Section: Cardiology

Original Research Article

ROLE OF SODIUM-RESTRICTED DIETARY APPROACHES TO CONTROL BLOOD PRESSURE IN PAKISTANI HYPERTENSIVE POPULATION

Altaf Hussain[1], Javed Khurshed Shaikh[2], Iftikhar Ahmed[3], Mashooq Ali[4], Shaikh Khalid Muhammad[5], Syed Fayaz Mujtaba[6]

[1]*Associate Professor Adult Cardiology, Sindh Institute of Cardiovascular Diseases Hyderabad Pakistan.*
[2]*Associate Professor Adult Cardiology, Sindh Institute of Cardiovascular Diseases Sukkur Pakistan.*
[3]*Associate Professor Adult Cardiology, Sindh Institute of Cardiovascular Diseases Baldia Pakistan.*
[4]*Associate Professor Adult Cardiology, Sindh Institute of Cardiovascular Diseases Sehwan Pakistan.*
[5]*Professor of Medicine, CMCH @ Shaheed Mohtarma Benazir Bhutto Medical University Larkana Pakistan.*
[6]*Associate Professor Adult Cardiology, Sindh Institute of Cardiovascular Diseases Larkana Pakistan.*

Received *: 08/10/2025*
Received in revised form *: 17/11/2025*
Accepted *: 05/12/2025*

Corresponding Author:
Dr. Altaf Hussain,
Associate Professor Adult Cardiology, Sindh Institute of Cardiovascular Diseases Hyderabad Pakistan.
Email: altafgajoo@hotmail.com

DOI: 10.70034/ijmedph.2025.4.412

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (4); 2288-2292

ABSTRACT

Background: Objective: The study aimed to determine the difference in systolic and diastolic blood pressure in the hypertensive adults after implementation of the sodium limited dietary plan which was applied using the principles of DASH.
Study design: Randomized controlled study.
Duration and place of study: this study was conducted at CMCH @ Shaheed Mohtarma Benazir Bhutto Medical University Larkana from May 2024 to May 2025.
Materials and Methods: This randomized controlled clinical trial included 200 patients diagnosed with primary hypertension. Participants were assigned to either an intervention group, which received a structured diet designed to limit daily sodium intake to approximately 1,500 mg, and a control group, which was instructed to continue their usual diet while avoiding foods with clearly high sodium content. Baseline measurements were recorded, followed by post-intervention assessments after the dietary period. A paired-sample t-test was used to evaluate differences in blood pressure both between and within the two groups.
Results: In the 200 interviewed participants, a fair percentage of them have strange blood pressure control, and a history of strong family hypertension. The mean age was within the middle aged. Following a period of compliance of about several weeks with the given diet plans, the intervention group had a more significant decrease in systolic and diastolic blood pressure than controls. The gains of both systolic and diastolic measurements were statistically significant ($p<0.05$) though the changes in the numerical values of the groups were not high.
Conclusion: A structured, sodium-restricted DASH-based diet produced modest but significant reductions in systolic and diastolic blood pressure among hypertensive adults. The intervention was practical, low-cost, and easily adaptable, supporting its use as an effective adjunct to routine hypertension management. These findings reinforce the importance of dietary counselling in non-pharmacological blood pressure control. Future studies with longer follow-up and objective sodium assessments may further clarify its long-term cardiovascular benefits.
Keywords: Systolic and diastolic blood pressure, sodium limited dietary plan, DASH, high sodium content.

INTRODUCTION

Hypertension is among the most crucial causes of morbidity and mortality in the world with over 9 million deaths per annum and it has been showing a prevalence both in the developed and the developing world.[1] It has been considered as one of the foremost modifiable cardiovascular disease, stroke and chronic kidney disease risk factors.[2] Despite being multifactorial in the determinants, eating behaviors especially high intake of sodium have a core role in the causing and maintenance of high blood pressure.[3] World Health Organization (WHO) has listed high salt content to be among the leading health issues of public health citing that the majority of the population consumes sodium significantly larger than the recommended amount of 2 grams per day (which equals to 5 grams of salt).[4] In South Asian nations such as Pakistan, there are established dietary patterns where the regular consumption of salt-containing foods, pickles, fried snacks, and processed spices make the sodium intake by far much greater than the rest of the world.[5]

The link between a decrease in sodium and better blood pressure control is highly supported by the evidence that has been developed over the past several decades. The results of landmark clinical trials, such as the DASH (Dietary Approaches to Stop Hypertension) study, proved that preventing hypertension in hypertensive and normotensive people through low sodium and increased fruit/vegets/low-fat dairy products can be effectively lowered and reduced with the help of low sodium diets and enriched with fruits and vegetables.[6,7] Follow-up controlled feeding reports have shown that even small decreases in sodium intake would lead to clinically significant stress drops in blood pressure.[8] These advantages are observed in a variety of populations, age categories, and comorbidity profiles, which supports the idea of supporting sodium restriction in terms of non-pharmacological hypertension treatment.[9]

The burden of hypertension in Pakistan has increased over the recent years and prevalence estimates fall between 2535 percent among the adults.[10] Some of the contributing factors are urbanisation, sedentary living, upsurge in the intake of processed food and lack of awareness concerning salt in the diet and its cardiovascular effects.[11] A local review of the literature also suggests that most of the hypertensive patients are unaware of the levels of sodium in their diets/lifestyles, and compliance with the dietary guidelines is low.[12] This demonstrates the necessity of structured culturally flexible interventions in nutrition with emphasis on practical dietary sodium reduction interventions.

The dietary modification is especially useful in regions where access to healthcare, its cost, and the ability of patients to adhere to medication are problematic.[13] The inclusion of sodium-restricted diets can be used in addition to pharmacological treatment and in certain instances, decrease the dose of taking various antihypertensive drugs.[14] In addition, sodium minimization programs at the population level have been demonstrated to be cost-saving and able to generate significant social health action.[15]

Although an established correlation exists between sodium consumption and blood pressure, little evidence exists on the efficacy of structured plans of sodium-restricted diets on Pakistani hypertensive patients. Adherence and final results may be dependent on cultural preferences, method of cooking, and different degrees of nutritional literacy. As such, comparative reviews of the targeted dietary interventions in this group are important to inform national hypertension control policies.

MATERIALS AND METHODS

This randomized level I controlled clinical trial used a sample of 200 previously diagnosed patients of primary hypertension. The two stage sampling method was applied to recruit participants in the outpatient departments. During the first step, the healthcare facilities frequented by hypertensive patients with different socioeconomic statuses were screened and simple random sampling was applied to allow similar percentage representation of clinics associated with low-, middle-, and high-income groups. The second stage involved the selection of individuals who met the admission conditions consecutively in the waiting areas of the outpatients. Patients aged between 30 and 70 years old that had confirmed hypertension and stable blood pressure were considered included. The eligibility criteria were that eligible patients were on either single-drug treatment of antihypertension or simply doing the lifestyle treatment. Patients with systolic blood pressure over 150 mmHg or diastolic blood pressure over 95mmHg, on more than one antihypertensive medication, smokers, pregnant women and comorbidities including diabetes, kidney diseases, heart associated complications and endocrine conditions were eliminated so as to reduce confounding variables and get a homogenous sample. All the participants were informed before they were enrolled by giving them a written informed consent.

The data on the demographic information, personal and family medical history, exercise, dietary habits, salt preferences, regular portion size, snacking behaviour, and time of the meal were collected by use of a structured interviewer administered questionnaire. The questionnaire was referenced to eating habits of the local population and was pretested among the 20 hypertensive people who were excluded in the study. The anthropometric measurements were taken using the standard

requirements such as height, weight, waist circumference, and hip circumference. A wall-mounted stadiometer was used to measure height (to within 0.5 cm) and a calibrated digital scale was used to measure weight. The measurements of the waist and hip circumference were taken with the help of a non-stretchable measuring tape as per the determined anatomical points.

During the measurement of the blood pressure, a calibrated mercury sphygmomanometer was used, and the trained personnel were able to conduct this measurement process. The readings were done on the two arms, when the person is seated and in a rest posture. This arm that had been initially measured more relative to the other arm was referred to as the reference arm. Two measurements of blood pressures were established during the visit i.e. before and after the routine clinical consultation separated by a time interval of 30 minutes to a maximum of 2 hours and mean value was documented. This was done the same way to get the post-intervention blood pressure readings.

The subjects were allocated at random to two similar groups based on their age, gender, education level, family income, baseline blood pressure and the frequency of exercising. The intervention group was given a traditional sodium-limited diet that contained around 1,500 mg of sodium and 2,000 kcal daily, and the control group was recommended to go on with their normal eating with-obvious high-sodium foods avoided. There was no individualization of the diet, but it was standardized and it was made according to the common eating habits in Pakistan. Each of the participants was asked to keep a diary of daily foods and submit weekly reports and to be followed up regularly on the telephone to encourage compliance and to call on any issues.

The blood pressure was checked after the dietary intervention period was over in the identical protocols used at the baseline. Since the main goal was to assess the blood pressure reaction, biochemist, including lipids profile were not tested. The SPSS version 21 was used to analyze the data statistically. Demographic and baseline variables were used to calculate descriptive statistics. Hamilton has employed paired sample t-tests to determine within group differences on the systolic and diastolic blood pressure and independent t tests to determine differences in results between the intervention and control groups. The p-value was considered significant when it was a p-value that was less than 0.05.

RESULTS

Out of the 200 hypertensive patients recruited, 188 (94.0% out of the 200) completed the study and were incorporated into the study. The characteristics of the control group (n = 94) and the intervention group (n = 94) were rather similar, which ensured that they were randomly allocated. [Table 1]

Table 1: Baseline Demographic Characteristics (n = 188)

Variable	Control (n = 94)	Intervention (n = 94)	p-value
Age (years), mean ± SD	52.8 ± 8.9	53.4 ± 9.2	0.61
Male, n (%)	48 (51.1%)	50 (53.2%)	0.77
Female, n (%)	46 (48.9%)	44 (46.8%)	0.77
Hypertension duration (years)	3.52 ± 1.14	3.61 ± 1.19	0.58
BMI (kg/m²), mean ± SD	27.6 ± 3.41	27.1 ± 3.38	0.42

There were also comparable Group behavioural blood-pressure monitoring, lifestyles and family history of hypertension (Table 2). One hundred and thirty-one (69.7% of the participants) had a home blood pressure device, and 118 (62.8) said they had a positive family history of hypertension. This percentage amounted to about a third of the participants (37.2 in control and 39.4 in the intervention group), meaning that exercised regularly.

Table 2: Lifestyle and Blood Pressure Monitoring Patterns

Variable	Control (n = 94)	Intervention (n = 94)	Total (n = 188)
BP checks <2 times in 6 months	26 (27.7%)	26 (27.7%)	52 (27.7%)
Owns BP device	68 (72.3%)	63 (67.0%)	131 (69.7%)
Family history of hypertension	60 (63.8%)	58 (61.7%)	118 (62.8%)
No exercise	12 (12.8%)	9 (9.6%)	21 (11.2%)
Regular exercise ≥3/week	37 (39.4%)	37 (39.4%)	74 (39.4%)
Sedentary lifestyle	64 (68.1%)	60 (63.8%)	124 (66.0%)

Pre-intervention dietary practices showed that 40.4% of the participants ate more than twice per week in snacks, 62.8% has avoided the intake of salt during meals. In general, 110 (58.5) respondents felt that they were under control of their blood pressure, and 121 (64.4) felt healthy. There was no significant difference in the baseline systolic and diastolic blood pressure of the two groups. [Table 3]

Table 3: Baseline Blood Pressure Values

Variable	Control (n = 94)	Intervention (n = 94)	p-value
Systolic BP (mmHg), mean ± SD	128.5 ± 3.6	128.4 ± 3.5	0.86
Diastolic BP (mmHg), mean ± SD	84.2 ± 3.0	84.3 ± 3.1	0.78

In both systolic and diastolic blood pressure, the intervention group improved significantly when compared to control group (Table 4) after the intervention. The intervention group showed an average of -2.3 mmHg systolic BP change compared to the control group which recorded a small increase of +0.4 mmHg systolic change of BP. These differences were found to be significant ($p < 0.05$).

Table 4: Post-Intervention Blood Pressure and Mean Changes

Outcome	Control (n = 94)	Intervention (n = 94)	p-value
Post-intervention SBP (mmHg)	128.9 ± 3.7	126.1 ± 3.3	<0.05
Post-intervention DBP (mmHg)	84.4 ± 2.9	83.1 ± 2.8	<0.05
Change in SBP (mmHg)	+0.4	−2.3	<0.05
Change in DBP (mmHg)	+0.2	−1.2	<0.05

The overall findings indicate that the sodium-restricted diet produced a modest yet meaningful improvement in blood pressure control among hypertensive patients.

DISCUSSION

The current research investigated whether a sodium-limited diet, which is grounded on the principles of the DASH diet, showed any impact on the regulation of blood pressure in hypertensive adults. The results indicated that a significant drop in dietary sodium content did lead to a statistically significant drop in systolic and diastolic blood pressure of the intervention group and not that of the control. Though the numerical change was not that large in absolute terms, these reductions are clinically significant, and these are in agreement with other evidence in the world that sodium restriction is an effective non-pharmacological intervention in the management of hypertension.

Hypertension is a major cause of cardiovascular morbidity and mortality across the globe, especially in low and the middle-income nations where lifestyle and diet trends add a lot of risk in burden.[16] Modifiable risk factors have been well-established as high sodium intake in the heightening blood pressure. There are many physiological mechanisms that elucidate this association, one of them the raised plasma volume, endothelial dysfunction, and the alteration of sodium renal elimination.[17] Findings of this research are closely correlated to these previously known mechanisms because people who followed a sodium-limited diet showed a statistically significant change in the blood pressure through the intervention process.

Findings of large controlled feeding studies have continually demonstrated the advantages of sodium lowering. The historic DASH-Sodium study showed that there is a significant dose-response to sodium limits and decreases in systolic blood pressure, and individual benefits become maximal with existing people with high blood pressure at baseline.[18] On the same note, observational and experimental research of various populations proves that reduction in sodium intake is part of short-term and long-term lowering effect on blood pressure.[19,20] These findings are in line with the results obtained during the current study indicating that even a moderate intake of sodium by reducing it to about 1,500 mg/day had significant effects.

The South Asians such as Pakistan have dietary practices that tend to increase amount of salt added, processed foods, pickles, and salted snacks leading to perpetual risk of hypertension.[21] We find that even though most participants stated that they had tried to limit their salt intake, actual compliance may be a missing variable depending on that group awareness, cultural norms and household behavior. Only 62.8% individuals reported being consciously trying to limit salt, which demonstrates that the nutritional education and practical advice about the diet should be more powerful at the community level. Sedentary lifestyle, inconsistent exercises, and inconsistent monitoring of the blood-pressure also included behavioral patterns that became common among the participants, and that could affect the effect that could be felt in the long run in control of the disease.

Sodium limitation is still one of the most available and affordable modes of managing hypertension, especially in low resource environments where lifelong medication compliance can be problematic.[22] No medication adjustments were needed in the intervention of this research and the results still provided significant improvements to support the importance of lifestyle adaptation in the management programs of hypertension. Notably, the decrease in systolic blood pressure (2-3 mmHg) despite being small in magnitude, has population-level effects with well-established benefits. A 2 mmHg decrease in systolic pressure has been linked to a 6% decrease in mortality of stroke and a 4% decrease in coronary heart mortality.[23]

Several strengths are associated with the study such as randomized assignment, respect of a standardized eating programme, and the matched baseline within-group characteristics. We also had the post-intervention blood pressure readings which were

carried out in the same validated procedures boosting the credibility of the results.

Nonetheless, there are a number of restrictions that have to be admitted. Food diaries were used to determine dietary adherence which can bring about reporting bias. Although the intervention period was adequate to describe the short-term changes in BP, it might not represent the long-term sustainability of the sodium-limited eating patterns. Moreover, a test of biochemical indices was not carried out like the serum sodium or urinary sodium excretion which might have offered objective data on dietary compliance. Their cultural eating habits could also impair the extrapolation to peoples with other food habits.

In spite of these, the study still carries relevant evidence in support of the use of sodium restriction in the management of blood pressure in the sample population hypertensive population. Further priority to dietary counselling, population health education and integrating of low-sodium dietary interventions into the routine clinical practice could play a significant role in enhancing cardiovascular outcomes.

CONCLUSION

This study shows that a structured sodium-restricted diet based on DASH principles produces a modest but significant reduction in both systolic and diastolic blood pressure among hypertensive adults. Despite the small numerical changes, their statistical significance and consistency with global evidence underscore the clinical value of dietary sodium reduction as an effective, low-cost, and culturally adaptable adjunct to standard hypertension care. These findings highlight the central role of dietary counselling and lifestyle modification in non-pharmacological blood pressure control. Broader public health efforts and improved patient education may enhance long-term outcomes. Future research with longer follow-up, objective sodium measurements, and community-level interventions could further clarify the sustained cardiovascular benefits of sodium restriction.

Source of Funding: None

Permission: Ethical approval obtained

Conflict of Interest: None

REFERENCES

1. Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet. 2012;380(9859):2224–2260.
2. Forouzanfar MH, Liu P, Roth GA, Ng M, Biryukov S, et al. Global burden of hypertension and systolic blood pressure of at least 110 to 115 mm Hg, 1990–2015. JAMA. 2017;317(2):165–182.
3. He FJ, MacGregor GA. Reducing population salt intake worldwide: from evidence to implementation. Prog Cardiovasc Dis. 2010;52(5):363–382.
4. World Health Organization. Guideline: Sodium intake for adults and children. Geneva: WHO; 2012.
5. Ahmad K, Jafar TH, Imran S, Bux R, Iqbal SP. Patterns of dietary salt intake and blood pressure in Pakistani adults. J Pak Med Assoc. 2018;68(6):873–878.
6. Appel LJ, Moore TJ, Obarzanek E, Vollmer WM, Svetkey LP, et al. A clinical trial of the effects of dietary patterns on blood pressure. N Engl J Med. 1997;336(16):1117–1124.
7. Sacks FM, Svetkey LP, Vollmer WM, Appel LJ, Bray GA, et al. Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. N Engl J Med. 2001;344(1):3–10.
8. He FJ, Li J, MacGregor GA. Effect of longer-term modest salt reduction on blood pressure: Cochrane systematic review and meta-analysis of randomised trials. BMJ. 2013;346:f1325.
9. Aburto NJ, Ziolkovska A, Hooper L, Elliott P, Cappuccio FP, et al. Effect of lower sodium intake on health: systematic review and meta-analyses. BMJ. 2013;346:f1326.
10. Pakistan Health Survey. National Survey of Non-Communicable Diseases. Government of Pakistan; 2019.
11. Jafar TH, Levey AS, White FM, Gul A, Jessani S, et al. Ethnic subgroup differences in hypertension in Pakistan. Hypertension. 2005;45(1):1110–1115.
12. Shaikh RB, Khan N, Aqeel T, Shahid H, Ahmed H. Knowledge, attitudes, and practices regarding salt intake among adults in Pakistan. BMC Public Health. 2020;20:12–20.
13. Burnier M, Egan BM. Adherence in hypertension: a review of prevalence, risk factors, impact, and management. Circ Res. 2019;124(7):1124–1140.
14. Whelton PK, Carey RM, Aronow WS, Casey DE, Collins KJ, et al. 2017 ACC/AHA hypertension guideline for the prevention, detection, evaluation, and management of high blood pressure. Hypertension. 2018;71(6):e13–e115.
15. Bibbins-Domingo K, Chertow GM, Coxson PG, Moran A, Lightwood JM, et al. Projected effect of dietary salt reductions on future cardiovascular events in the United States. N Engl J Med. 2010;362(7):590–599.
16. Forouzanfar MH, et al. Global burden of hypertension and systolic blood pressure trends. JAMA. 2017;317(2):165–182.
17. He FJ, MacGregor GA. Salt, blood pressure and cardiovascular disease. Nat Rev Cardiol. 2010;7(10):499–508.
18. Sacks FM, et al. Effects on blood pressure of reduced dietary sodium and the DASH diet. N Engl J Med. 2001;344(1):3–10.
19. Aburto NJ, et al. Effect of lower sodium intake on blood pressure: systematic review. BMJ. 2013;346:f1326.
20. He FJ, Li J, MacGregor GA. Longer-term modest salt reduction and blood pressure. BMJ. 2013;346:f1325.
21. Jafar TH, et al. Hypertension epidemiology in Pakistan. Hypertension. 2005;45(6):1110–1115.
22. Burnier M, Egan BM. Adherence in hypertension: impact and management. Circ Res. 2019;124(7):1124–1140.
23. Law MR, et al. Benefits of blood pressure reduction: meta-analysis. BMJ. 2009;338:b1665.