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Original Research Article

Effect of anuloma viloma pranayama on cardiorespiratory parameters in apparently healthy young adults

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ABSTRACT

Background: Alternate nostril breathing (anuloma viloma pranayama) has been reported to influence autonomic balance and improve cardiorespiratory function. The present study was conducted to assess the effect of regular anuloma viloma practice on selected cardiorespiratory parameters in healthy young individuals.
Methods: This study was carried out in the department of physiology, King George's Medical University, Lucknow, after institutional ethics committee approval. A total of 52 apparently healthy young adults aged 18-26 years with BMI 18.5-22.9 kg/m^2 were enrolled. Participants were divided into two groups. During the experimental phase, subjects practiced anuloma viloma for 10 minutes daily for 4 weeks, while the control phase involved no breathing intervention. Pulse rate, systolic blood pressure, diastolic blood pressure and PEFR were assessed. Statistical analysis was done using SPSS 21.0.
Results: Baseline cardiac and respiratory parameters of both groups were comparable. After intervention, group A showed significantly lower pulse rate, systolic blood pressure and diastolic blood pressure compared with group B. PEFR was significantly higher in the intervention group.
Conclusions: Regular practice of anuloma viloma pranayama produced favourable cardiorespiratory changes in apparently healthy young adults, with reduction in pulse rate and blood pressure, along with improvement in peak expiratory flow rate (PEFR).

Keywords: Alternate nostril breathing, Anuloma viloma, Cardiorespiratory function, Healthy young adults, Peak expiratory flow rate, Pranayama

INTRODUCTION

Modern time quietly pushes the body into patterns of sitting longer, breathe shallower, and move less, while the mind carries a constant load of deadlines, noise, and digital stimulation. Over time, this combination affects internal rhythms, the heart beats a little faster, breathing becomes faster, and the autonomic system leans toward sympathetic dominance. These changes causes stress-related disorders long before symptoms appear. In today's changing world, simple breathing exercises especially those based on yoga, are becoming popular again.

Among the various breathing techniques, anuloma viloma pranayama- often called alternate nostril breathing- has emerged as one of the most widely practiced because of its ease and gentleness. It does not demand physical exertion, equipment, or even a dedicated space. Yet, evidence shows that slow, regular breathing can improve the performance of heart and lungs.[1]

Stress plays a major role here. Persistent stress elevates catecholamines, increases heart rate and blood pressure, and alters metabolic responses. When alternate nostril breathing was practiced by individuals experiencing stressful lifestyles, improvements in cardiac function were observed, hinting at a rebalancing of autonomic tone.[2]

Anuloma viloma works in a different way. It involves slow and controlled inhalation and exhalation. This helps remove stale air from the lungs, improves ventilation of the alveoli, and allows oxygen and carbon dioxide to be exchanged more efficiently.

Research on pranayama supports these benefits. Regular pranayama practice can affect the autonomic nervous system, heart rate, reaction time, and heart-lung functions in a consistent way. During pranayama people focus their attention on their breathing, which helps improve awareness and control of the breathing process.

Studies have shown that yogic breathing can improve baroreflex sensitivity and reduce chemoreflex activity. These changes help maintain stable blood pressure and reduce the body's cardiovascular response to stress. In healthy people, this may lead to better endurance, more efficient breathing, and greater ability to cope with stress. Regular practice also strengthens the respiratory system. Better coordination of the diaphragm, abdominal muscles, and intercostal muscles reduces airway resistance and helps the lungs expand more deeply.

In recent years the prevalence of lifestyle-related disturbances- sedentary habits, environmental stress, air-pollution exposure, and elevated psychosocial burden- has increased among adults in both urban and semi-urban settings.

Several systematic reviews and meta-analyses indicated that alternate-nostril breathing significantly reduced systolic and diastolic blood pressure in both normotensive and hypertensive individuals (mean difference for SBP≈–7 mmHg, DBP≈–5 mmHg)- emphasizing its potential for cardiovascular health.[3] Yet there was substantial heterogeneity (I^2>75%) and methodological limitations in the included trials, such as lack of blinding, small sample sizes and short durations of follow-up.[3]

Therefore, in the context of growing non-communicable disease burden and increasing interest in non-pharmacological interventions, a carefully designed study of anuloma viloma pranayama, measuring cardiorespiratory outcomes, is highly justified.

Recent analyses- including pooled data from randomized trials- suggest measurable reductions in blood pressure and improved autonomic markers following alternate nostril or slow breathing techniques.[3,4] However, heterogeneity in study quality and methodology makes it difficult to apply these findings confidently to young, apparently healthy adults.

A focused study in healthy young adults can help determine whether the benefits of pranayama seen in patients and stressed individuals also present in healthy people. It allows a closer look at short-term physiological adaptations, provides cleaner data by controlling for individual variability, and brings together respiratory and cardiovascular measures in a single study. Ultimately, this work can contribute to standardizing pranayama as a non-pharmacological tool for improving cardio-respiratory health in young adults, while also offering insights into its broader role in everyday well-being.

METHODS

Study design and setting

The study was initiated after obtaining approval from the institutional ethics committee (No. 2471/Ethics/2024) of King George's Medical University, Lucknow, the work was carried out in the Department of Physiology, King George's Medical University, Lucknow, India using a prospective approach over a period of one year from April 2025 to March 2026, with due consideration to ethical requirements for studies involving human participants

Subject selection

Recruitment was on the basis of voluntary participants from general population of Lucknow. Subjects were recruited after taken detailed history and applying inclusion and exclusion criteria. Written consent of patients under study was taken before intervention.

Inclusion criteria

Apparently healthy young individual, age criteria- 18-26 years, BMI criteria- 18.5-22.9 kg/m^2.

Exclusion criteria

History of any medical disorder including diabetes, cardiac disease, upper respiratory tract infections, nasal obstruction. Doing regular yogic breathing were also excluded from the study. Person currently on medication.

Sample size

Sample size was calculated on the basis of variation in least significant cardio-respiratory function parameter in experimental and control group after the observation period using the formula:

$$n = k\frac{(Z_\alpha + Z_\beta)^2(\sigma_1^2 + \sigma_2^2)}{d^2}$$

Where:

σ_1=0.0825, The SD of least significant cardio-respiratory function parameter in experimental group

σ_2=0.08225, the SD of the least significant cardiorespiratory function parameter in the control group, as reported by Jahan et al.[1]

d = min (σ_1, σ_2), the difference considered to be clinically significant

k = 1.0 the effect size

type I error α=5% corresponding to 95% confidence level

type II error β=10% for detecting results with 90% power of study

So, the required sample size: n=26 each group, (26 in experimental group and 26 in control group), total 52 subjects were enrolled in this study.

Parameters to be measured

Parameters measured were: pulse rate, systolic blood pressure, diastolic blood pressure, and peak expiratory flow rate.

Age, height, body weight, and BMI were recorded in a predesigned case record form.

Participants were assigned into two groups: group A (experimental) and group B (control).

Baseline cardiorespiratory parameters were recorded before the start of each study period.

During the experimental period, subjects performed the designated breathing protocol for 10 minutes daily for 4 weeks while seated comfortably with the head, neck, and trunk erect, eyes closed, and in a relaxed mental state.

The control period involved no breathing intervention and served as the non-intervention phase.

All cardiorespiratory parameters were recorded again after completion of each 4-week period.

Radial pulse was counted for 1 minute.

Systolic and diastolic blood pressure were measured using both palpatory and auscultatory methods with a stethoscope and LED sphygmomanometer.

PEFR was measured using the NDD EasyOn-PC spirometer.

Steps of alternate nostril breathing exercise

The participants were instructed to inhale through their right nostril for 6 seconds while closing their left nostril with the finger of their left hand. After that, they held their breath for 6 seconds while closing their right nostril with their index finger. After that, they slowly exhaled for 6 seconds through their left nostril. After that, they kept their right nostril closed for 6 seconds while inhaling through their left nostril. After that, the participants closed both nostrils for 6 seconds to hold their air. After that, they kept their left nostril closed for 6 seconds and exhaled through their right nostril.

Data collection

Data collection followed the predefined sequence and was organized into eight structured datasets. Baseline measurements before the intervention and control period were documented, followed by post intervention and post-control recordings, identical physiological variables were recorded, including age, gender, BMI, pulse rate, systolic and diastolic blood pressure and PEFR. All collected observations were systematically tabulated in Microsoft Excel sheets, ensuring clean organization and enabling accurate alignment of each participant's measurements across all stages of the study design.

Statistical analysis

The statistical analysis was performed using SPSS (Statistical Package for the Social Sciences), version 21.0. Data were presented as number (%) and mean±SD. The Chi-square test was used to compare proportions between the two groups. Student's t-test was used to compare mean values between the two groups, while the paired t-test was used to compare mean values at two time points within the same group. A p value <0.05 was considered statistically significant.

RESULTS

A total of 52 participants were included, with 26 participants each in group A and group B. Group A underwent anuloma viloma intervention, whereas group B remained in the control phase. The mean age was 20.12±0.91 years in group A and 19.92±1.02 years in Group B. In both groups, 16 (61.5%) participants were males and 10 (38.5%) were females (Table 1).

Table 1: Comparison of demographic profile of two study groups.

Characteristics		Group A (n=26)	Group B (n=26)	Total (n=52)
Age (years), Mean±SD (range)		20.12±0.91 (19-22)	19.92±1.02 (18-22)	20.02±0.96 (18-22)
Gender	Male, N (%)	16 (61.5)	16 (61.5)	32 (61.5)
	Female, N (%)	10 (38.5)	10 (38.5)	20 (38.5)

Values are presented as mean±SD or n (%), as appropriate. SD: standard deviation.

Table 2: Comparison of pre-intervention cardiac parameters of two study groups.

Cardiac parameters	Group A (experimental-pre) (n=26)		Group B (control-pre) (n=26)		Student 't' test	
	Mean	SD	Mean	SD	't'	'p'
Pulse rate (per min)	79.38	4.46	79.54	4.97	-0.117	0.907
Systolic BP (mmHg)	112.85	3.84	111.46	4.92	1.131	0.263
Diastolic BP (mmHg)	72.38	3.75	72.62	3.38	-0.233	0.817

Values are presented as mean±SD. PR: pulse rate; SBP: systolic blood pressure; DBP: diastolic blood pressure; SD: standard deviation. Student's t-test was used for comparison between groups.

Table 3: Comparison of pre-intervention respiratory parameters of two study groups.

Respiratory parameters	Group A (experimental-pre) (n=26)		Group B (control-pre) (n=26)		Student 't' test	
	Mean	SD	Mean	SD	't'	'p'
PEFR	6.02	0.78	6.10	0.85	-0.355	0.724

Values are presented as mean±SD. PEFR: peak expiratory flow rate; SD: standard deviation. Student's t-test was used for comparison between groups.

Table 4: Comparison of post-intervention cardiac parameters of two study groups.

Cardiac parameters	Group A (experimental-post) (n=26)		Group B (control-post) (n=26)		Student 't' test	
	Mean	SD	Mean	SD	't'	'p'
Pulse rate (per minute)	73.54	4.23	80.19	4.64	-5.407	<0.001
Systolic BP (mmHg)	106.46	3.85	111.92	4.68	-4.595	<0.001
Diastolic BP (mmHg)	67.92	3.60	72.85	3.06	-5.317	<0.001

Values are presented as mean±SD. PR: pulse rate; SBP: systolic blood pressure; DBP: diastolic blood pressure; SD: standard deviation. Student's t-test was used for comparison between groups.

Table 5: Comparison of post-intervention respiratory parameters of two study groups.

Respiratory parameters	Group A (experimental-post) (n=26)		Group B (control-post) (n=26)		Student 't' test	
	Mean	SD	Mean	SD	't'	'p'
PEFR	6.61	0.71	6.11	0.86	2.281	0.027

Values are presented as mean±SD. PEFR: peak expiratory flow rate; SD: standard deviation. Student's t-test was used for comparison between groups.

Baseline cardiac parameters of the subjects

In this phase, group A was in the experimental pre-intervention stage and group B was in the control stage. The difference in pre-intervention pulse rate between group A (79.38±4.46 per min) and group B (79.54±4.97 per min) was not statistically significant. Pre-intervention systolic blood pressure was slightly higher in group A (112.85±3.84 mmHg) than in group B (111.46±4.92 mmHg), but this difference was also not statistically significant. Pre-intervention diastolic blood pressure was slightly higher in group B (72.62±3.38 mmHg) than in group A (72.38±3.75 mmHg), without statistical significance. Overall, the pre-intervention cardiac parameters of both study groups were comparable (Table 2).

Baseline respiratory parameters of the subjects

Pre-intervention PEFR of group B (6.10±0.85 litre/minute) was higher than that of group A (6.02±0.78 litre/minute), but this difference was also not statistically significant. Overall, the pre-intervention respiratory parameters of the two study groups were comparable (Table 3).

Post-intervention cardiac parameters of the subjects

Post-intervention pulse rate of group A was significantly lower than that of group B (73.54±4.23 vs 80.19±4.64 per min). Post-intervention systolic blood pressure of group A (106.46±3.85 mmHg) was significantly lower than that of group B (111.92±4.68 mmHg). Post-intervention diastolic blood pressure of group A (67.92±3.60 mmHg) was significantly lower than that of group B (72.85±3.06 mmHg) (Table 4).

Post-intervention respiratory parameters of the subjects

Post-intervention PEFR of group A (6.61±0.71 litre/minute) was significantly higher than that of group B (6.11±0.86 litre/minute). Overall, post-intervention respiratory parameters showed significantly higher PEFR in group A compared to group B (Table 5; Figure 4).

DISCUSSION

Baseline parameters in both groups were comparable. group A performed anuloma viloma pranayama for four weeks while group B did not. This process presents a robust framework to compare intergroup differences.

Practice of anuloma viloma was associated with significant reductions in pulse rate, systolic blood pressure, and diastolic blood pressure. A significant improvement in PEFR was also observed following intervention, particularly when subjects were in the experimental phase.

Reductions in heart rate and blood pressure were seen during studies which suggests enhanced parasympathetic activity and reduced sympathetic drive. Similarly, improvement in respiratory efficiency may indicate better ventilatory control and increased lung compliance.

These patterns were observed that strengthen the hypothesis of regular practice of anuloma viloma pranayama positively affects cardio-respiratory function in healthy young individuals.

Age plays an important role in determining resting heart rate, blood pressure, and pulmonary function. With respect to gender distribution, both groups had identical proportions, with 61.5% males and 38.5% females in each group. The difference was not statistically significant ($p=1.000$). Comparable gender distribution further strengthened the validity of intergroup comparisons.

Baseline cardiac parameters are shown in Table 2. At the beginning of study, when group A was to undergo anuloma viloma pranayama and group B was to remain without breathing exercise, both groups were comparable in pulse rate, systolic blood pressure and diastolic blood pressure ($p>0.05$ for all parameters). Baseline equivalence of cardiac variables is essential in autonomic intervention studies because resting heart rate and blood pressure are strongly influenced by sympathetic-parasympathetic balance. Comparable baseline values were similarly reported by Upadhyay et al and Pal et al before initiation of alternate nostril breathing interventions.[5,6] These studies emphasized that pre-intervention similarity allows subsequent changes to be confidently attributed to the breathing practice rather than inherent autonomic differences.

Slow breathing techniques are known to influence respiratory rhythm generation and vagal modulation of airway tone, as described by Jerath et al and Russo et al, making it essential to establish comparable starting points before evaluating intervention-induced changes.[7,8] Thus, the findings in Table 3 confirmed that both groups had similar respiratory status at baseline, allowing meaningful assessment of post-intervention respiratory outcomes.

Furthermore, autonomic modulation through nostril breathing has been shown to influence cardiovascular parameters via shifts in sympathovagal balance as described by Telles et al, making baseline comparability crucial before assessing intervention effects.[9] Thus, the findings in Table 2 confirmed that both groups were physiologically matched at the start of study, ensuring valid comparison of post-intervention cardiac outcomes.

Baseline respiratory parameters prior to initiation of the intervention are presented in Table 3. The findings indicated that baseline PEFR was similar in both groups before initiation of pranayama practice. Baseline respiratory equivalence is important because lung volumes and airflow parameters are influenced by individual ventilatory habits, thoracic compliance, and autonomic respiratory control. Comparable pre-intervention respiratory values were also reported by Jahan et al and Turankar et al in studies assessing alternate nostril and slow breathing exercises.[10,11] These authors emphasized that without baseline equivalence, interpretation of post-intervention pulmonary improvement becomes unreliable.

Findings in Table 4 indicated that four weeks of anuloma viloma pranayama resulted in significant improvement in post-intervention cardiac parameters, supporting the primary objective related to cardiac function. After completion of anuloma viloma practice, group A demonstrated a statistically significant reduction in pulse rate, systolic blood pressure and diastolic blood pressure when compared with group B ($p<0.001$ for all). The reduction in heart rate and blood pressure suggested enhanced parasympathetic activity with suppression of sympathetic drive. Similar significant reductions in heart rate and blood pressure following alternate nostril breathing were reported by Kalaivani et al.[12] This study attributed the decline in cardiovascular parameters to improved vagal tone and reduced peripheral vascular resistance.

The significant improvement in PEFR in Table 5 indicated better airway patency and expiratory flow dynamics. Chanavirut et al also demonstrated increased chest wall expansion and lung volumes following yogic breathing practices, suggesting improved thoracic compliance and respiratory muscle efficiency.[13] The mechanism underlying these changes has been explained by Pal et al, who demonstrated that slow yogic breathing shifts sympathovagal balance toward vagal predominance.[14] Additionally, Telles et al and Bernardi et al described how controlled breathing enhances baroreflex sensitivity and reduces sympathetic vasoconstrictor activity, resulting in lower blood pressure and heart rate.[15,16]

The duration of intervention was limited to four weeks, so long-term physiological adaptations could not be assessed. The sample size was relatively small and included only healthy young adults, which limited the generalizability of the findings to other age groups and clinical populations. Autonomic function was assessed indirectly through heart rate and blood pressure, while advanced measures such as heart rate variability were not included. Respiratory muscle strength and lung compliance were also not directly assessed, which could have provided further insight into pulmonary adaptations. In addition, the study was conducted at a single center, which may limit the external validity of the findings.

CONCLUSION

The present study showed that regular practice of anuloma viloma pranayama produced favourable cardio-respiratory changes in apparently healthy young adults. After four weeks of intervention, participants in the experimental phase had significantly lower pulse rate, systolic blood pressure and diastolic blood pressure as compared to the control phase. Peak expiratory flow rate also improved significantly following pranayama practice. These findings suggested that regular anuloma viloma practice helped improve autonomic balance, reduce cardiovascular load, and enhance respiratory efficiency. Thus, anuloma viloma pranayama may serve as a simple, safe, and useful non-pharmacological measure for improving cardio-respiratory health in healthy young individuals.

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