and is therefore referred to as a silent killer (Nadkarni, 2010).

In 2008, worldwide, approximately 40 per cent of adults aged 25 and above have been diagnosed with hypertension; the number of people with the condition rose from 600 million in 1980 to 1 billion in 2008. The prevalence of hypertension is highest in the African region at 46 per cent of adults aged 25 and above, while the lowest prevalence at 35 per cent is found in the Americans. Overall, high-income countries have a lower prevalence of hypertension 35 per cent than other groups at 40 per cent. (WHO, 2008 and WHO, 2011). Not only is hypertension more prevalent in low- and middle-income countries, there are also more people affected because more people live in those countries than in high-income countries. Further, because of weak health systems, the number of people with hypertension

who are undiagnosed, untreated and uncontrolled are also higher in low- and middle income countries compared to high-income countries (WHO, 2013).

In India, hypertension is the leading Non Communicable Disease (NCD) risk and estimated to be attributable for nearly 10 per cent of all deaths (Patel *et al.*, 2011). According to Sen (2014) “One in three” Indian adults has high blood pressure. Adult hypertension prevalence has risen dramatically over the past three decades from 5 per cent to between 20-40 per cent in urban areas and 12-17 per cent in rural areas. The number of hypertensive individuals is anticipated to nearly double from 118 million in 2000 to 213 million by 2025. In any case, in thirty years India’s population will overcome China and even at the current rate of hypertension, will have the largest number of hypertension in the world. India will have label as hypertension capital of world. Hence there is an urgent need to address this problem (Joshi and Parikh, 2007).

Identification of subjects with pre-hypertension around 30 years of age and using high risk strategy of prevention of hypertension among them is important in the prevention of hypertension in rural and urban societies to prevent the emerging pandemic of hypertension (Kokwar *et al.*, 2012).

Hypertension is a known problem in Tamil Nadu, although accurate statistics are difficult to come by. Among urban residents >18 years living in Chennai the prevalence of prehypertension was reported as 47 per cent. The prehypertension is highest in the age group of 30-39 years (36 per cent) (Gupta *et al.*, 2011).

Yadav *et al.*, (2008) state that prehypertensive subjects have greater obesity, central and abdominal obesity and have an increased prevalence of diabetes compared to normotensive subjects. The subjects with prehypertension are 1.65 times as likely to have at least 1 other adverse cardiovascular risk factor than those who are normotensive and to have 1.8 times increased risk of cardiovascular events.

Raised blood pressure is a major risk factor for coronary heart disease and ischemic as well as hemorrhagic stroke. Blood pressure levels have been shown to

be positively and continuously related to the risk for stroke and coronary heart disease. In some age groups, the risk of cardiovascular disease doubles for each increment of 20/10 mm Hg of blood pressure, starting as low as 115/75 mm Hg. In addition to coronary heart diseases and stroke, complications of raised blood pressure include heart failure, peripheral vascular disease, renal impairment, retinal hemorrhage and visual impairment (WHO, 2015).

As per the World Health Statistics (2012), of the estimated 57 million global deaths in 2008, 36 million (63 per cent) were due to non communicable diseases. The largest proportion of NCD deaths is caused by cardiovascular diseases (48 per cent). In terms of attributable deaths, raised blood pressure is one of the leading behavioural and physiological risk factor to which 13 per cent of global deaths are attributed.

Health data compiled from more than 190 countries show that heart disease remains the No. 1 global cause of death with 17.3 million deaths each year. That number is expected to rise to more than 23.6 million by 2030. Stroke remains the No. 2 cause of death in the world. The stroke death rate (the number of deaths per 100,000 people) went down between 1990 and 2010. However, the number of people having first and recurrent strokes each year went up, reaching 33 million in 2010 (American Heart Association, 2015).

Meta-analysis of multiple cardiovascular epidemiological studies in India, reported that prevalence rates of coronary artery disease and stroke have more than tripled in the Indian population. In the INTERHEART and INTERSTROKE study, hypertension accounted for 17.9 per cent and 34.6 per cent of population attributable risk of various cardiovascular risk factors for coronary artery disease and stroke respectively (Kantha and Indira, 2015).

India has the highest burden of Cardio Vascular Disease (CVD) and about 9.2 million were lost in 2000 and 17.9 million are expected to be lost in 2030. The incidence of coronary artery disease in young population has been reported to be 12 to 16 per cent in Indians. The effect of CVD is felt on the productive workforce from 35–65 years (Reddy 2007). A study by Cardiological Society of India 2012

revealed that age of getting heart attacks in India has fallen from 40 to 30 in the last decade. Twenty-five per cent of heart attack deaths occur in people less than 40 years. Four people die of heart attack every minute in India and the age group is mainly between 30 and 50 years. Nine hundred people under 30 die due to heart disease in India every day (The Hindu, 2015).

This rate is higher than most ethnic groups including Chinese, Japanese, Americans and Europeans. Heart diseases among the Indians occur five to 10 years earlier than in other populations around the world. According to the INTERHEART study, the median age for first presentation of acute Myocardial Infarction (MI) in the South Asian (Bangladesh, India, Nepal, Pakistan, Sri Lanka) population is 53 years, whereas that in Western Europe, China, and Hong Kong is 63 years (Nath, 2014).

Stroke is a major cause for loss of life, limbs and speech in India, with the Indian Council of Medical Research (ICMR) estimating that in 2004, there were 9.3 lakh cases of stroke and 6.4 lakh deaths due to stroke in India, most of the people being less than 45 years old. Blood pressure is the most consistent and powerful predictor of stroke. A systolic blood pressure >115 mm Hg explains 60 per cent of the population-attributable risk of stroke. By 2015, India will report 1.6 million cases of stroke annually, at least one-third of whom will be disabled. (Sinha, 2010).

Studies from all over the world have shown that, increasing age, body mass index, waist hip ratio and impaired glucose tolerance/ diabetes are independent risk factors for development of both hypertension and pre hypertension (Gupta *et al.*, 2011).

Bastos *et al.*, (2011) opined that there are several factors trigger the onset of hypertension. In India, industrialization, urbanization and migration have played havoc with healthy lifestyles. Nevertheless it is the Industrial revolution with the widespread use of refined vegetable oils, refined cereal grains, and refined sugars and the modern age with the advent of the “junk food” industry, generalized physical inactivity, reduction in sleep time and quality coupled with increased

chronic psychological stress that brought about the most disruptive and maladaptive changes, which may have serious pathophysiological consequences like cardio vascular disease, diabetes, hypertension and obesity.

Discernable changes in the per capita calorie consumption over the past few decades in India has not been reported, but noteworthy increases in edible oil and fat consumption has been documented in the rural as well as the urban areas. Oil intake had increased from 18 g per person daily in 1990–92 to 27 g per person daily in 2003–05, while fat intake increased from 41 g to 52 g per person daily during the same period. Aggregate consumption data also indicate an increasing trend in edible oil consumption, which has grown from 9.7 million tonnes in 2000-01 to 14.3 million tonnes in 2007–08, and 17.5 million tonnes in 2012–13 (Jha and Kumar, 2013) with a large proportion of unhealthy oils high in saturated and trans-fats that are linked to NCDs, particularly CVD (Mohan *et al.*, 2013).

Higher habitual intakes of saturated and trans fats are independently associated with increased subclinical atherosclerosis in diverse populations including Asian Indians with 1g of trans fat having the same impact as 10 g of saturated fat. Asian Indians consumed more fried foods and high-fat dairy products. (Merchant *et al.*, 2008).

An UN university estimates that one third of all fat in India is consumed by the five per cent of the population, the urban rich, and on an average, more than 30 per cent of their energy intake is from fat. Further, fruits and vegetable consumption which provides protection against non communicable diseases is inadequate, particularly so among the poor. On the same note, physical activity, another protective factor has also been found to be less than recommended levels. (IIPS, 2006).

Foods with trans-fats and other saturated fats are not good. They are universally bad, affecting both the heart and arteries, raising bad (low-density lipoprotein) cholesterol while lowering good high-density lipoprotein cholesterol, and contributes the most to high blood pressure diets. They're found in many snack foods and baked goods, and almost all fast foods and frozen foods. Even the

muffins and doughnuts at the supermarket often have more trans fats than any other type of food and could very well be a big part of one of the high blood pressure diets. Those fast foods have lots of sodium too – excess levels of sodium may increase the risk of hypertension (www.cadiresearch.com, 2012).

In 12.4 year of follow up study by Aerde *et al.*, (2013) observes that the intake of high fat dairy products is associated with increased risks of CVD mortality. The risk of elevated blood pressure is positively associated with red and processed meat intake, whereas it is inversely associated with intakes of whole grain, fruits, nuts and milk. The risk of hypertension tends to be inversely related to low-fat dairy intake (Engberink *et al.*, 2009).

Many research studies have been showing a positive linear relationship between the prevalence of hypertension and mean sodium intake across populations. Both systolic and diastolic blood pressure significantly increases with increase in total dietary salt among hypertensive and normotensive subjects which is a leading risk for cardiovascular disease, a major risk factor for premature deaths globally .The recent global burden of disease study reports excess salt intake to be the 7th leading cause of mortality in South East Asia Region which is much higher than in rest of the world (11th globally), highlighting the adverse impact of high intake in countries like India (Dhemla and Varma, 2015).

The existing data indicates that population salt intake is very high across different regions of India with the average daily intake ranging between 9 and 12 grams daily. This is extremely high compared to the World Health Organization (WHO) recommended intake level of 5 g daily. The intake is reported to be higher in urban settings compared to rural settings. India consumes 55-58 lacs tons of edible salt annually and can reduce incidence of stroke by 25 per cent and heart attacks by 10 per cent by cutting down on salt consumption (Dobe, 2013).

The typical westernized diet substantially lower the average intake of potassium content (2620 mg/d) than its sodium content (3271 mg/d), which is due to the use of table salt, a high intake of processed foods (with added salt), and the displacement of potassium-rich foods (eg: fruit and vegetables) by potassium-poor

foods, such as vegetable oils, refined sugars, whole grains, and dairy products. This inversion of potassium and sodium concentrations is a recent event in human evolutionary history. It is believed to contribute to hypertension (Cordian *et al.*, 2005).

In modern society people prone to stress in all walk of their life. Stress has a direct impact on the heart, as it leads to the release of substances such as catecholamines and cortisol, which are not good for the functioning of heart. (Kataki, 2015).

Negative emotions are strongly related to the development of heart diseases. A reduction in positive mood and increase in worry can reduce blood supply to the heart within 15 min, which may lead to "silent transient myocardial ischemia." Chronic stress, personality characteristics, and emotional states are associated with essential hypertension. Chronic stress can contribute to the development of hypertension by enhancing sympathetic nervous system activity and thus causing pathological effects (Chaudhuri *et al.*, 2014).

Diverse health and life style transition increases the hypertension rapidly in most Low and Middle Income Countries (LMICs). In 2001, it accounted for 10 per cent of global healthcare expenditure underlining the considerable economic implications to resource constrained health systems, particularly those in LMICs. Apart from health implications it has huge societal, developmental and economic costs. There is also noteworthy income loss to families affected by hypertension not only due to illness but also due to care giving and premature death. In 2004, the annual income loss from NCDs among working adults in India was 251 billion (about US\$ 50 billion) and that due to hypertension alone amounted to 43 billion. Further, hypertension was also a leading cause for hospitalizations and outpatient visits (Mahal *et al.*, 2010).

WHO study in 36-country reported that in most countries, including India, a month's treatment with just one anti-hypertensive medication costs 1.8 day's wages (Maaikie *et al.*, 2010). This is even more unaffordable if multiple drugs, as this is usually the case with hypertension treatment, are necessary for

attaining treatment targets, and if more than one family member has hypertension (Joshi *et al.*, 2007, Mohan *et al.*, 2013).

Reports also indicate the reversal of the social gradient whereby the poor suffer increased exposure to risks such as tobacco use, hypertension and acquiring diseases such as CVD and diabetes, a situation similar to that observed in developed countries that already have undergone health transitions (Reddy *et al.*, 2007, Kar *et al.*, 2010).

These factors are further compounded by the poor lacking access to expensive medical care once disease occurs leading to widening disparities in care and social inequity. India cannot afford the resource intensive model of health-care to address hypertension and non communicable disease and should, therefore, prioritize population based prevention approaches requiring multi-sectoral actions across non-health sectors to minimize population risk factor exposure in tandem with evidence based clinical approaches focused on early detection and treatment, which can maximize the gains for population health (Mohan *et al.*, 2013).

In many cases, failure to achieve blood pressure goals may be attributable to the poverty of patient's knowledge, perception, attitudes and lifestyle practices. Assessing the knowledge, perception, attitudes and lifestyle practices of hypertensive patients is vitally important in achieving hypertension control goals at the population level and also for meeting quality standards in health care deliver (Lyalomhe and Lyalomhe, 2010).

Screening as a tool for greater hypertension detection and awareness is important. Opportunistic screenings for blood pressure in all adults should be performed at every healthcare system encounter. Early diagnosis is the critical step to initiating proper management and is associated with substantial reductions in cardiovascular mortality and morbidity. This approach is likely to be an extremely cost-effective strategy and is essential if a large and resource challenged country, such as India, is to control a common condition such as hypertension affecting one third of adults (Gupta and Yusufi, 2014).

Dietary pattern, lifestyle factors, environmental factors and stress management can all play roles in hypertension. Adjusting and addressing each of these factors can play a strong part in the non-pharmacological treatment of hypertension (Staff, 2013).

Dietary modification and lifestyle modifications are the main stay interventions to prevent or delay the onset of hypertension and are essential concomitant therapy for those who require pharmacological drug treatment for hypertension. These modifications include weight reduction in patients who are overweight or obese, physical activity, restricted sodium intake, the adaptation of the Dietary Approaches to Stop Hypertension (DASH) diet, moderate alcohol consumption and tobacco cessation. According to Joint National Committee on prevention, detection, evaluation and treatment of hypertension -VII ((JNC -VII) guidelines, patients whose SBP and DBP fall between 130 and 139 mm Hg and 80 and 89 mm Hg, respectively, should follow lifestyle and dietary modifications alone for a maximum of three months before receiving pharmacological agents. Patient education represents additional strategies to achieve sustained blood pressure control with minimal risk of side effects. These strategies can also empower patients to take control of their health (Iqbal, 2011).

Gupta and Guptha (2010) states that in middle aged as well as elderly subjects with mild to moderate hypertension, diet, exercise induced weight loss and sodium restriction can be sustained and are associated with significant blood pressure reductions.

A healthy lifestyle including diet is important in both preventing increased blood pressure over the lifespan and management of blood pressure in people with hypertension. Evidence based national guidelines recommend diets low in salt and high in fruits, vegetables, legumes and low fat dairy products to reduce blood pressure in hypertensive subjects and decrease hypertension risk in healthy individuals. (McGrane *et al.*, 2011).

Following healthy diet by including functional foods rich in hypotensive components is essential in the treatment of hypertension. Eating foods high in

potassium and low in sodium can also help prevent kidney disease and heart problems caused by hypertension. Furthermore, potassium benefits the health by reducing risk of stroke and premature death. Potassium plays a key role in balancing levels of sodium and other important minerals that are linked to high blood pressure. However, they also discovered that a high intake of potassium protected men from stroke—those with the lowest consumption of potassium (2.4 g per day) had a significantly increased risk of stroke when compared to men with the highest potassium intake (4.3 g). The easiest way to enjoy the potassium benefits is to eat lots of vegetables, legumes, whole grains and fruit (Whitaker, 2014).

A decrease in sodium (a major component of salt) is associated with a decrease in blood pressure. The current dietary guidelines recommend consuming no more than 2,300 milligrams of sodium per day. Special recommendations for those with high blood pressure, middle aged, or elderly, are advised to consume no more than 1,500 milligrams of sodium per day. Following the DASH dietary pattern which is rich in fruits, vegetables and low-fat dairy products with a reduced content of saturated and total fat, as well as consuming less than 1,500 milligrams of sodium per day, has been shown to lower and maintain a normal blood pressure (Bellows and Moore, 2015).

Partial replacement of dietary carbohydrate with protein helps prevent and treat hypertension (Rebholz *et al.*, 2012). Adults, who consume a high-protein diet, whether from animal or plant sources, may be at a lower risk for developing high blood pressure. Studies states that they have statistically significantly lower systolic blood pressure and diastolic blood pressure levels after four years of follow-up. They also found that consuming more dietary protein also is associated with lower long-term risks for high blood pressure. When the diet also was characterized by higher intakes of fiber, higher protein intakes led to 40-60 percent reductions in risk of high blood pressure (Buendia *et al.*, 2014).

Legumes are complex foods rich in soluble fibers and polyphenols, as well as folic acid. Legumes are the only food group predictive of survival among five long-lived elderly cohorts in Japan, Sweden, Greece, and Australia. Furthermore,

cumulative evidence from experimental research indicates that cholesterol-lowering effect of legumes is probably due to the combined effects of several bioactive components, such as protein, soluble and insoluble fibers, and phytosterols. A recent interventional trial in humans has shown that lupine kernel flour added to bread has also a positive effect on blood pressure: both the fiber and the protein were suggested to be responsible (Alissa *et al.*, 2012).

The concentrated mung bean sprout juice has potential applications in the preventive management of hypertension. Peptides from legumes protein hydrolysis have been demonstrated to exert hypotensive effects. Glu–Phe, Ile–Arg and Lys–Phe, dipeptides from pea protein digestion, have been reported to exert ACE-inhibitory activity (Malaguti *et al.*, 2014).

Meta-analysis suggests that a fiber increase of approximately 17 g/day will decrease systolic blood pressure by 1.15 mm Hg and diastolic blood pressure by 1.65 mm Hg, with soluble fiber showing a stronger effect than insoluble fiber. Protein and dietary fiber may have additive effects to lower blood pressure. One feasible approach to increasing both protein and fiber in the daily diet could be through the incorporation of legumes, a protein- and fiber-rich food (Lee *et al.*, 2008).

Angiotensin Converting Enzyme (ACE) regulates blood pressure and ACE inhibition will help reduce hypertension, cardiovascular disease and other related ailments. Banana is rich in potassium and is reportedly has antihypertensive. They are an excellent source of potassium. A single banana provides 23 per cent of the potassium that one need on a daily basis. The US Food and Drug Administration have allowed the banana industry to make official claims for the fruit's ability to reduce blood pressure. Scientists report that natural compounds in bananas act in a manner similar to anti-hypertensive drugs (Kumar *et al.*, 2012).

Concord grape juice antioxidant polyphenols reduce inflammation, blood pressure and vascular pathology in individuals with CVD (Krikorian *et al.*, 2010). Quercetin, a phenol, is one of onion's active ingredients which have been shown as anti-hypertensive. Natto, a fermented product of boiled soy beans with *Bacillus*

natto, produces ACE inhibitor activity. Gamma-Amino Butyric Acid (GABA) enriched tempeh can lower blood pressure (Pack, 2009).

Various studies recommend therapeutic lifestyle changes as the initial step in the management of hypertension. A meta-analysis showed that an average weight loss of 5.1 kg, achieved by energy restriction and / or increasing physical activity, reduced systolic blood pressure by 4.4 mm Hg and diastolic blood pressure by 3.6 mm Hg (Zhao *et al.*, 2009).

Dietary and lifestyle intervention therapy are still have an important and expanding role that complement drug therapy. There is growing evidence to support the use of several complementary and alternative medicine activities to improve blood pressure. These include yoga, certain relaxation techniques, and meditation. Various studies state that yoga can be preliminarily recommended as an effective intervention for reducing blood pressure (Hagins *et al.*, 2013).

The mechanism of the positive role of yoga/meditation appears to be the reduction of sympathetic activity by yoga. The sympathetic nervous system may initiate or maintain human hypertension and the method to reduce sympathetic tone will help in its management. Some antihypertensive drugs like reserpine, clonidine and alpha methyl dopa act by affecting sympathetic activity. Non drug measures such as meditation, yoga, biofeedback, avoidance of particular food (alcohol and caffeine) that augment sympathetic activity and regular physical exercise achieve the same antihypertensive effects though to a varying degree with the advantage of no side effects (Manchanda and Madan, 2014).

Several studies shows that the level of overall blood pressure reduction achieved by yoga is similar to that of other lifestyle modifications advocated by current guidelines, including exercise and reduced intake of sodium and alcohol. While the overall declines resulting from yoga practice were modest, even small reductions in blood pressure have been shown to reduce risk for coronary heart disease and stroke (Hagins *et al.*, 2013). Most of these dietary and lifestyle modifications are reasonably safe and can play a key role in the first step towards

blood pressure control. If it is controlled without drugs entirely, multiple lifestyle modifications have to be combined. (Sarah, 2011).

Non-drug therapy of hypertension is needed more than ever but its application remains much below optimum. The greater need reflects the much larger population of asymptomatic people being identified as mildly hypertensive in whom, the pressures could be lowered to a level deemed safe without the need for pills. Modifications of diet and life style pattern are the two ends to prevent and control the blood pressure which further reduce the onset of deadly complications. There is a need for prioritizing hypertension for better prevention, diagnosis and management on the basis of known modifiable risk factors (Anand *et al.*, 2007).

However, even many states that a correct lifestyle can be very helpful in controlling blood pressure, non-pharmacological measures are frequently not taken into account as a flexible and realistic tool to reduce blood pressure. Furthermore antihypertensive drugs usually prescribed to reduce rather eliminate risk and can cause adverse biological changes if taken for a period of time. Since the final goal of the treatment is not only reducing risks, it should also eliminate complications as much as possible. Hence, for this diet modification and lifestyle changes can be a winning strategy to prevent hypertension and eliminate complications. To popularize and stimulate practical application, evidence based results are needed. There are many studies carried out in India to predict the prevalence of hypertension but only very few studies are undertaken on the application of non-pharmacological treatment for hypertension in India. Hence the present study is undertaken with the following objectives:

- ♥ Study the prevalence of hypertension in urban and rural areas
- ♥ Determine the associated etiological factors among the selected hypertensives
- ♥ Assess the demographic profile, dietary habits, lifestyle pattern and nutritional status of the selected hypertensives
- ♥ Intervention with functional foods and lifestyle modification strategies
- ♥ Evaluate the impact of intervention strategies