

Role of Life Style Modification on Blood Pressure: Evidence from Meta-Analysis Studies

Vandana Yadav¹, Rekha Chaturvedi¹, Sivachidambaram Kulandaivelan¹,
Ravinder Yadav²

¹Assistant Professor, Dept. of Physiotherapy, GJUST, Hisar-125001. Haryana. India.

²H.O.D., Dept. of Physiotherapy, Arora Orthopedic Hospital, Hisar-125001. Haryana. India.

Corresponding Author: Vandana Yadav

ABSTRACT

Background: Hypertension is more prevalent in India and risk factors for hypertension are classified into modifiable and non-modifiable.

Objectives: To find out meta-analytic studies that investigate the alteration of modifiable risk factors such as engaging physical activity, weight reduction, yoga; reduction of stress, alcohol consumption, salt/sodium; vegetarian or DASH diet consumption on blood pressure.

Methodology: Systematic search was done on February 2015 in Google Scholar search engine using scientific terms yielded more than 8,00,000 articles. We systematically screened 3000 titles. After inclusion and exclusion criteria, we found 20 articles for final analysis.

Results: 4 articles on physical activity showed mean reduction of 3.46 mmHg in SBP and 1.28 mmHg in DBP. 2 articles on weight reduction showed mean difference of -5.37 mmHg in SBP and -3.49 mmHg in DBP. 2 articles on yoga showed mean reduction of 4.69 mmHg in SBP and 4.3 mmHg in DBP. 5 articles on salt reduction showed mean difference of -2.57 mmHg in SBP and -1.58 mmHg in DBP. 3 articles on alcohol reduction showed mean difference of -3.31 mmHg in SBP and -2.04 mmHg in DBP. 2 articles on DASH diet showed mean reduction of 5.0 mmHg in SBP and 2.98 mmHg in DBP. 2 articles on stress reduction in the form of transcendental meditation showed mean difference of -4.9 mmHg in SBP and -3.0 mmHg in DBP.

Conclusion: Modification of above modifiable hypertension risk factors are significantly reduces blood pressure. Reduction effect is more pronounced in hypertensive subjects hence used as first line treatment option.

Key words: Physical activity, Weight reduction, Yoga, Salt reduction, DASH diet, Alcohol reduction.

INTRODUCTION

Hypertension, elevated blood pressure (BP), is rising at alarming rate in India. Approximately every third Indian is affected by hypertension. The urban-rural difference is lowering in the last decade. [1] Once considered that it will affect only rich, is now affecting even slum and rural poor in India. It is aptly called as 'silent killer' disease and one of the leading risk factor for all cause mortality in India. [2,3] Risk factors for developing hypertension are broadly

classified into modifiable and unmodifiable. Unmodifiable risk factors for hypertension are race, family history, age, sex and personality. The modifiable risk factors for hypertension are overweight and obese, sedentary life style (low physical activity), smoking and tobacco usage, unhealthy food habits, excessive alcohol intake, stress and diabetes. In 1998, Ebrahim and Smith [4] later Bhatt et al. [2] reviewed how life style interventions reduce the blood pressure

(BP). They are primarily based on individual studies.

Since then, many systematic reviews and meta-analytical studies published in leading journals on life style modifications on blood pressure in both normotensives and hypertensive patients. Meta-analytical study is superior to systematic reviews because former is analysis of individual studies both qualitatively as well as quantitatively using statistical tests.

The purpose of this study is to review how the modification some of the modifiable risk factors influences the blood pressure thus enhancing overall health. Thus, the primary objective of the present paper was to find out meta-analytic studies that investigate the alteration of modifiable risk factors such as engaging physical activity, weight reduction and yoga; reduction of stress through meditation; reduction of alcohol consumption and salt/sodium intake; vegetarian or DASH diet consumption on blood pressure.

METHODOLOGY

Systematic search was done on February 2015 in Google Scholar search engine using scientific terms. Scientific term include 'meta-analysis' AND 'hypertension'. This search yielded more than 800000 articles. We screened first 1000 titles, then used filter (duration since 2011). This resulted 26100 hits and we screened first 1,000 titles. Then again we used filter (duration since 2014) which yielded 17500 hits and we screened first 1000 titles. Thus total of 3000 titles were screened using inclusion and exclusion criteria. Inclusion criteria includes article should be meta-analytic study in English, availability of full text, articles published after 1990, articles that deal with either hypertensive or normal population. Population who was on non-pharmacological activity like tea, coffee, food supplementation and articles that did not meet inclusion criteria are excluded. After inclusion and exclusion criteria, we found 18 articles for final analysis.

RESULTS

We identified 4 meta-analytical studies of physical activity on blood pressure. Murtagh et al. [5] identified 16 articles of walking as intervention on blood pressure among 816 subjects. They ranged from light to self-pace to brisk intensity of walking for 20-60 min in 2-7 days/week. They reported a mean difference (MD) of -3.58 mmHg (95% CI -5.19 to -1.97) in SBP and -1.54 mmHg (95% CI -2.83 to -0.26) in DBP. Hanson and Jones [6] reported mean reduction of 3.72 mmHg (95% CI 2.17 to 5.28) in SBP and 3.14 mmHg (95% CI 2.13 to 4.15) in DBP on 440 walking intervention peoples. Intensity, duration of intervention varied between 42 included studies. Bravata et al. [7] used pedometer as motivation to improve physical activity and enhance health. They identified 12 experimental or observational studies that investigated blood pressure on 468 subjects. They observed MD of -3.8mmHg (-1.7 to -5.9) in SBP and -0.30mmHg (-0.02 to -0.46) in DBP. Kelley et al. [8] studied effect of walking on resting blood pressure in 16 RCTs consists of 650 subjects. They found MD of -3.0mmHg (-5.0 to -2.0) in SBP and -2.0mmHg (-3.0 to -1.0) in DBP.

We identified 2 meta-analytical studies that dealt with weight reduction on blood pressure. Neter et al. [9] 2003 studied the effect of weight reduction on blood pressure in 4874 subjects and 25 randomized controlled trials subgroups. They reported a significant reduction in SBP (MD -4.44 mm Hg; 95% CI, -5.93 to -2.95) and (MD -3.57 mm Hg; 95% CI, -4.88 to -2.25) in DBP. They reported mean weight loss of 5.1 Kg (95% CI 6.03 to 4.25) after intervention. BP reduction per Kg of weight loss was -1.05 mmHg (95% CI, -1.43 to -0.66) for SBP and -0.92 mmHg (95% CI, -1.28 to -0.55) for DBP. They concluded weight reduction played significant role in BP reduction. Karl Horvath et al. [10] 2008 studied the effect of weight reduction on BP in 48 articles. 38 articles used dietary intervention and 10 articles used pharmacological intervention

(5 on Orlistat and 5 on Sibutramine) for weight loss. They found dietary intervention produced significant reduction in weight mean -4.14 Kg (95% CI -4.98 to -3.30). This resulted BP reduction of -6.26 mmHg (95% CI, -9.82 to -2.70) for SBP and -3.41 mmHg (95% CI, -5.55 to -1.27) for DBP. In patients with essential hypertension, therapy with a weight loss diet or Orlistat resulted in reductions in body weight and BP. Although Sibutramine treatment reduced body weight, it did not lower BP.

We identified two meta-analytical studies that dealt with yoga on blood pressure. Marshall Hagins et al. [11] 2013 studied yoga training on blood pressure in 17 study groups. Yoga had a modest but significant effect -4.17 mmHg (-6.35 to -1.99) on SBP and -3.62 mmHg (-4.9 to -1.60) on DBP. Paula Chu et al. [12] 2014 studied the impact of yoga training on blood pressure. In this study, 37 RCTs were included in the systematic review and 32 in the meta analysis. The included studies comprised a total of 2768 participants, with about an equal mix of men (47%) and women (53%). Yoga showed significant improvement 5.21 mmHg (-8.01 to -2.42) for SBP and 4.98 mmHg (-7.17 to -2.80) for DBP.

The Food & Drug Administration established the daily reference value for sodium as 2400 mg to 3900 mg (104 mmol of sodium or 6 g of salt). We identified 5 meta-analytical studies that dealt with salt reduction on blood pressure. Midgley et al. [13] 1996 analyzed effect of salt reduction on blood pressure in 56 trials through urinary sodium excretion. The decrease in blood pressure for every 100 mmol/day reduction in daily sodium excretion was 3.7 mmHg (-2.35 to -5.05 mm Hg) for systolic and 0.9 mmHg (0.13 to -1.85 mm Hg) for diastolic in the hypertensive trials (28 trials; 1131 subjects); 1.0 mm Hg (-0.51 to -1.56 mm Hg) for systolic and 0.1 mmHg (0.32 to -0.51 mm Hg) for diastolic in the normotensive subjects (28 trials; 2374 subjects). They concluded that sodium reduction is effective in older (45 years or

more) and hypertensive subjects. Later He and MacGregor, [14] 2002 did the same methodology in longer duration (intervention duration of 4 weeks or longer) trials. They found more pronounced reduction in SBP (-7.11 mmHg) and DBP (-3.88 mmHg) in 17 hypertensive trials (734 subjects) as well as mean reduction of -3.57 mmHg and -1.66 mmHg in 11 normotensive trials (2220 subjects). They concluded that salt reduction reduce the BP to clinically significant level in normotensive subjects too. Geleijnse et al. [15] 2003 reviewed effect of sodium reduction on blood pressure in human population using 40 trials with minimum duration of 2 weeks. Sodium reduction (median: -77 mmol/24 h) was associated with a change of -2.54 mmHg (95% CI: -3.16 to -1.92) in SBP and -1.96 mmHg (-2.41 to -1.51) in DBP. They concluded that sodium reduction positively reduced BP and the reduction is more in high BP subjects. Niels A. Graduals et al. [16] 2012 studied the effect of salt reduction on blood pressure consists of 167 studies. They found reduction of -5.48 mm Hg (95% CI: -6.53 to -4.43) for SBP and -2.75 mm Hg (95% CI: -3.34 to -2.1) for DBP. Feng J He et al. [17] 2013 studied the effect of salt reduction on blood pressure in 34 trials consists of 3230 subject. They found the mean change in blood pressure was -4.18 mm Hg (95% CI -5.18 to -3.18) for SBP and -2.06 mm Hg (-2.67 to -1.45) for DBP.

Alcohol consumption is one of the most important modifiable risk factors for hypertension among populations. We identified 3 meta-analytical studies that dealt with alcohol reduction on blood pressure. Xue Xin et al. [18] 2001 studied the effect of alcohol reduction on blood pressure in 15 RCT consist of 2234 participant. They found a significant reduction in blood pressure at 95% CI was (-2.52 to -4.10 mm Hg) for SBP and (-1.49 to -2.58 mm Hg) for DBP. Benjamin Taylor et al. [19] 2009 studied the effect of alcohol reduction on blood pressure in 12 cohort studies consists of 28848 females and 13455

males. A significant protective effect was reported for consumption at or below about 5 g per day. Among men, Asian populations had higher risks than non-Asian populations. Alexandros Briasoulis et al. [20] 2012 studied the effect of alcohol reduction on blood pressure in 16 prospective studies consists of 33,904 men and 193,752 women. They found that men with alcohol consumption with <10 g/d and 11 to 20 g/d had a trend toward increased risk of hypertension. Among women, the meta-analysis indicated protective effects at <10 g/d and a trend toward decreased risk of hypertension with alcohol consumption 11 to 20 g/d whereas a significantly increased risk of hypertension was indicated with heavy alcohol consumption of 21 to 30 g/d.

Dietary modifications have been shown to be particularly effective in preventing and managing hypertension. We identified 2 meta-analytical studies that dealt with vegetarian diet on blood pressure. Yoko Yokoyama et al. [21] 2014 studied the effect of vegetarian diet on blood pressure in 7 controlled trials consist of 311 participants and 32 observational studies consists of 21604 participants. Consumption of vegetarian diets was associated with a reduction in mean SBP -4.8 mmHg (95%CI, -6.6 to -3.1) and DBP -2.2 mmHg (95%CI, -3.5 to -1.0) for controlled trial and for observational studies associated with lower mean SBP -6.9mmHg (95%CI, -9.1 to 4.7) and DBP -4.7mmHg (95%CI, -6.3 to -3.1) compared with the consumption of omnivorous diets. Mario Siervo et al [22] 2015 studied the effect of DASH diet on blood pressure in 27 studies consist of 1917 participants. The DASH diet was found to result in significant decreases in SBP 25.2 mmHg (95% CI, 7.0 to 3.4) and DBP 2.6 mmHg (95% CI, 3.5 to 1.7).

Lifestyle Modifications in form of transcendental meditation are recommended as sole therapy when blood pressure (BP) is greater than 120/80 mm Hg. We identified two meta-analytical studies that dealt with stress reduction on blood pressure. Maxwell V Rainforth et al. [23] 2007 studied stress

reduction inform of transcendental meditation training on blood pressure in 107 studies consists of 960 participants. They found BP change of -5.1/-2.1 mm Hg (95% CI, -9.4 to -0.8) for SBP and (95% CI, -5.4 to +1.4 mm Hg) for DBP. James W. Anderson et al [24] 2008 studied stress reduction inform of transcendental meditation training on blood pressure in 9 RCT. They found BP changes of -4.7 mm Hg (95%CI, -7.4 to -1.9 mm Hg) for SBP and -3.2 mm Hg (95% CI, -5.4 to -1.3 mm Hg) for DBP.

DISCUSSION

4 articles on physical activity showed mean reduction of 3.46 mmHg in SBP and 1.28 mmHg in DBP. 2 articles on weight reduction showed mean difference of -5.37 mmHg in SBP and -3.49 mmHg in DBP. 2 articles on yoga showed mean reduction of 4.69 mmHg in SBP and 4.3 mmHg in DBP. 5 articles on salt reduction showed mean difference of -2.57 mmHg in SBP and -1.58 mmHg in DBP. 3 articles on alcohol reduction showed mean difference of -3.31 mmHg in SBP and -2.04 mmHg in DBP. 2 articles on DASH diet showed mean reduction of 5.0 mmHg in SBP and 2.98 mmHg in DBP. 2 articles on stress reduction in the form of transcendental meditation showed mean difference of -4.9 mmHg in SBP and -3.0 mmHg in DBP.

CONCLUSION

Modifiable hypertension risk factors include obesity, physical inactivity, high dietary salt intake, stress and high alcohol consumption. Modification of these modifiable hypertension risk factors by including physical activity inform of walking, cycling etc; yoga and transcendental meditation for stress, dietary salt reduction, vegetarian, DASH diet and alcohol reduction, significantly reduces blood pressure. Reduction effect is more pronounced in hypertensive subjects hence used as first line treatment option.

REFERENCES

1. Anchala R, Kannuri NK, Pant H, Khan H et al. Hypertension in India: a systematic review and meta-analysis of prevalence, awareness, and control of hypertension. *Journal of Hypertension*. 2014;32(6):1170-77.
2. Bhatt SP, Luqman-Arafath TK, Guleria R. Non-pharmacological management of hypertension. *Indian Journal Of Medicine Science*. 2007;61(11):616-24.
3. Patel V, Chatterji S, Chisholm D et al. Chronic diseases and injuries in India. *The Lancet*. 2011; 377:413–28.
4. Ebrahim S, Smith GD. Lowering blood pressure: A Systematic Review of sustained effects of non-pharmacological interventions. *Journal of Public Health Medicine*. 1998;20(4): 441-48.
5. Murtagh E M, Nichols L, Mohammed M A, Holder R, Nevill A M, Murphy MH. The effect of walking on risk factors for cardiovascular disease: An updated Systematic Review and Meta-Analysis of randomized control trials. *Preventive Medicine*. 2015;72:34-43.
6. Hanson S, Jones A .Is there evidence that walking groups have health benefits? A Systematic Review and Meta-Analysis. *British Journal of Sports Medicine*. 2015; 49:710-15.
7. Bravata D M, Smith-Spangler G, Sundaram V et al. Using pedometers to increase physical activity and improve health: A Systematic Review. *JAMA*. 2007; 298(19):2296-304.
8. Kelley GA, Kelley K S, Tran ZV. Walking and resting blood pressure in adults: A Meta-Analysis. *Preventive Medicine*. 2001;33(2):120-27.
9. Neter JE, StamBE, Kok FJ, Grobbee DE, Geleijnse JM. Influence of weight reduction on blood pressure-A Meta-Analysis of randomized controlled trials. *Hypertension*. 2003;42(11):878-84.
10. Horvath K, Jeitler K, Siering U et al. Long-term effects of weight-reducing interventions in hypertensive patients. *Archives Of Internal Medicine*. 2008; 168(6):571-80.
11. Hagins M, States R, Selfe T, Innes K. Effectiveness of yoga for hypertension: Systematic Review and Meta-Analysis. *Evidence-Based Complementary and Alternative Medicine*. 2013;2013, Article ID 649836:13 pages.
12. Chu P, Gotink RA, Yeh GY, Goldie SJ, Hunink MGM. The effectiveness of yoga in modifying risk factors for cardiovascular disease and metabolic syndrome: A Systematic Review and Meta-Analysis of randomized controlled trials. *European Journal of Preventive Cardiology*. 2014;23(3):291-307.
13. Midgley JP, Matthew AG, Greenwood CMT, Logan AG. Effect of reduced dietary sodium on blood pressure- A Meta-Analysis of randomized controlled trials. *JAMA*. 1996; 275(20):1590-97.
14. He FJ, MacGregor GA. Effect of modest salt reduction on blood pressure: A Meta-Analysis of randomized trials. Implications for public health. *Journal of Human Hypertension*. 2002;16:761-70.
15. Geleijnse JM, Kok FJ, Grobbee DE. Blood pressure response to changes in sodium and potassium intake: A Meta-Regression Analysis of randomized trials. *Journal of Human Hypertension*. 2003;17:471-80.
16. Graudal NA, Hubeck-Graudal T, Jurgens G. Effect of low-sodium diet vs. high-sodium diet on blood pressure, renin, aldosterone, catecholamines, cholesterol and triglyceride (Cochrane Review). *American Journal of Hypertension*. 2012;25(1):1-15.
17. He FJ, Li J, MacGregor GA. Effect of longer term modest salt reduction on blood pressure: Cochrane Systematic Review and Meta-Analysis of randomized trials. *BMJ*. 2013;346: f1325, doi: 10.1136/bmj.f1325.
18. Xin X, He J, Frontini MG, Ogden LG, Motsamai OI, Whelton PK. Effect of alcohol reduction on blood pressure-A Meta-Analysis of randomized controlled trials. *Hypertension*. 2001;38(11):1112-17.
19. Tarlor B, Irving H M et al. Alcohol and hypertension: gender difference in dose – response relationships determined through Systematic Review and Meta-Anaylsis. *Society for the study of addiction*. 2009;104(12):1981-1990.
20. Briasoulis A, Agarwal V, Messerli FH. Alcohol Consumption and the Risk of

- Hypertension in Men and Women: A Systematic Review and Meta-Analysis. Journal of Clinical Hypertension. 2012;14(11):791-798.
21. Yokoyama Y, Nishimura K, Barnard ND et al. Vegetarian diets and blood pressure: A Meta-Analysis. JAMA Internal Medicine. 2014;174:577-87.
 22. Siervo MM, Lara J, Chowdhury S, Ashor A, Oggioni C, Mathers J C. Effects of dietary approach to stop hypertension (DASH) diet on cardiovascular risk factors: A Systematic Review and Meta-Analysis. British Journal of Nutrition. 2015;113:1-15.
 23. Rainforth MV, Schneider RH, Nidich SI, Gaylord-King C, Salerno JW, Anderson JW. Stress reduction programs in patients with elevated blood pressure: A Systematic Review and Meta-Analysis. Current Hypertension Reports. 2007; 9:520-28.
 24. Anderson JW, Liu C, Kryscio RJ. Blood pressure response to transcendental meditation: A Meta-Analysis. American Journal of Hypertension. 2008;21(3): 310-16.

How to cite this article: Yadav V, Chaturvedi R, Kulandaivelan S et al. Role of life style modification on blood pressure: evidence from meta-analysis studies. Int J Health Sci Res. 2017; 7(11):290-295.
