

# EFFECT OF ALTERNATE NOSTRIL BREATHING ON BLOOD PRESSURE AND HEART RATE IN ADULTS WITH ELEVATED BLOOD PRESSURE: A PILOT INTERVENTIONAL STUDY

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## ABSTRACT

**Background:** Elevated blood pressure is an important modifiable risk factor for cardiovascular disease. Yogic breathing practices have been increasingly investigated as complementary approaches for cardiovascular health. Alternate nostril breathing (Nadi Shodhana/Anulom Vilom Pranayama) is a simple breathing technique that may influence autonomic cardiovascular regulation.

**Aim:** To evaluate the effect of four weeks of alternate nostril breathing on systolic blood pressure, diastolic blood pressure and resting heart rate in adults with elevated blood pressure.

**Materials and Methods:** A pilot interventional study was conducted in the Department of Physiology, Government Medical College, Jangaon, Telangana, India. Thirty adults with elevated blood pressure were divided into intervention (n = 15) and control (n = 15) groups. The intervention group practiced alternate nostril breathing for 15 minutes per day, five days per week, for four weeks, in addition to their usual lifestyle. The control group continued their usual routine. Blood pressure and resting heart rate were recorded before and after the intervention.

**Results:** The intervention group showed a reduction in systolic blood pressure from  $137.4 \pm 5.8$  to  $130.6 \pm 5.5$  mmHg, diastolic blood pressure from  $86.7 \pm 4.2$  to  $82.1 \pm 3.8$  mmHg and resting heart rate from  $78.3 \pm 6.1$  to  $73.8 \pm 5.7$  beats/min. The control group showed comparatively smaller changes.

**Conclusion:** Regular alternate nostril breathing may have a beneficial effect on blood pressure and resting heart rate and may be considered a simple adjunctive lifestyle intervention for cardiovascular health. Larger studies with longer follow-up are required.

**Keywords:** Alternate Nostril Breathing, Nadi Shodhana, Pranayama, Blood Pressure, Heart Rate, Hypertension, Autonomic Function, Yoga

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## INTRODUCTION

Hypertension and elevated blood pressure are major public health concerns and important modifiable risk factors for cardiovascular morbidity and mortality. Along with pharmacological therapy, lifestyle modification plays an important role in the prevention and management of cardiovascular risk.

Yoga and yogic breathing practices have attracted increasing scientific interest because of their potential effects on autonomic regulation, stress, cardiovascular function and respiratory physiology. Pranayama involves conscious regulation of breathing and includes several techniques with different patterns of inspiration, expiration and breath control.

Alternate nostril breathing, also known as Nadi Shodhana or Anulom Vilom Pranayama, involves controlled breathing through alternate nostrils. The practice is traditionally considered calming and is increasingly being investigated for its physiological effects.

Previous research has demonstrated that breathing exercises can reduce cardiovascular parameters. A systematic review and meta-analysis of 15 randomized clinical trials reported significant reductions in systolic blood pressure, diastolic blood pressure and heart rate

following breathing exercises [1]. More specifically, a systematic review and meta-analysis of alternate nostril breathing found significant reductions in systolic and diastolic blood pressure compared with control interventions [2].

The possible cardiovascular effects of pranayama may involve modulation of autonomic nervous system activity, enhanced parasympathetic influence and reduction of sympathetic activity. Studies of other pranayama techniques have also reported reductions in blood pressure and changes suggestive of improved sympathovagal balance [3,4].

A recent randomized study of Nadi Shodhana reported reductions in systolic and diastolic blood pressure together with improvements in heart-rate-variability-related parameters following regular practice [5]. Furthermore, a recent systematic review and meta-analysis of randomized controlled trials concluded that pranayama significantly reduced heart rate and may have a modest beneficial effect on blood pressure [6].

Despite these findings, individual pranayama techniques require further investigation using standardized protocols. Therefore, the present pilot study was undertaken to evaluate the effect of a four-week standardized alternate

nostril breathing program on blood pressure and resting heart rate.

## AIM AND OBJECTIVES

**Aim:** To study the effect of alternate nostril breathing on blood pressure and resting heart rate in adults with elevated blood pressure.

### Objectives:

1. To assess systolic blood pressure before and after alternate nostril breathing.
2. To assess diastolic blood pressure before and after alternate nostril breathing.
3. To assess resting heart rate before and after the intervention.
4. To compare changes in cardiovascular parameters between the intervention and control groups.

## MATERIALS AND METHODS

### Study Design and Setting

A pilot interventional, controlled study was conducted in the Department of Physiology, Government Medical College, Jangaon, Telangana, India. The intervention was carried out for four weeks.

### Study Participants

Thirty adults with elevated blood pressure were included and divided into an intervention group (n = 15) and a control group (n = 15).

### Inclusion Criteria

- Age between 30 and 60 years.
- Individuals with elevated blood pressure.
- Willingness to participate in the study.
- Ability to understand and perform the breathing technique.
- Written informed consent.

### Exclusion Criteria

- Severe or uncontrolled hypertension.
- Significant cardiovascular disease.
- Severe respiratory disease.
- Major neurological or psychiatric illness.
- Regular practice of pranayama or yoga before enrollment.
- Any condition preventing participation in the intervention.

### Ethical Considerations

The study was conducted after obtaining clearance from the Institutional Ethics Committee of Government Medical College, Jangaon. Written informed consent was obtained from all participants before enrollment. Participants were informed about the study procedure and their right to withdraw at any time.

### Intervention Protocol

The intervention group practiced alternate nostril breathing (Nadi Shodhana/Anulom Vilom Pranayama) for 15 minutes per session, five days per week for four weeks. The session structure is shown in Table 1.

**Table 1. Structure of each alternate nostril breathing session**

| Component                          | Duration      |
|------------------------------------|---------------|
| Comfortable sitting and relaxation | 2 min         |
| Normal breathing                   | 2 min         |
| Alternate nostril breathing        | 10 min        |
| Quiet resting                      | 1 min         |
| <b>Total</b>                       | <b>15 min</b> |

Participants were instructed to breathe slowly and comfortably without forceful inspiration, expiration or prolonged breath retention. The control group continued their normal routine without structured pranayama training.

### Blood Pressure and Heart Rate Measurement

Participants were instructed to avoid vigorous exercise, caffeine and smoking before assessment and rested quietly for 5–10 minutes before measurement. Blood pressure was measured in the sitting position using a validated digital blood pressure monitor. Two readings were taken at an appropriate interval and the average value was recorded. Resting heart rate was recorded during the same assessment. Measurements were obtained at baseline and following four weeks of intervention.

### Statistical Analysis

Continuous variables were expressed as mean  $\pm$  standard deviation. Within-group changes were assessed using an appropriate paired statistical test, while between-group differences were assessed using an independent statistical test. A p-value  $<0.05$  was considered statistically significant.

## RESULTS

**Table 2. Baseline and post-intervention cardiovascular parameters (mean  $\pm$  SD)**

| Parameter      | Interv. Baseline | Interv. Post    | Control Baseline | Control Post    |
|----------------|------------------|-----------------|------------------|-----------------|
| SBP (mmHg)     | 137.4 $\pm$ 5.8  | 130.6 $\pm$ 5.5 | 136.9 $\pm$ 6.1  | 135.8 $\pm$ 6.0 |
| DBP (mmHg)     | 86.7 $\pm$ 4.2   | 82.1 $\pm$ 3.8  | 86.1 $\pm$ 4.5   | 85.5 $\pm$ 4.3  |
| HR (beats/min) | 78.3 $\pm$ 6.1   | 73.8 $\pm$ 5.7  | 77.9 $\pm$ 5.8   | 77.2 $\pm$ 5.6  |

SBP: systolic blood pressure; DBP: diastolic blood pressure; HR: heart rate; Interv.: intervention group.

The intervention group showed reductions in systolic blood pressure, diastolic blood pressure and resting heart rate after four weeks of alternate nostril breathing.

**Table 3. Mean change in cardiovascular parameters following the intervention**

| Parameter      |      | Control Group Mean Change |        |
|----------------|------|---------------------------|--------|
| SBP (mmHg)     | -6.8 | -1.1                      | -4.95% |
| DBP (mmHg)     | -4.6 | -0.6                      | -5.31% |
| HR (beats/min) | -4.5 | -0.7                      | -5.75% |

The data demonstrate a greater reduction in all three cardiovascular parameters in the intervention group compared with the control group. The greatest absolute change was observed in systolic blood pressure, followed by diastolic blood pressure and resting heart rate.

## DISCUSSION

The present pilot study evaluated the effect of four weeks of alternate nostril breathing on blood pressure and resting heart rate. The findings demonstrated reductions in systolic blood pressure, diastolic blood pressure and resting heart rate following regular practice.

The observed reduction in blood pressure is consistent with previous evidence regarding breathing-based interventions. A systematic review and meta-analysis involving 15 randomized clinical trials reported that breathing exercises produced significant reductions in systolic blood pressure, diastolic blood pressure and heart rate [1].

Specifically, alternate nostril breathing has been investigated as an individual breathing intervention. Nam et al. reported in a systematic review and meta-analysis that alternate nostril breathing was associated with significant reductions in systolic and diastolic blood pressure compared with control interventions [2]. Their pooled analysis demonstrated a mean reduction of approximately 7.16 mmHg in systolic and 5.16 mmHg in diastolic blood pressure, although considerable heterogeneity was observed between studies [2].

The reduction in resting heart rate is also consistent with evidence suggesting that slow breathing and pranayama can influence autonomic cardiovascular regulation [1,6]. A recent systematic review and meta-analysis of seven randomized controlled trials reported a significant reduction in heart rate following pranayama interventions [6].

One possible explanation is modulation of the autonomic nervous system. Slow, controlled breathing may enhance parasympathetic activity and reduce excessive sympathetic activity, which may influence heart rate, vascular tone and blood pressure [3,5].

The autonomic effects of pranayama have also been demonstrated with other techniques. Thanalakshmi et al. reported that Sheetal pranayama significantly reduced blood pressure and improved heart-rate-variability parameters in patients with primary hypertension, suggesting increased parasympathetic influence [3]. Similarly, studies involving Sheetal and Sheetkari pranayama have shown reductions in systolic blood pressure and heart rate along with changes in heart-rate-variability parameters, supporting a possible role of altered sympathovagal balance [4].

Recent evidence specifically examining Nadi Shodhana also supports the present findings. Mittal et al. reported immediate reductions in systolic and diastolic blood pressure and improvements in several heart-rate-variability parameters following Nadi Shodhana practice, with favorable changes in autonomic indices over a six-week intervention [5].

The physiological mechanisms may involve several interacting factors. Slow respiratory movements can influence vagal afferent activity, respiratory sinus arrhythmia and cardiovascular reflex mechanisms. Improved autonomic balance may consequently result in reduced resting heart rate and vascular resistance.

Reduction in psychological stress may also contribute to the cardiovascular benefits of regular pranayama practice [1,5,6].

The present study is relevant because it evaluated a single pranayama technique rather than a combination of yoga postures, meditation and breathing exercises, making it easier to consider the possible contribution of alternate nostril breathing itself.

## LIMITATIONS

The findings should be interpreted cautiously. The sample size was small, the intervention period was relatively short and participants could not be blinded to the intervention. In addition, factors such as dietary intake, physical activity, sleep, medication adherence and psychological stress may influence blood pressure. Future studies with larger samples, longer intervention periods and objective autonomic measurements such as heart-rate variability would provide stronger evidence regarding the physiological mechanisms and clinical significance of alternate nostril breathing.

## CONCLUSIONS

Regular practice of alternate nostril breathing for four weeks may have a beneficial effect on systolic blood pressure, diastolic blood pressure and resting heart rate in adults with elevated blood pressure. The technique is simple, inexpensive and requires no specialized equipment, and may be considered a complementary lifestyle intervention alongside standard medical and lifestyle management. However, pranayama should not be considered a replacement for prescribed antihypertensive therapy. Larger randomized controlled studies with standardized protocols and longer follow-up are required to confirm these findings.

## ETHICAL APPROVAL

The study was conducted after obtaining approval from the Institutional Ethics Committee, Government Medical College, Jangaon, Telangana, India. Written informed consent was obtained from all participants.

## AUTHORS' CONTRIBUTION

All authors contributed to the conception and design of the study, data collection, analysis and interpretation of results, manuscript preparation and critical revision of the manuscript.

## SOURCE OF SUPPORT / CONFLICT OF INTEREST

Source of Support: Nil. Conflicts of Interest: None declared.

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