

## PRACTITIONERS' SECTION

### NON-PHARMACOLOGICAL MANAGEMENT OF HYPERTENSION

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#### ABSTRACT

*Hypertension is a silent killer. Indians are racially predisposed to cardiovascular disease, and the increasing burden of hypertension has only added to the problem. Economic constraints and the allure of additional benefits without adverse effects have made lifestyle modifications an attractive proposition in developing and developed countries alike. Blood pressure is a continuum and any increase above optimal confers additional independent risk of vascular disease, even in ranges previously considered normal. While antihypertensive agents have been used for those patients with blood pressure above the traditional cutoff, there has been increasing emphasis on the prevention and treatment of hypertension by non-pharmacological means, termed 'lifestyle modifications.' A MEDLINE search was done for relevant references with emphasis on original studies, randomized controlled trials and meta-analyses. Lifestyle modifications that effectively lower blood pressure are increased physical activity, weight loss, limited alcohol consumption, reduced sodium intake and the Dietary Approaches to Stop Hypertension diet. Lifestyle modification is recommended as initial therapy in stage 1 hypertension before initiation of drug therapy and as an adjunct to medication in persons already on drug therapy. In pre-hypertensives, it can reduce the incidence of hypertension and lower end-organ damage. It is emphasized that simple advice from physicians can have a positive influence on patients' motivation to make lifestyle changes.*

Key words: **Hypertension, lifestyle modifications, non-pharmacological**

#### BACKGROUND

High blood pressure is an independent risk factor for cardiovascular and cerebrovascular disease. At the defining cutoff of 140/ 90 mmHg, 28-44% of the world population has

hypertension, with ethnic variations.<sup>[1]</sup> It is estimated that the prevalence of hypertension in India is about 25% among urban adults and 10% in the rural areas.<sup>[2]</sup> The lifetime risk of developing hypertension is estimated to be 90%.<sup>[3]</sup> Even blood pressure (BP) not in the hypertensive range but above optimal increases the cardiovascular risk. Indeed, blood pressure is a continuum and any increase above optimal confers additional independent risk of coronary heart disease, stroke, congestive heart failure, end-stage renal disease and

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peripheral vascular disease,<sup>[4-5]</sup> even in ranges previously considered normal. It is estimated that almost one-third of BP-related deaths from coronary heart disease occur in normotensive individuals with a systolic BP of 120-139 mmHg or diastolic BP of 80-89 mmHg.<sup>[6]</sup> For this reason, the 7<sup>th</sup> report of the Joint National Committee on prevention, detection, evaluation and treatment of high blood pressure (JNC 7) has categorized this class of subjects as pre-hypertensives.<sup>[7]</sup> For every 20 mmHg systolic or 10 mmHg diastolic rise in BP, the mortality from both IHD and stroke doubles.<sup>[7]</sup> In fact, even small reductions in BP in the general population could significantly reduce cardiovascular events. For example, a 3 mmHg reduction in systolic BP would lead to an 8% reduction in mortality due to stroke and a 5% reduction in mortality from coronary artery disease.<sup>[8]</sup> While antihypertensive agents have been used for those patients with blood pressure above the traditional cutoff, it is imperative that

reduction of blood pressure to optimal levels and prevention of age-related increase in BP be pursued actively. There has been increasing emphasis on the prevention and treatment of hypertension by non-pharmacological means, termed ‘lifestyle modifications.’ Lifestyle modifications that effectively lower BP are increased physical activity, weight loss, limited alcohol consumption, reduced sodium intake and the Dietary Approaches to Stop Hypertension (DASH) diet [Table 1].<sup>[7]</sup>

The aim of this review is to provide a brief commentary on the major lifestyle modifications recommended for prevention and treatment of hypertension and their relative efficacies.

METHODS

A MEDLINE search (from 1966 to date) was done for relevant references with emphasis on original studies, randomized controlled trials

Table 1: Summary of effects of non-pharmacologic measures to reduce blood pressure and goal setting for patients

Interventions with documented efficacy*	
Weight reduction	6-16 mmHg/ 10 kg body weight loss <sup>[9,11]</sup> Goal: maintaining body mass index between 18.5 to 25 kg/m <sup>2</sup> 3.8 mmHg <sup>[16]</sup>
Increased physical activity	Goal: exercise for at least 30 minutes on most, if not all, days of the week 3.3 mmHg <sup>[23]</sup>
Limited alcohol consumption	Goal: intake should be limited to 1 oz of alcohol per day (2 oz of 100-proof whiskey, 8 oz of wine or 24 oz of beer) in most men and half that amount in women and small men <sup>[8]</sup>
Reduced salt intake	4.6 to 6.7 mmHg <sup>[27]</sup> Goal: limit salt intake to 6 g/d, (100 mmol of sodium or 2.4 g per day).
Vegan diet	5 mmHg <sup>[28,29]</sup>
DASH diet	5.5 mmHg <sup>[32]</sup> Goal: increased usage of fruits, vegetables and low-fat dairy products and includes whole grains, nuts, poultry and fish
Increased potassium intake	1.8 to 4.4 <sup>[36]</sup> Goal: consuming foods such as fruits and vegetables that are rich in potassium
Interventions with limited or uncertain efficacy*	
Fish oil supplementation	4 mmHg <sup>[39]</sup>
Fiber	1.2 mmHg <sup>[40]</sup>
Calcium	0.9 to 1.4 mmHg <sup>[43]</sup>
Behavioral techniques, meditation and yoga	4.7 to 10.7 mmHg <sup>[47,48]</sup> *Effect on systolic blood pressure is time dependent and needs sustained maintenance of lifestyle modification.

and meta-analyses. Key phrases searched for included activity, alcohol, blood pressure, body mass, calcium, diet, fiber, fish oil, hypertension, lifestyle modifications, non-pharmacologic, pre-hypertension, potassium, physical activity, salt, sodium, vegetarian, weight and yoga.

INTERVENTIONS WITH DOCUMENTED EFFICACY

Weight reduction

Overweight (body mass index  $\geq 25$  kg/m<sup>2</sup>) has been seen in epidemiologic studies to be an important risk factor for higher blood pressure, and there seems to be a linear relation between body weight and blood pressure.<sup>[9]</sup> Clinical trials have shown that weight loss, especially when combined with dietary sodium restriction, lowers blood pressure in hypertensive and also in normotensive patients.<sup>[1,10]</sup> The Hypertension Prevention Trial showed that a 4% reduction in body weight over 3 years was associated with a 2.4 mmHg reduction in systolic and a 1.8 mmHg reduction in diastolic blood pressures.<sup>[11]</sup> In a landmark study, He *et al.* showed that the effects of even short-term weight loss persist for long. Over a mean follow-up of 7 years, an 18-month weight loss intervention program was significantly associated with a 77% reduction in the incidence of hypertension.<sup>[12]</sup> A meta-analysis by Staessen *et al.* showed that mean systolic and diastolic BP reductions were 1.6/ 1.1 mmHg per kilogram of weight loss.<sup>[9]</sup> The exact mechanism by which weight reduction lowers blood pressure is not known. There are however certain possible reasons. Obese individuals have been seen to have an overactivated renin-angiotensin-aldosterone system with higher renin and aldosterone concentrations than in lean individuals.<sup>[13]</sup>

Activity of the sympathetic nervous system is found to be higher in obese hypertensives, and obese subjects require increased arterial pressure to maintain sodium balance, indicating impaired renal-pressure natriuresis.<sup>[14]</sup> Insulin resistance, hyperinsulinemia and the associated endothelial dysfunction may also contribute.<sup>[15]</sup> It is therefore important that all patients be advised to maintain weight near optimal by reducing calorie intake and increasing physical activity. Since sustained weight reduction is difficult to achieve, prevention of weight gain should be emphasized.

Increased physical activity

Increasing aerobic physical activity such as brisk walking, jogging, swimming or bicycling has been shown to lower BP. Significantly, this reduction is independent of any concomitant weight loss.<sup>[16]</sup> A meta-analysis of 54 randomized controlled trials showed a net reduction of 3.8 mmHg in systolic and 2.6 mmHg in diastolic BP in individuals performing aerobic exercises, compared to controls.<sup>[16]</sup> Physical activity has been shown to reduce systemic vascular resistance, most likely due to a decrease in the activity of the sympathetic nervous system. This is evidenced by lower plasma norepinephrine levels in exercising individuals compared to sedentary ones.<sup>[17]</sup> Also, there is a decrease in plasma renin activity,<sup>[18]</sup> which could be a function of reduced sympathetic tone. Reduction of insulin resistance and improvement in endothelial function may also contribute.<sup>[19,20]</sup> Importantly, this reduction appeared to be independent of the intensity, frequency and type of exercise program. BP reduction was seen in normotensives also and was not influenced by initial weight. It is recommended that persons

exercise for at least 30 min on most, if not all, days of the week.<sup>[21]</sup>

### Limited alcohol consumption

Alcohol consumption has both acute and chronic deleterious effects on BP. The relationship between high alcohol intake (typically three or more drinks per day) and elevated BP has been documented in many epidemiologic studies.<sup>[22]</sup> Trials have also reported that reductions in alcohol intake can lower BP in normotensive and hypertensive men who are heavy drinkers. A meta-analysis of 15 randomized controlled trials showed that reduction in alcohol consumption was associated with a significant 3.3 mmHg reduction in systolic and a 2 mmHg reduction in diastolic blood pressures.<sup>[23]</sup> This reduction showed a dose-response relationship between mean percentage of alcohol reduction and mean blood pressure reduction. The effects of intervention were more in those with a higher baseline blood pressure. Also, increased alcohol intake seems to cause resistance to antihypertensive therapy.<sup>[24]</sup> The JNC 7 recommends that alcohol intake should be no more than two drinks per day by men and one drink per day by women among those who drink. In view of other health benefits, alcohol consumption is not recommended for nondrinkers; and for drinkers, intake should be limited to 1 oz of alcohol per day (2 oz of 100-proof whiskey, 8 oz of wine or 24 oz of beer) in most men and half that amount in women and small men.<sup>[7]</sup>

### Reduced salt (sodium chloride) intake

Dietary salt intake has a linear association with blood pressure. Reduced sodium intake to approximately 100 mmol/day can prevent

hypertension,<sup>[11]</sup> can facilitate blood pressure control in elderly patients on medication<sup>[25]</sup> and can potentially prevent cardiovascular events in overweight individuals.<sup>[26]</sup> The Trials of Hypertension Prevention, Phase II, showed that sodium reduction, alone or combined with weight reduction, can reduce the incidence of hypertension by approximately 20%.<sup>[11]</sup> The data from these trials led to current recommendations to limit salt intake to 6 g/day, (100 mmol of sodium or 2.4 g per day). The Dietary Approaches to Stop Hypertension (DASH)-Sodium feeding study showed that an even lower intake of sodium, approximately 60 mmol/day, further reduces BP in both normotensives and hypertensives.<sup>[27]</sup> However, palatability concerns and the fact that other nutrients intake would suffer whilst trying to stick to such an intensive regimen make the 100 mmol/day regimen prudent. Though there have been concerns about the advisability of low-salt diet in 'salt-resistant' individuals, the effect is seen uniformly, though in varying degrees, tending to be greater in blacks, the elderly; and in individuals with hypertension, diabetes or chronic kidney disease. To reduce salt intake, individuals should consume foods low in salt and limit the amount of salt added to food. Food rich in salt, like pickles, processed foods, chips and chutneys, should be avoided.

### Whole diets

*Vegan diet:* In industrialized countries, vegans have been noted to have lower blood pressure,<sup>[28]</sup> with a lower age-related rise in BP. Several factors might be responsible for this effect, such as increased potassium, low-to-moderate alcohol intake and high fiber. In studies involving normotensives<sup>[29]</sup> and hypertensives,<sup>[30]</sup> vegetarian diets reduced

systolic BP by approximately 5 mmHg but had equivocal effects on diastolic BP. Cereals however have been seen to raise BP levels.<sup>[31]</sup>

*DASH diet:* The DASH diet advocates increased usage of fruits, vegetables and low-fat dairy products and includes whole grains, nuts, poultry and fish. It has low quantities of fats, red meat, sweets and sugar-containing beverages. It is thus rich in potassium, magnesium, calcium and fiber and has low amounts of total fat, saturated fat and cholesterol.<sup>[32]</sup> Overall, the DASH diet lowered systolic BP by 5.5 mmHg and diastolic BP by 3 mmHg.<sup>[33]</sup> Within the DASH diet cohort, reducing sodium intake showed a graded reduction in blood pressures.

*Mediterranean diet:* The Mediterranean diet shares many components of the DASH diet. The main difference between the two is that the Mediterranean diet is high in olive oil, resulting in higher amounts of monounsaturated fatty acids and lower saturated fatty acids.<sup>[34]</sup> The Mediterranean diet lowers blood pressure, possibly primarily due to the large quantities of olive oil.

*Animal products:* Meat and meat products have been shown to raise BP whereas fish has been shown to reduce BP, probably because of the higher quantities of omega-3 fatty acids.<sup>[35]</sup>

### Increased potassium intake

High potassium intake is associated with reduced BP. A meta-analysis by Whelton *et al.* showed that average systolic and diastolic BP reductions associated with an increase in urinary potassium excretion of 2 g/day (50 mmol/day) were 4.4 and 2.5 mmHg in hypertensives

and 1.8 and 1.0 mmHg in normotensives.<sup>[36]</sup> This effect was more in blacks. Potassium intake can be increased by consuming foods such as fruits and vegetables that are rich in potassium, rather than supplements. The effect of potassium on BP depends on the concurrent intake of salt and vice versa. Increased potassium intake has a greater BP-lowering effect with a higher salt intake and lesser BP-lowering effect with a lower salt intake. However, the BP reduction from low salt intake is highest when potassium intake is low.<sup>[37]</sup> Since data regarding a dose-response relation is scarce, a specific level of potassium intake cannot be recommended. Most trials had diets with 4.7 g/day (120 mmol/day) of potassium.<sup>[37]</sup> It is however recommended that individuals with stage 3 or 4 chronic kidney disease – that is, with an estimated glomerular filtration rate <60 ml/min/1.73m<sup>2</sup> – should restrict intake of potassium.<sup>[38]</sup>

### INTERVENTIONS WITH LIMITED OR UNCERTAIN EFFICACY

The following have been seen to lower blood pressure in many trials, but the findings are not strong enough to routinely recommend these as means of lowering blood pressure.

#### Fish oil supplementation

Omega-3 polyunsaturated fatty acid (commonly called fish oil) supplements at high doses ( $\geq 3$  g/day) can lower BP in hypertensives by an average of 4 mmHg systolic and 2.5 mmHg diastolic.<sup>[39]</sup> Insignificant BP reductions are seen in normotensives. However, the side effects occurring at such high doses, including belching and a fishy taste, preclude dietary supplementation of fish oil to lower BP.

### Fiber

A meta-analysis of 25 trials that increased just fiber intake showed that an average increase of 14 g/day of supplemental fiber reduced the average systolic and diastolic BP by 1.15 and 1.65 mmHg respectively.<sup>[40]</sup> However, a large randomized controlled trial failed to show any benefit.<sup>[41]</sup> At very high doses, however, fish oil supplements can cause increased bleeding time.<sup>[42]</sup>

### Calcium

Calcium supplementation of 400-2000 mg/day is associated with small reductions in systolic and diastolic blood pressures, viz., of 0.9 to 1.4 mmHg and 0.2 to 0.8 mmHg respectively.<sup>[43]</sup> There is also some evidence that calcium intake may affect the BP response to salt.<sup>[44]</sup>

### Dietary polyphenols

Polyphenols in the diet, like soy phytoestrogen, grape seed proanthocyanidins, tea catechins, wine polyphenols and procyanidins in cocoa, appear to have 'blood pressure'-lowering effects.<sup>[45,46]</sup> These effects have seen to be enhanced by other dietary constituents like onions, garlic and olive oil.<sup>[46]</sup> More data is however needed before recommendations can be made about dietary polyphenols.

Other dietary constituents like magnesium, carbohydrate and increased protein intake from plant sources have been observed in some studies to lower blood pressure. This effect, however, has been an inconsistent finding.

### Behavioral techniques, meditation and yoga

Transcendental meditation was seen in one study to reduce systolic and diastolic blood pressures by 10.7 mmHg and 6.4 mmHg

respectively over a period of 3 months.<sup>[47]</sup> Progressive muscle relaxation lowered systolic pressure by 4.7 mmHg and diastolic pressure by 3.3 mmHg.<sup>[47]</sup> Yoga is also widely believed to reduce blood pressures.<sup>[48]</sup> However, larger and more trials are needed to confirm these effects.

### CONCLUSIONS

Lifestyle modification, previously termed non-pharmacologic therapy, has an important role in hypertensive as well as nonhypertensive individuals. In hypertensive individuals, lifestyle modification is recommended as initial therapy in stage 1 hypertension (for up to 12 months in those without other risk factors and for up to 6 months in those with other risk factors) before initiation of drug therapy and as an adjunct to medication in persons already on drug therapy. In those with medication-controlled blood pressure, lifestyle modifications can help reduce drug dosage or, in some cases, even stop drug therapy. In normotensives, lifestyle modifications can reduce the incidence of hypertension and also lower end-organ damage. Non-pharmacologic measures should be part of routine management of hypertension. It is emphasized that simple advice from physicians can have a positive influence on patients' motivation to make lifestyle changes.

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