

**EFFECT OF FOUR WEEKS OF SLOW DEEP BREATHING ON BLOOD PRESSURE
AND CARDIAC AUTONOMIC MODULATION IN HEALTHY YOUNG ADULTS**Dr. R. Gayathri¹, Dr. Vanathy K.², Dr. Arvind T.³^{1,2}Assistant Professor, Department of Physiology, Bhaarith Medical College and Hospital, Biher.³Associate Professor, Department of Physiology, Bhaarith Medical College and Hospital, Biher.***Corresponding Author: Dr. R. Gayathri**

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ABSTRACT**Background:** Autonomic dysregulation characterized by sympathetic predominance and reduced vagal activity is implicated in the early development of cardiovascular morbidity. Slow deep breathing has emerged as a non-pharmacological strategy capable of modulating autonomic function. **Objective:** To evaluate the effect of four weeks of slow deep breathing on blood pressure and heart rate variability (HRV) indices in healthy young adults.**Methods:** In this pre–post interventional study, 60 healthy participants aged 17–22 years underwent supervised slow deep breathing at six breaths per minute for 10 minutes daily over four weeks. Systolic blood pressure (SBP), diastolic blood pressure (DBP), and HRV parameters (SDNN, RMSSD, LF, HF, LF/HF ratio) were recorded at baseline and post-intervention. Data were analyzed using paired t-test, with $p < 0.05$ considered statistically significant. **Results:** A significant reduction in SBP (118.4 ± 8.6 vs. 112.1 ± 7.9 mmHg; $p < 0.001$) and DBP (76.2 ± 6.4 vs. 72.8 ± 5.9 mmHg; $p = 0.004$) was observed following intervention. Time-domain HRV indices (SDNN and RMSSD) increased significantly ($p \leq 0.002$), accompanied by an increase in HF power and a significant reduction in LF/HF ratio ($p < 0.001$), indicating enhanced parasympathetic modulation and improved sympathovagal balance.**Conclusion:** Four weeks of slow deep breathing significantly improved cardiac autonomic regulation and reduced blood pressure in healthy young adults, supporting its potential role as a preventive cardiovascular strategy.**KEYWORDS:** Slow breathing, Heart rate variability, Autonomic modulation, Sympathovagal balance, Blood pressure regulation.**INTRODUCTION**

Autonomic imbalance, characterized by heightened sympathetic drive and diminished parasympathetic activity, is increasingly recognized as a precursor to cardiovascular pathology.^[1] Reduced heart rate variability (HRV) has been associated with elevated cardiovascular risk and impaired autonomic regulation.^[3] Even among apparently healthy young individuals, lifestyle stressors and reduced physical activity may predispose to early autonomic dysregulation.

Slow deep breathing has been proposed as a simple behavioral intervention capable of modulating autonomic tone through respiratory–cardiac coupling and baroreflex mechanisms.^[2] Breathing at approximately six cycles per minute corresponds to the resonance frequency of the cardiovascular system, optimizing vagal afferent

stimulation and enhancing baroreflex sensitivity.^[6] Prior investigations have demonstrated reductions in blood pressure and improvements in autonomic indices with slow breathing practices.^[4,5]

However, systematic physiological evaluation of short-term breathing interventions in healthy young adults remains limited. Given the increasing emphasis on early preventive strategies, the present study was designed to examine the effect of four weeks of slow deep breathing on blood pressure and HRV-derived autonomic indices.

MATERIALS AND METHODS**Study Design and Participants**

This pre–post interventional study was conducted in the Department of Physiology, Balaji Medical College and

Hospital. Sixty healthy undergraduate students aged 17–22 years were recruited through voluntary participation.

Inclusion Criteria

- Apparently healthy individuals
- No history of cardiovascular or respiratory disorders
- Not on medications influencing autonomic function

Exclusion Criteria

- Diagnosed hypertension or chronic illness
- Regular practitioners of yoga or meditation
- Substance abuse

Written informed consent was obtained from all participants. Institutional Ethics Committee approval was secured prior to study initiation.

Intervention Protocol

Participants performed slow deep breathing at a controlled rate of six breaths per minute (5-second inhalation and 5-second exhalation) for 10 minutes daily under supervision for four consecutive weeks.

Outcome Measures

Blood Pressure

Measured in the seated position after 5 minutes of rest using a calibrated sphygmomanometer. The average of two readings was recorded.

Heart Rate Variability

A five-minute resting ECG recording was obtained under standardized conditions. HRV analysis was performed using validated software.

- **Time-domain parameters:** SDNN, RMSSD
- **Frequency-domain parameters:** LF power, HF power, LF/HF ratio

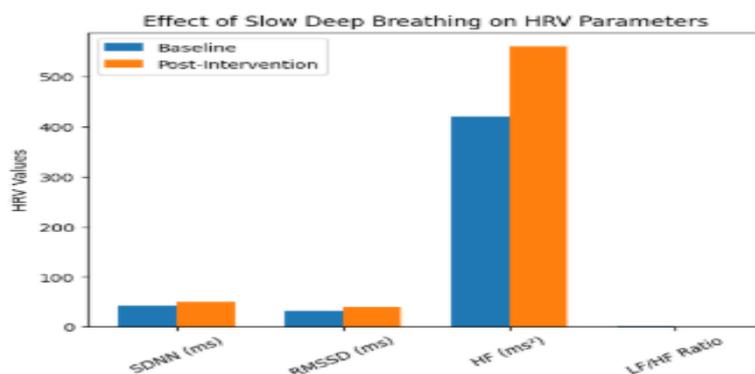
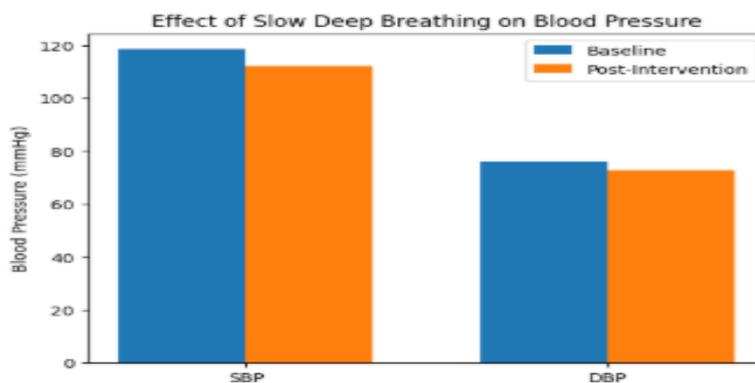
Statistical Analysis

Data were expressed as mean ± standard deviation. Normality was assessed prior to analysis. Pre- and post-intervention comparisons were performed using paired t-test. Statistical significance was defined as p<0.05.

RESULTS

A statistically significant reduction in blood pressure was observed following four weeks of slow deep breathing.

Parameter	Baseline (Mean ± SD)	Post-Intervention (Mean ± SD)	p-value
SBP (mmHg)	118.4 ± 8.6	112.1 ± 7.9	<0.001
DBP (mmHg)	76.2 ± 6.4	72.8 ± 5.9	0.004
SDNN (ms)	42.3 ± 9.2	49.6 ± 10.4	0.002
RMSSD (ms)	32.8 ± 7.5	40.7 ± 8.3	<0.001
HF (ms ²)	420 ± 110	560 ± 130	0.001
LF/HF Ratio	1.9 ± 0.5	1.2 ± 0.4	<0.001



Time-domain indices (SDNN, RMSSD) demonstrated significant improvement. Frequency-domain analysis revealed a significant increase in HF power and a reduction in LF/HF ratio, indicating enhanced vagal modulation and reduced sympathetic predominance.

DISCUSSION

The present study demonstrates that four weeks of slow deep breathing significantly improves cardiac autonomic modulation and reduces blood pressure in healthy young adults.

The observed reduction in SBP and DBP aligns with prior findings indicating that slow breathing enhances arterial baroreflex sensitivity and attenuates sympathetic outflow.^[4] Bernardi *et al.* reported that breathing at six cycles per minute optimizes cardiovascular variability and improves autonomic regulation.^[2]

The significant increase in RMSSD and HF power reflects augmentation of parasympathetic activity. HRV indices, particularly RMSSD and HF power, are well-established markers of vagal modulation.^[3] Lehrer *et al.* described resonance frequency breathing as a mechanism to amplify respiratory sinus arrhythmia and autonomic stability.^[6]

The reduction in LF/HF ratio suggests improved sympathovagal balance. While LF/HF interpretation requires caution, its decrease in this context likely reflects attenuation of sympathetic influence and enhancement of vagal dominance.

Proposed Mechanisms

- Enhanced respiratory sinus arrhythmia
- Improved baroreflex sensitivity
- Reduced central sympathetic discharge
- Increased vagal efferent activity

Collectively, these mechanisms may explain the observed improvements in cardiovascular regulation.

Limitations

- Absence of a randomized control group
- Short duration of intervention
- Limited generalizability beyond healthy young adults

Future randomized controlled trials with longer follow-up are warranted to confirm long-term benefits.

CONCLUSION

Four weeks of slow deep breathing produced significant improvements in blood pressure and cardiac autonomic balance in healthy young adults. These findings support the integration of structured breathing exercises as a low-cost, non-pharmacological preventive strategy for cardiovascular health.

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