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Impact of lifestyle modifications on blood pressure control in hypertensive patients: A Prospective cohort observational study.

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Abstract

Background
Hypertension remains a leading modifiable risk factor for cardiovascular morbidity and mortality worldwide. While pharmacological treatment is widely prescribed, lifestyle modification is a cornerstone of non-pharmacologic management. This study aimed to evaluate the impact of structured lifestyle changes on blood pressure control among hypertensive patients.
Objectives: To assess the effectiveness of dietary, behavioral, and physical activity-based lifestyle modifications on systolic and diastolic blood pressure control over six months.

Methods
This prospective observational study was conducted on 100 adult hypertensive patients over six months. Baseline demographics, co-morbidities, and blood pressure readings were recorded. Patients received counseling on lifestyle modifications, including DASH diet adherence, salt restriction, physical activity, smoking cessation, weight management, and alcohol moderation. Follow-up measurements of blood pressure and lifestyle adherence were recorded and analyzed using appropriate statistical methods.

Results
The mean age of participants was 52.4 ± 10.8 years, with 56% males. At baseline, the mean systolic and diastolic blood pressures were 148.6 ± 9.5 mmHg and 92.4 ± 6.3 mmHg, respectively. After six months, significant reductions were observed in systolic (134.2 ± 8.6 mmHg) and diastolic (84.1 ± 5.4 mmHg) blood pressure ($p < 0.001$). Among patients with high adherence to lifestyle changes (≥4 factors), 86% achieved blood pressure control, compared to only 25% in the low adherence group. Lifestyle adherence was strongly associated with better blood pressure outcomes.

Conclusion
Lifestyle modifications significantly improve blood pressure control in hypertensive patients, particularly when multiple changes are adopted consistently. These non-pharmacologic strategies should be integrated into routine hypertension management.

Recommendations
Primary care settings must prioritize lifestyle counseling and follow-up reinforcement to improve adherence and long-term hypertension control.

Keywords: *Hypertension, Lifestyle modification, Blood pressure, DASH diet, Physical activity, Adherence, Non-pharmacologic treatment*
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Introduction

Hypertension is one of the most prevalent non-communicable diseases worldwide, affecting approximately 1.28 billion adults aged 30–79 years. A significant proportion of these individuals remain undiagnosed or inadequately controlled despite the availability of effective pharmacologic treatments. As a major risk factor for cardiovascular diseases, stroke, renal dysfunction, and premature death, hypertension poses a serious global health challenge that necessitates comprehensive and sustainable management strategies [1].

While antihypertensive medications remain the cornerstone of treatment, substantial evidence supports the effectiveness of lifestyle modifications in both preventing and controlling elevated blood pressure [2]. International guidelines from leading health organizations, including the American Heart Association (AHA) and the World Health Organization (WHO), strongly advocate non-pharmacologic interventions such as dietary sodium restriction, regular physical activity, weight management, moderation of alcohol intake, smoking cessation, and adoption of the Dietary Approaches to Stop Hypertension (DASH) diet [3,4].

Despite the strength of these recommendations, real-world implementation and adherence to lifestyle changes remain suboptimal, especially in low- and middle-income countries like India. Cultural norms, socioeconomic status, healthcare access, and behavioral factors often pose significant barriers to the sustained adoption of these strategies [2,5]. Moreover, the incorporation of lifestyle counseling into routine clinical care is inconsistent, and healthcare providers may not consistently reinforce these interventions, as highlighted in recent studies examining physician practices and patient compliance [3,6].

This study was conducted to evaluate the effectiveness of structured lifestyle modifications in controlling blood pressure among hypertensive patients in a prospective observational design. By assessing adherence and outcomes over six months, the study aims to quantify the benefits of non-pharmacologic strategies and inform clinical practices in primary and community healthcare settings.

Methodology

Study design

This was a prospective cohort observational study conducted for seven months, from August 2024 to February 2025. The study aimed to evaluate the impact of structured lifestyle interventions on blood pressure control in adult hypertensive patients. Participants were enrolled at baseline and followed longitudinally for six months to monitor changes in blood pressure and lifestyle adherence. No experimental drugs or interventional procedures were involved; all patients continued to receive standard medical care in addition to individualized lifestyle counseling.

Study setting

The study was conducted in the Department of General Medicine at Mahatma Gandhi Memorial (MGM) Hospital, Warangal, Telangana, India - a tertiary care teaching hospital affiliated with Kakatiya Medical College, Warangal. The hospital caters to a large catchment of both urban and rural populations, offering a representative clinical setting to evaluate the feasibility and effectiveness of structured lifestyle interventions in routine hypertension management.

Study population

A total of 100 adult patients diagnosed with essential hypertension, attending the outpatient department or admitted to the inpatient wards, were enrolled in the study based on eligibility criteria.

Sample size calculation

The sample size was determined based on previous literature indicating that lifestyle interventions can produce an average reduction of 10–12 mmHg in systolic blood pressure with a standard deviation of approximately 15 mmHg. Using a two-sided alpha of 0.05, power of 80%, and expecting a minimum detectable difference of 8 mmHg in systolic BP, the required sample size was estimated to be 88. Accounting for a potential 10–15% dropout rate over the follow-up period, a final sample size of 100 participants was targeted.

Inclusion criteria

- Adults aged 30 to 70 years.
- Diagnosed with essential hypertension (based on JNC-8 criteria).

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- Either newly diagnosed or already on antihypertensive treatment, but with uncontrolled blood pressure.
- Willing to participate and provide written informed consent.

Exclusion criteria

- Secondary hypertension due to renal, endocrine, or other systemic diseases.
- Pregnant or lactating women.
- Patients with recent myocardial infarction or stroke (within the last 3 months).
- Individuals with cognitive impairments affecting compliance or understanding.

Data collection and baseline assessment

At enrollment, baseline data were collected, including demographic details, BMI, residence (urban/rural), duration of hypertension, comorbidities (diabetes, obesity, dyslipidemia), and baseline systolic and diastolic blood pressures measured using a standard sphygmomanometer in a seated position after 5 minutes of rest.

Intervention and follow-up

All participants received structured counseling on six key lifestyle modifications:
DASH diet adherence.
Salt intake reduction (<5g/day).
Physical activity (≥150 minutes/week).
Weight management strategies.
Smoking cessation (if applicable).
Alcohol moderation (if applicable).
Lifestyle adherence was assessed monthly through direct interviews and a self-reported adherence checklist. Follow-up blood pressure readings were taken at 3 and 6 months.

Outcome measures

Primary outcome

Change in systolic and diastolic blood pressure after 6 months.

Secondary outcome

Proportion of patients achieving target BP <140/90 mmHg and correlation with adherence level.

Measures to minimize bias

Efforts were made to reduce potential sources of bias throughout the study. Selection bias was minimized by consecutively enrolling eligible hypertensive patients who met the inclusion criteria and consented to participate, regardless of gender or socioeconomic status. Information bias was reduced by standardizing the data collection procedure, using the same sphygmomanometer model for all BP measurements, and ensuring measurements were taken by trained personnel under similar conditions. Recall bias was minimized by conducting monthly follow-ups and using a structured adherence checklist to validate self-reported lifestyle practices. Observer bias was limited by blinding the data analyst to the adherence categories during statistical analysis.

Statistical analysis

Data were entered in Microsoft Excel and analyzed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as percentages. Paired t-tests were used to compare pre- and post-intervention blood pressure values. A p-value <0.05 was considered statistically significant.

Ethical considerations

The study was approved by the Institutional Ethics Committee of MGM Hospital, Warangal. Written informed consent was obtained from all participants. Confidentiality was maintained, and participation was voluntary with the right to withdraw at any stage without consequence.

Results

Participant flow

A total of 138 individuals were screened for eligibility during the study period. Of these, 18 were excluded for not meeting the inclusion criteria (secondary hypertension = 8, cognitive impairment = 6, recent cardiovascular event = 4). Twenty individuals declined to participate due to personal reasons or unwillingness to follow up. Finally, 100 patients were enrolled and included in the baseline analysis. Of these, 92 participants completed the full six-month follow-up, while 8 were lost to follow-up (moved away = 4, withdrew consent = 3, lost contact

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= 1). Data from all 100 participants were included in the intention-to-treat analysis.

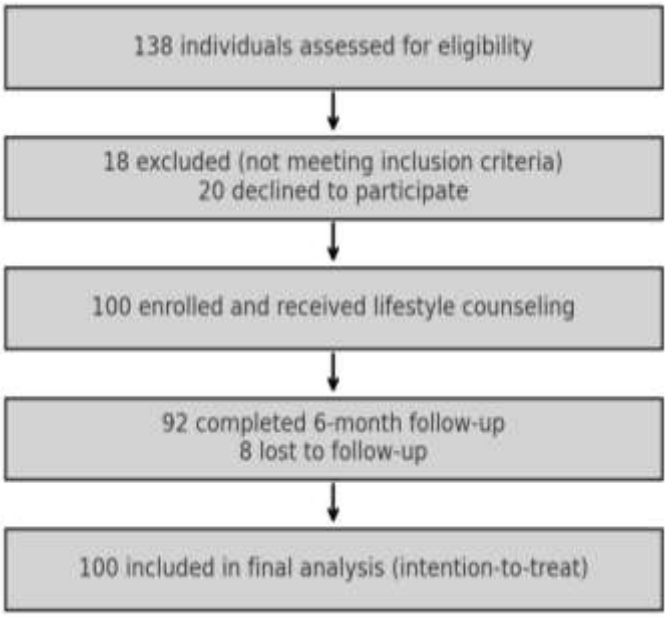

Figure 1. Participant flow diagram

A total of 100 hypertensive patients were enrolled in the study. The mean age of participants was 52.4 ± 10.8 years, with 56% males and 44% females. The average Body Mass Index (BMI) was 27.2 ± 3.6 kg/m². Most participants resided in urban areas (62%), and 59% had been diagnosed with hypertension for more than five years. Common co-morbidities included diabetes (35%), obesity (28%), and dyslipidemia (22%). The mean baseline systolic and diastolic blood pressures were 148.6 ± 9.5 mmHg and 92.4 ± 6.3 mmHg, respectively (Table 1).

Table 1: Demographic and baseline characteristics of study participants (N = 100)

Characteristic	Value
Age (mean ± SD)	52.4 ± 10.8 years
Gender	Male: 56 (56%) Female: 44 (44%)
BMI (mean ± SD)	27.2 ± 3.6 kg/m²
Residence	Urban: 62% Rural: 38%
Duration of Hypertension	<5 years: 41% ≥5 years: 59%
Co-morbidities	Diabetes: 35% Obesity: 28% Dyslipidemia: 22%
Baseline Systolic BP (mean ± SD)	148.6 ± 9.5 mmHg
Baseline Diastolic BP (mean ± SD)	92.4 ± 6.3 mmHg

Adherence to various lifestyle modifications was assessed at baseline and over the six-month follow-up period. Among the participants, 78% adhered to the DASH diet, 66% engaged in regular physical activity (≥150 minutes per week), and 60% reduced their daily salt intake to less than 5 grams. Weight

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management efforts were reported by 54% of patients. Among smokers (n=30), 70% successfully ceased smoking, and among alcohol consumers (n=50), 58% practiced moderation in alcohol intake (Table 2).

Table 2: Lifestyle modification adherence among participants

Lifestyle Modification	Number of Patients Adhered	Percentage (%)
DASH Diet	78	78%
Physical Activity (≥150 min/week)	66	66%
Salt Intake Reduction (<5 g/day)	60	60%
Weight Management Efforts	54	54%
Smoking Cessation (among smokers, n=30)	21	70%
Alcohol Moderation (among drinkers, n=50)	29	58%

After six months of implementing lifestyle interventions, a significant reduction in blood pressure was observed. The mean systolic blood pressure decreased from 148.6 ± 9.5 mmHg to 134.2 ± 8.6 mmHg, and the mean diastolic pressure dropped from 92.4 ± 6.3 mmHg to 84.1 ± 5.4 mmHg. These changes were statistically significant ($p < 0.001$ for both comparisons) (Table 3).

Table 3: Blood Pressure Changes After 6 Months of Lifestyle Modification

Parameter	Baseline (Mean ± SD)	After 6 Months (Mean ± SD)	p-value
Systolic BP (mmHg)	148.6 ± 9.5	134.2 ± 8.6	<0.001
Diastolic BP (mmHg)	92.4 ± 6.3	84.1 ± 5.4	<0.001

Patients were categorized into three adherence groups based on the number of lifestyle modifications followed: high adherence (≥4 modifications), moderate adherence (2–3 modifications), and low adherence (≤1 modification). The high adherence group showed the most substantial improvements, with a mean systolic BP reduction of 17.2 ± 6.1 mmHg and a diastolic BP reduction of 9.3 ± 3.2 mmHg. In contrast, the low adherence group exhibited reductions of only 5.2 ± 3.1 mmHg and 3.5 ± 2.1 mmHg, respectively. Overall, 86% of patients in the high adherence group achieved blood pressure control (BP <140/90 mmHg) compared to just 25% in the low adherence group (Table 4).

Table 4: BP control based on level of lifestyle adherence

Adherence Group	No. of Patients	Mean SBP Reduction (mmHg)	Mean DBP Reduction (mmHg)	Patients with Controlled BP (%)
High adherence (≥4 modifications)	58	17.2 ± 6.1	9.3 ± 3.2	86%
Moderate adherence (2–3)	30	10.5 ± 4.9	6.7 ± 2.8	60%
Low adherence (≤1)	12	5.2 ± 3.1	3.5 ± 2.1	25%

Discussion

This prospective observational study evaluated the impact of structured lifestyle modifications on blood pressure control among hypertensive patients over six months. The results showed a statistically significant reduction in both systolic and diastolic blood pressure following the adoption of non-pharmacologic strategies, including dietary changes, increased physical activity, salt reduction, weight management, and smoking/alcohol moderation.

At baseline, the majority of participants exhibited uncontrolled hypertension, with a mean systolic blood pressure of 148.6 mmHg and a diastolic

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pressure of 92.4 mmHg. After six months of lifestyle interventions, these values significantly decreased to 134.2 mmHg and 84.1 mmHg, respectively ($p < 0.001$). These findings are consistent with the PREMIER clinical trial, which demonstrated substantial reductions in blood pressure through comprehensive lifestyle changes, particularly among participants who adhered to the DASH diet and physical activity regimens [7]. Similar conclusions were drawn in a recent review that emphasized lifestyle interventions as first-line strategies in hypertension prevention and management [8].

This study further demonstrated that the degree of adherence to lifestyle modifications directly influenced blood pressure outcomes. Participants with high adherence (≥4 lifestyle changes) achieved target BP levels in 86% of cases, compared to just 25% among those with low adherence. This supports the conclusions of previous reports that highlighted the synergistic effect of combined lifestyle measures being more effective than isolated interventions [9,10].

Beyond blood pressure control, lifestyle modifications offer broader cardiovascular and metabolic benefits, including improved glycemic control, weight reduction, and lipid profile enhancement. These long-term benefits are well-documented in preventive cardiology literature and current clinical guidelines [11,12].

Despite these positive outcomes, patient adherence remains a major barrier, influenced by socioeconomic, cultural, and behavioral factors. Ongoing patient education, individualized counseling, and structured follow-up are essential to reinforce adherence and sustain long-term benefits.

Generalizability

The findings of this study have meaningful implications for real-world clinical practice, particularly in primary care and resource-limited settings. Given that the study population was drawn from both urban and rural backgrounds within a government hospital context, the results apply to a broad demographic representative of typical hypertensive patients in India. The use of standard clinical tools, pragmatic lifestyle interventions, and regular follow-up schedules enhances the external validity of the results. However, since the study was conducted at a single tertiary care center, caution should be exercised when extrapolating findings to other regions with different healthcare infrastructure, cultural norms, or patient adherence behaviors. Multicentric studies are warranted to further confirm these findings across diverse populations.

Conclusion

This study demonstrated that structured lifestyle modifications significantly improve blood pressure control in patients with hypertension. Interventions such as adherence to the DASH diet, regular physical activity, salt intake reduction, smoking cessation, and weight management were effective in lowering both systolic and diastolic blood pressure over six months. The extent of blood pressure reduction was directly proportional to the level of adherence, with the highest success observed in patients following four or more lifestyle changes. These findings reinforce the role of non-pharmacologic measures as essential components of hypertension management. Integrating lifestyle counseling into routine clinical practice can enhance patient outcomes, reduce medication dependence, and lower long-term cardiovascular risks.

Limitations

This study was limited by its observational design, relatively small sample size, and reliance on self-reported adherence. Future randomized controlled trials with larger populations and longer follow-up are needed to validate and generalize these findings.

Recommendations

Based on the findings of this study, it is recommended that lifestyle modification counseling be made an integral part of routine hypertension management in both outpatient and inpatient settings. Primary care physicians and healthcare providers should emphasize dietary changes, physical activity, and behavioral interventions alongside pharmacologic treatment. Regular follow-up visits should include lifestyle adherence assessments to reinforce compliance. Community-based education programs can enhance awareness and engagement. Furthermore, individualized intervention plans tailored to cultural and socioeconomic contexts can improve long-term adherence and optimize blood pressure control among diverse patient populations.

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this study. I also extend my heartfelt appreciation to all the patients who participated in this study for their cooperation and willingness to contribute. Lastly, I acknowledge the support of my family and peers, whose motivation and assistance made this work possible.

List of abbreviations

BP – Blood Pressure
SBP – Systolic Blood Pressure
DBP – Diastolic Blood Pressure
DASH – Dietary Approaches to Stop Hypertension
BMI – Body Mass Index
SD – Standard Deviation
n – Number of Participants
SPSS – Statistical Package for the Social Sciences
mmHg – Millimeters of Mercury
AHA – American Heart Association
WHO – World Health Organization

Source of funding

The study had no funding.

Conflict of interest

The authors declare no conflict of interest.

Author contributions

SP-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript.SG-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript.RY-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript.

Data availability

Data available on request

Author biography

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