Received: 30 November 2020 | Revised: 1 January 2021 | Accepted: 19 January 2021

DOI: 10.1111/jch.14236

REVIEW PAPER

WILEY

Non-pharmacological management of hypertension

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Abstract

Hypertension is an insidious disease which predisposes to cardiovascular complications and if not treated properly can lead to various serious complications. Economic limitations, having additional benefits with few or almost no side effects have made non-pharmacological management of hypertension an attractive approach for dealing with hypertension, in developed and developing countries alike. A MEDLINE search was done for relevant references with emphasis on original studies, randomized controlled trials, and meta-analyses for this review paper. Lifestyle modifications including changes in the dietary pattern, adopting special diets with low sodium, saturated fat and high calcium, magnesium and potassium and trying the new methods like time restricted meal intake which work in tandem with the circadian rhythm are opening new vistas in the field of non-pharmacological management of hypertension. Lifestyle modifications that effectively lower blood pressure are increased physical activity, weight loss, limited alcohol consumption, relaxation techniques of Yoga, Acupuncture, Tai chi, mindfulness-based stress-reduction program, and Transcendental Meditation. Air pollution of the surrounding air is linked with poor health outcomes and is a major

contributor to the global burden of disease. Fine particulate matter <2.5 μm in diameter (PM2.5) is strongly associated with cardiovascular morbidity and mortality. Short-term PM exposure (hours to weeks) increases the likelihood of adverse cardiovascular events including myocardial infarction, stroke, and heart failure, and longer-term exposure multiplies that risk. Non-pharmacological methods should be initiated early phase of disease and should be continued with medication.

Non-pharmacological methods are an integral part of management of hypertension. It includes lifestyle changes in farm of special diets and reduction of salt, alcohol, and saturated fat. Reduction of weight, increased physical activity and time restricted meal has also been found effective. Some traditional methods like yoga, acupuncture, and transcendental meditation are helpful.

1 | INTRODUCTION

Hypertension is one of the most important preventable cardiovascular risk factor which impacts health, disease, and death.[1-3] It is prevalent in most of the developed, underdeveloped, and developing countries. In Asia, the prevalence ranges from 20,8% in Taiwan to 50.3% in Pakistan.[4] In India, the prevalence of hypertension is about 29.8% (95% confidence interval: 26.7-33.0). (also same prevalence in my paper) Significant differences in prevalence are seen between rural and urban areas, respectively (27.6% [23.2-32.0] and 33.8% [29.7-37.8]; $P = .05$] [4]

Hypertension is one of the most common non-communicable disease treated in primary care and if not treated properly can lead to various serious complications like myocardial infarction, stroke, renal failure, and death.[5] It is considered as a primary cause for cerebrovascular (51%) and cardiovascular (45%) mortality.[6] A reduction of just 5 mm of Hg SBP has been found to be associated with mortality reductions of 14% from stroke, 9% from heart disease, and 7% from all-cause mortality.[7] The latest American guidelines on management of hypertension in 2017 introduced a lower threshold of BP of ≥130/80 mmHg be the cut-off point for a diagnosis of hypertension. Although this lower threshold for diagnosis was introduced much to the alarm of many practitioners, the American guidelines do not recommend pharmacological therapy for such individuals diagnosed as hypertension. In fact, it was specifically emphasized that life-style modifications be instituted at this point and that only those with an global CV risk of ≥10% be treated pharmacologically on the top of life-style modifications. That non-pharmacological management was recommended was that there is good data that supports the use of non-pharmacological interventions for reducing BP. These non-pharmacological modifications include weight loss, dietary modifications, increasing physical activity, and reducing alcohol intake. Other interventions like tobacco cessation, meditation, acupuncture, biofeedback, home monitoring, dietary supplements (eg, garlic, cocoa, vitamin C, coenzyme Q10, omega-3 fatty acids, calcium, potassium, and magnesium), and the use of continuous positive airway pressure for patients with obstructive sleep apnoea have also been examined.

2 | DIET

To reduce BP, a diet consisting of whole grains, more vegetables, and fruits is recommended.[8,9] Other recommendations include consuming low-fat dairy products, poultry, fish, legumes, non-tropical vegetable oils, and nuts; and reducing intake of sweets, sugar-sweetened beverages, and red meat. Dietary pattern is also influenced by appropriate calorie requirements, personal and cultural food preferences, and nutritional therapy for other medical conditions, such as diabetes mellitus and chronic kidney disease. This can be achieved by various dietary plans. One way to achieve this is by following plans such as the Dietary Approaches to Stop Hypertension diet, US Department of Agriculture Food Patterns, or the American Heart Association diet. The Dietary Approaches to Stop Hypertension diet emphasized consuming more fruits and vegetables, but less dairy products, saturated fats red meat and less sweets, and sugar-sweetened beverages. With the Dietary Approaches to Stop Hypertension diet, a lowering of SBP by 5.5 mm Hg and DBP by 3 mm Hg[10-12] was seen. Results from the EPIC(European Prospective Investigation into Cancer and Nutrition) study showed that for 7061 non-hypertensive women (35-64 years), body weight, waist circumference, body mass index, processed meat, and wine and potatoes consumption correlated directly with BP values; while increased eating of vegetables, yoghurt, and eggs was inversely associated with SBP (and consumption of oil with DBP levels.[13] Another study showed a negative association between BP levels and a Mediterranean diet of fruits and vegetables[14] The long-term effects of Dietary Approaches to Stop Hypertension diet in overweight hypertensive individuals in the ENCORE Exercise and Nutritional Interventions for Cardiovascular Health study, where a follow-up 8 months after the end of their 16 weeks treatment, showed some beneficial impact on BP, exercise, and body weight control. However, effective methods that promote permanent lifestyle modification are needed.[15] In the SUN ("Seguimiento Universidad de Navarra") project study, involving 9408 men and women followed for six years, the implementation of the Mediterranean diet was associated

with a decrease in SBP and DBP values. Moderate implementation of the Mediterranean diet showed a decrease of 2.4 mmHg for SBP and 1.3 mmHg for DBP; while more systematic application decreased SBP and DBP by 3.1 and 1.9 mmHg, respectively.[16] Additionally, the adoption of the Mediterranean diet in 772 subjects (55-80 years), in high risk for cardiovascular disease, resulted in SBP reduction of 7.1 mmHg.

3 | How do these diets actually work?

Both the Mediterranean diet and the Dietary Approaches to Stop Hypertension diet are relatively easy to adhere to and are palatable, high in fruit, vegetables, whole grains, nuts, and unsaturated oils[17]; moreover, both minimize the consumption of red and processed meat, and are in accordance with dietary recommendations for cardiovascular health. The difference is that the Dietary Approaches to Stop Hypertension diet is more suitable for recommending a low sodium intake,[18,19] whereas this is not a feature of the Mediterranean diet. Second, it may well be that the Dietary Approaches to Stop Hypertension diet includes more proteins since it includes poultry and fish and emphasizes the consumption of free- or low-fat dairy products (two or three servings per day).[18,19] In this regard, either a higher protein intake or protein supplementation has been shown to decrease BP.[20,21] Concerning dairy products, in particular, the addition of conventional non-fat dairy products to the routine diet has hypotensive effects.[22] Moreover, a recent systematic review has shown a favorable association between a higher dairy intake and a lower risk of hypertension.[23]One of the reasons could also be the lower salt consumption associated with vegetables and fruits etc The Dietary Approaches to Stop Hypertension diet reduces high BP by lowering the amount of sodium in your diet to 2300 milligrams (mg) a day. Lowering sodium to 1500 mg a day reduces BP even more. It also includes a variety of foods rich in nutrients that help some people lower BP, such as potassium, calcium, and magnesium. The Mediterranean diet may mediate its effects in part through the maintenance of BP and endothelial function.[24] The consumption of a diet that is high in fruit, vegetables, nuts, and unsaturated oils and low in sodium can lower BP.[25,26] In addition, a number of components of a Mediterranean dietary pattern have been shown to improve endothelial function.[27]

Intermittent Fasting is another method which can be implemented easily by the patients. There are two major subcategories of intermittent fasting: (a) fasting 1-4 d per week, that is, alternate-day fasting or the 5:2 diet [1]; or (b) fasting every day for a 14 to 20 h period, that is, time restricted feeding.[28] Cardioprotective effects of the alternate-day fasting diet are associated with a reduction of visceral fat tissue, increased adiponectin, decreased leptin and low-density lipoproteins cholesterol. Intermittent fasting has also shown a beneficial effect on prevention of stroke.[29] In 2018, Erdem et al, 2018[30] undertook a study with the Cappadocia cohort of 60 prehypertensive and hypertensives, where SBP was 120—139 and ≥ 140; DBP values were 80-89 and ≥90 mmHg. A decrease in SBP ($P < .001$) and DBP values ($P < .039$) was observed. Intermittent fasting inhibits the development of atherosclerotic plaque by reducing the concentration of inflammatory markers IL-6 (Interleukin −6),

homocysteine, and C-reactive protein.[20] Intermittent fasting increases brain-derived neurotrophic factor (BDNF) resulting in lowering BP by activating the parasympathetic system.[31,32]

4 | SODIUM MAGNESIUM AND POTASSIUM INTAKE

There is strong and consistent evidence that reducing sodium intake reduces BP. Adults should be advised to limit their sodium intake to no more than 2,400 mg per day (equivalent to around 5 gm/1 teaspoon of table salt per day). Further reduction of sodium intake to 1,500 mg per day is desirable because it is associated with an even greater reduction in BP. The average BP reduction in patients consuming a sodium-restricted diet of 2,400 mg per day is 2/1 mm Hg, or 7/3 mm Hg for those restricting sodium to 1,500 mg per day.[33] Reducing baseline sodium intake by at least 1,000 mg per day will lower BP even if the desired daily sodium intake is not yet achieved. Food prepared out of home, canned foods, and prepackaged foods (dry or frozen) tend to contain more sodium than home-cooked meals or frozen vegetables, so it is best to be avoided. Recent analysis of 15 randomized control trials (RCTs) for potassium supplementation (75-125 mmol per day) in 917 normotensive and hypertensive patients independent to antihypertensive drugs had a reduction in SBP by 4.7 mmHg and in DBP values by 3.5 mmHg in all patients, an effect that was stronger in hypertensive by 6.8 and 4.6 mmHg for SBP and DBP values, respectively.[34] An analysis of 34 trials involving 2028 normotensive and hypertensive patients showed a positive effect of magnesium supplementation (368 mg/d) for three months, in lowering SBP by 2.0 mmHg and DBP values by 1.78 mmHg. We need more studies to clarify the role of potassium and magnesium supplementation in the management of hypertension. (Table 1)

5 | PHYSICAL ACTIVITY AND WEIGHT LOSS

Adults should practice moderate to vigorous aerobic physical activity at least 4 times per week for an average of 40 min per session to lower BP.[35] Most health benefits have been reported with at least 150 min per week of moderate-intensity physical activity, such as brisk walking. Some physical activity is better than none, and more activity results in greater benefits. Health benefits of exercise include reduced rates of all-cause mortality, coronary heart disease, hypertension, stroke, type 2 diabetes, metabolic syndrome, colon cancer, breast cancer, and depression.[36] Weight loss of approximately 10 kg may reduce SBP by 5 to 20 mm Hg.[37]

TABLE 1 Summarizing the main points/message of the review

1.	A reduction of just 5 mm of Hg systolic blood pressure has been found to be associated with mortality reductions of 14% from stroke, 9% from heart disease, and 7% from all-cause mortality
2.	Dietary pattern is a very important part of non-pharmacologic management of blood pressure as it is influenced by appropriate calorie requirements, personal, cultural food preferences, and nutritional therapy for other medical conditions, such as diabetes mellitus and chronic kidney disease.
3.	Both the Mediterranean Diet and the Dietary Approaches to Stop Hypertension diet are relatively easy to adhere to and are palatable, high in fruit, vegetables, whole grains, nuts, and unsaturated oils; moreover, both minimize the consumption of red and processed meat, and are in accordance with dietary recommendations for cardiovascular health.
4.	Cardioprotective effects of the alternate-day fasting diet are associated with a reduction of visceral fat tissue, increased adiponectin, decreased leptin, and low-density lipoproteins cholesterol. A method of intermittent fasting, like alternate-day fasting or time restricted meal intake could be adopted by the patient.
5.	Adults should be advised to limit their sodium intake to no more than 2,400 mg per day (equivalent to around 5 gm/1 teaspoon of table salt per day).
6.	Food prepared out of home, canned foods, and prepackaged foods (dry or frozen) tend to contain more sodium than home-cooked meals or frozen vegetables, so a hypertensive patient should consciously restrict the intake of such foods.
7.	Regular exercise, stopping the use of tobacco, decreased alcohol intake or substitution by non-alcoholic beverages are helpful in controlling blood pressure.
8.	Practising yoga, transcendental meditation, acupuncture, mindfulness-based stress-reduction program (MBSRP), Tai chi / taiji / tai chi chuan (origin: China) which combines movement, deep breathing could help in alleviating stress.
9.	Home monitoring of blood pressure is highly recommended
10.	Quality nutrition, physical activity of few times per week, attaining normal body weight, cessation of alcohol and tobacco, reduction in sodium intake & increasing calcium, magnesium & potassium, stress management and supplementation of certain ingredients may prove beneficial.

6 | TOBACCO CESSATION

Use of tobacco is the leading preventable cause of death and significantly increases the risk of cardiovascular disease. Tobacco causes an immediate increase in sympathetic nervous activity, which in turn increases myocardial oxygen demand through increased BP, heart rate, and myocardial contractility. A meta-analysis of 20 prospective cohort studies found that quitting smoking after a heart attack or cardiac surgery decreases a patient's risk of death by more than 33% over five years.[38]

7 | ALCOHOL CONSUMPTION

Many cross-sectional epidemiologic studies have demonstrated that the prevalence of hypertension increases with higher average alcohol consumption, with longitudinal studies suggesting that BP changes are positively correlated with drinking changes (ie, reduced drinking lowers BP). Clinical trials involving counseling or substitution of low alcohol substitutes for hazardous drinkers have confirmed that BP reduction will follow drinking reduction in days to weeks. Studies confirm this effect in dependent, high consumption drinkers, demonstrating an average overall reduction in SBP of roughly 5 mm Hg, and in DBP of approximately 3 mm Hg during the first month of treatment. More importantly, this reduction appeared to be limited to persons with higher than average systolic or diastolic pressure at baseline. In these persons, the average reduction in systolic pressure was 12 mm Hg, and the average reduction in diastolic pressure was 8 mm Hg. More generally, due to the dependence of BP reduction on the baseline, those with the highest initial pressure experienced the greatest reduction. This finding is consistent with prior research suggesting that only about half of heavy drinkers experience a pressor effect, most of whom will experience BP reduction with reduced drinking. If maintained in the long term, such reductions would be expected to result in improved survival. This may magnify gains in life expectancy expected with reduced drinking or abstinence in alcohol-dependent populations.[39]

8 | DIETARY SUPPLEMENTS

Garlic as a dietary supplement can lower BP. Data from two randomized controlled trials comparing the use of garlic versus placebo in patients with hypertension showed that garlic may have some BP-lowering effect.[40] However, still we have insufficient evidence to support the use of garlic in reducing morbidity or mortality associated with cardiovascular events.

Cocoa has also shown small but statistically significant BP-lowering effect (average of 2 to 3 mm Hg) in adults with hypertension, but there is no concrete evidence that it improves patient-oriented outcomes in the long term.[41] Although vitamin C, coenzyme Q10, omega-3 fatty acids, and magnesium have been used for lowering BP, there is very little evidence to support their use in the management of hypertension. (Table 2)

9 | RELAXATION TECHNIQUES

The mechanism by which relaxation techniques lower BP is not clear. It is thought that they may help lower the stress and physiologic

TABLE 2 A table summarizing the degree of BP reduction according to each non-pharmacological treatment

	NON-PHARMACOLOGIC TREATMENT	DEGREE OF BLOOD PRESSURE REDUCTION
1.	Dietary Approaches to Stop Hypertension diet DASH Diet	SBP = 5.5 mm Hg DBP = 3 mm Hg
2.	Mediterranean Diet	SBP = 3.1 mmHg DBP = 1.9 mmHg
3.	Decreased Sodium Intake (sodium-restricted diet of 2,400 mg per day) (sodium-restricted diet of 1,500 mg per day)	Decrease = 2/1 mm Hg Decrease = 7/3 mm Hg
4.	Decreased Potassium Intake	SBP = 6.8 mmHg DBP = 4.6 mmHg
5.	Increased Magnesium Intake (magnesium supplementation (368 mg/day) for three months)	SBP = 2.0 mmHg DBP = 1.78 mmHg
6.	Weight Loss (approximately 10 kg)	Overall decrease of 5 to 20 mm Hg
7.	Cocoa	2 to 3 mm Hg
8.	Substitution of alcohol consumption with low alcohol substitutes (during the first month of treatment)	SBP = 5 mm Hg DBP = 3 mm Hg
9.	Mindfulness-based stress-reduction program (MBSRP)	From a mean of 154.7 ± 7.5 to 138.1 mm Hg in the Intervention Group Diastolic blood pressure values from 90.6 ± 5.3 to 86.1 mm Hg
10.	Transcendental Meditation	In men, systolic blood pressure decreased by 12.7 mm Hg. Diastolic blood pressure decreased by 8.1 mm Hg. In women, systolic blood pressure decreased by 10.4 mm Hg Diastolic blood pressure decreased by 5.9 mm Hg.
11.	Home monitoring of blood pressure	Mean reduction in systolic blood pressure of 3.9 mm Hg at six months Additional support resulted in a reduction in systolic blood pressure of 2.1 to 8.3 mm Hg
12.	Use of personal air cleaners	Over a median 13.5-day duration was associated with a ≈4 mmHg reduction in systolic blood pressure and with no evidence of an effect on diastolic blood pressure values.

arousal produced by the autonomic nervous system, thereby reducing BP. Evidences support that transcendental meditation may modestly lower BP[42]; however, no specific method has been proven beneficial. Because of mixed results in trials and numerous limitations, the American Heart Association does not recommend yoga or acupuncture to lower BP. Biofeedback techniques have been proven effective and may be used in clinical practice to lower BP.[43]

In a study conducted amongst hypertensive Thai elders, three highest priorities of healthy lifestyle behavior that were identified are health responsibility, healthy eating, and engaging in social activities.[44]

As far as relieving stress is concerned, there is a wide variety of meditative exercises to choose from. Tai chi / taiji / tai chi chuan (origin: China) combines movement, deep breathing, and meditation. Yoga (origin: India) includes stretching, meditation, postural, and breathing exercises. Both techniques have similar components like growing mind/body connections via slow voluntary movements, diaphragmatic breathing practice, and meditative states of mental concentration.[45] In a study (in 2019) regarding heart rate variability and perceived stress, it was observed that in 17 randomized control trials using either Tai chi or yoga, normalized high frequency was significantly increased which means an increased level of parasympathetic nervous function. Additionally, low frequency/high frequency was significantly decreased which means decreased level of sympathetic nervous function. The most important finding was that the perceived stress level was significantly reduced (by −0.80; −1.17 to −0.44) by the intervention. It was concluded that stress reduction may be attributed to the sympathetic-vagal balance modulated by the mind/body exercises associated with tai chi and yoga.[46]

Another method is that of the **mindfulness-based stress-reduction program (MBSRP)** which is based on avoiding judgment, increasing awareness, and emphasis only on the present moment. It includes automatic exercise, focus, and relaxation training (body scan, relaxation, and Hatha yoga). SBP decreased from a mean of 154.7 ± 7.5 to 138.1 mm Hg in the Intervention Group and DBP values from 90.6 ± 5.3 to 86.1 mm Hg, two months after doing mindfulness-based stress-reduction program.[47]

In **Transcendental Meditation**, mantras, which are used for sound become increasingly secondary in experience and finally disappearing, and where self-awareness becomes primary in experience, the practitioner finally moves on to a state of pure consciousness.

Significant declines were observed after 3 months for both genders. In men, SBP decreased by 12.7 mm Hg and DBP values decreased by 8.1 mm Hg. In women, decrease in SBP was 10.4 mm Hg and in DBP values was 5.9 mm Hg.[48]

Acupuncture,[49,50,51,52] may also be helpful in lowering BP in pre-hypertension and stage I hypertension patients. Tan Ying-ying et al[53] found that electroacupuncture stimulation of "Quchi" (LI 11) can downregulate arterial BP and sympathetic nerve activity, increase the baroreflex sensitivity in hypertensive rats, which may be related to its effects in downregulating p47 phagocyte oxidase mRNA and protein expression in the rostral ventrolateral medulla.

10 | SELF-MEASURED BP MONITORING

A review of 52 trials by the Agency for Healthcare Research and Quality has indicated that home monitoring may be with or without additional support such as education, counseling, telemedicine, home visits, or Web-based logging lowers BP compared with usual care, but effects and long-term benefits beyond 12 months remain uncertain. Home monitoring of BP resulted in a mean reduction in SBP of 3.9 mm Hg at six months, and with additional support resulted in a reduction in SBP of 2.1 to 8.3 mm Hg, which remained significant at 12 months. Better-structured studies are required to determine the long-term benefits of self-measured BP monitoring. Most of the guidelines and recommending bodies have favored home monitoring of BP for better control, and it also add to adherence of drug treatment. The value of Home monitoring further increases in situations like white coat and masked hypertension.

11 | OBSTRUCTIVE SLEEP APNEA

Recent data have established that obstructive sleep apnea may contribute to poorly controlled high BP. International guidelines now recognize obstructive sleep apnea as one of the most common risk factors for resistant hypertension.[54] The link between obstructive sleep apnea and hypertension is likely related to recurrent increased sympathetic activity (due to intermittent hypoxia), endothelial dysfunction and systemic inflammation, and abnormal autonomic function.[55,56] A recent meta-analysis of randomized controlled trials has shown that the use of continuous positive airway pressure lowered 24-h BP levels in persons with resistant hypertension and obstructive sleep apnea.[57]

12 | HOME PARTICULATE AIR FILTRATION

Air pollution of the surrounding air is linked with poor health outcomes and is a major contributor to the global burden of disease. Fine particulate matter <2.5 μm in diameter ($PM_{2.5}$) is strongly associated with cardiovascular morbidity and mortality. In 2016, ambient and household air pollution were together responsible for an estimated 6.1 million deaths globally, the majority of which were due to cardiovascular disease.[58-60] Short-term PM exposure (hours to weeks) increases the likelihood of adverse cardiovascular events including myocardial infarction, stroke, and heart failure, and longer-term exposure multiplies that risk. One pathway through which long-term PM exposures may contribute to cardiovascular disease is by potentiating chronic cardiovascular risk factors, including hypertension. Hypertension is already a well-established risk factor for cardiovascular disease. Most individuals spend ≈80% to 90% of their time indoors,[61,62] therefore, improving the indoor environment could prove to be an effective cardiovascular disease prevention strategy. Outside and indoor $PM_{2.5}$ levels are correlated, particularly at high levels of $PM_{2.5}$ exposure, and the indoor environment contributes substantially to human pollutant exposure.[63-66]

High-efficiency indoor air filters or personal air cleaners have been proposed as an intervention to decrease indoor $PM_{2.5}$ exposure. Among 10 randomized controlled trials enrolling over 600 non-smoking participants, the use of personal air cleaners over a median 13.5-day duration was associated with a ≈4 mmHg reduction in SBP and with no evidence of an effect on DBP values. This observation was consistent across categories of cardiopulmonary risk factors, medication categories, age, or levels of particulate matter PM 2.5 exposure. It is highly relevant that the finding of a significant reduction in SBP was observed despite inclusion of participants with hypertension, diabetes mellitus, and vasoactive medication regimens, indicating that short-term health effects of in-home air filtration may be widely applicable.

13 | MECHANISM

Evidence from human and animal controlled exposure studies suggests that particulate matter PM 2.5 raises BP through (1)increasing inflammation and oxidative stress; (2) impairing endothelial function; or (3) increasing sympathetic activation, while decreasing parasympathetic tone.[67] Putative changes in sympathetic and parasympathetic tone may be one pathway for the differential effects of in-home air filtration on SBP compared with DBP values observed in this analysis. The study presented by Li et al[68] showed an association between indoor air filtration and reduction in circulating stress hormones, markers of inflammation, and metabolic activity. These findings suggest that particulate matter PM 2.5 likely influences autonomic signaling to affect Hypothalamic-Pituitary-Adrenal axis activation and, subsequently, BP.[68,69]

14 | CONCLUSION

In conclusion, in order to treat Essential Hypertension based on non-pharmacological interventions, a multifactorial approach is needed,

targeting at a more permanent and finally less physician-dependent measures. Quality nutrition, physical activity of few times per week, attaining normal body weight, cessation of alcohol and tobacco, reduction in sodium intake & increasing calcium, magnesium & potassium, stress management, and supplementation of certain ingredients may prove beneficial. This should be started in beginning and continued along with drugs to have maximum effects. Although a number of studies have been conducted in this field, more extensive and better-designed research is necessary to provide better understanding of the optimal approach to reduce cardiovascular morbidity and mortality associated with hypertension.

ACKNOWLEDGEMENTS

We would like to thank all the authors for their valuable suggestions and feedback. This paper and its worth would never have been achieved had it not been for the guidance and thorough sincerity of all the authors.

AUTHOR CONTRIBUTIONS

Narsingh Verma was involved in inception, headings material to be referenced for the review paper, design of the review, and matter to be written under the various sections of the review. Smriti Rastogi was involved in thorough review of the various non-pharmacological methods mentioned in the paper, designed both the tables to be added to the review, and matter to be written under the various sections of the review. Yook-Chin Chia gave in valuable suggestions for the paper, errors in language, studies etc were earmarked, she helped with proofreading of the entire document, and role of particulate matter in hypertension has been included on her behalf. Saulat Siddique revised the entire paper, errors in language, studies etc were earmarked and did proofreading of the entire document. Yuda Turana involved in valuable suggestions for improvement of draft. Hao-min Cheng, Jam Chin Tay, Boon Wee Teo, Tzung-Dau Wang, Kelvin Kam Fai TSOI, and Kazuomi Kario suggested resources for review. Guru Prasad Sogunuru suggested resources for the Indian data which is mentioned.

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How to cite this article: Verma N, Rastogi S, Chia Y-C, et al. Non-pharmacological management of hypertension. *J Clin Hypertens*. 2021;23:1275–1283. https://doi.org/10.1111/jch.14236