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Ventilatory and Oxygenation Responses to Integrated Yogic Breathing Practices in Sedentary Adult Women

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Abstract:
Efficient pulmonary ventilation and optimal oxygen saturation are essential for maintaining functional capacity and cardiopulmonary health. Sedentary lifestyle patterns are associated with reduced ventilatory efficiency, shallow breathing patterns, and suboptimal oxygen utilization, even in apparently healthy individuals. Yogic breathing practices emphasize controlled, deep, and rhythmic respiration, which may positively influence lung mechanics and oxygenation. However, evidence examining their effect on objective pulmonary parameters remains limited. This study aimed to evaluate the effects of an integrated yogic breathing program on pulmonary function and oxygen saturation in sedentary adult women. Thirty sedentary females aged 20–45 years participated in a pre–post interventional study. Baseline assessments included pulmonary function parameters (forced vital capacity, forced expiratory volume in one second, peak expiratory flow rate), resting oxygen saturation (SpO_2), and post-exertional SpO_2 following a standardized 6-minute walk test. Participants underwent a structured yogic breathing intervention for six weeks, consisting of slow diaphragmatic breathing, thoracic expansion breathing, and controlled pranayama techniques.
Post-intervention analysis demonstrated statistically significant improvements in pulmonary function parameters and both resting and post-exertional oxygen saturation. These findings suggest that integrated yogic breathing practices enhance ventilatory efficiency and oxygen utilization in sedentary adult women. Yogic breathing may serve as a simple, cost-effective strategy to improve respiratory performance and oxygenation in populations with sedentary lifestyles.

Keywords: Yogic Breathing, Pulmonary Function, Oxygen Saturation, Ventilatory Efficiency, Sedentary Women.

Introduction

Pulmonary ventilation is a complex physiological process that depends on the coordinated function of the respiratory muscles, lung compliance, airway resistance, and neural control mechanisms. Adequate ventilation is essential for maintaining optimal oxygen uptake and delivery to tissues, thereby supporting functional capacity and overall cardiopulmonary health [1]. In individuals with sedentary lifestyles, habitual shallow breathing patterns and reduced chest wall mobility may lead to decreased ventilatory efficiency and impaired pulmonary function, even in the absence of overt respiratory pathology [2].

Oxygen saturation (SpO_2) serves as an important indicator of the efficiency of pulmonary gas exchange and oxygen transport. It is influenced by factors such as alveolar ventilation, ventilation–perfusion matching, and respiratory mechanics. Subtle reductions in oxygen saturation, particularly during physical exertion, may reflect compromised ventilatory reserve and reduced cardiopulmonary efficiency in sedentary individuals [2,9].

Yogic breathing practices, collectively referred to as pranayama, emphasize slow, deep, and controlled breathing patterns with conscious regulation of inspiratory and expiratory phases. These practices are believed to improve lung expansion, enhance diaphragmatic excursion, reduce dead space ventilation, and promote efficient alveolar ventilation [3,4]. Physiological studies have demonstrated that regular practice of yogic breathing can positively influence respiratory muscle strength, lung volumes, and airflow parameters [3,10].

Previous research has shown that pranayama techniques can improve pulmonary function parameters such as forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), and peak expiratory flow rate (PEFR) in healthy individuals [4,5]. Additionally, yogic breathing has been reported to enhance oxygen utilization and cardiorespiratory efficiency by optimizing breathing patterns and reducing sympathetic overactivity [5,6].

Despite the growing popularity of yogic breathing as a low-cost and non-pharmacological intervention, limited evidence exists regarding its effect on objective pulmonary function parameters and oxygen saturation, particularly in sedentary adult women. Understanding these effects is important, as sedentary behaviour is increasingly prevalent and associated with reduced respiratory efficiency and functional capacity [2,9].

Therefore, the present study was undertaken to evaluate the effects of an integrated yogic breathing program on pulmonary function and oxygen saturation in sedentary adult women, using standardized spirometric measures and oxygen saturation assessment before and after a structured intervention period [7,8].

Aim

To evaluate the effect of integrated yogic breathing practices on pulmonary function and oxygen saturation in sedentary adult women.

Objectives

1. To assess changes in pulmonary function parameters following yogic breathing intervention.
2. To evaluate the effect of yogic breathing on resting oxygen saturation (SpO_2).
3. To assess changes in post-exertional oxygen saturation following the intervention.

Hypothesis

- Null Hypothesis (H_0): Integrated yogic breathing practices have no significant effect on pulmonary function and oxygen saturation in sedentary adult women.98w
- Alternate Hypothesis (H_1): Integrated yogic breathing practices significantly improve pulmonary function and oxygen saturation in sedentary adult women.

Methodology

Study Design- Pre–post interventional study.
Study Population- Sedentary adult women aged (20–45 years).
Sample Size- 30 participants.
Sampling Method- Convenience sampling.

Inclusion Criteria

- Sedentary adult females (no regular structured exercise)
- Apparently healthy individuals
- Willingness to participate

Exclusion Criteria

- History of respiratory or cardiovascular disease
- Recent respiratory infection (within past 4 weeks)
- Current smokers
- Regular practice of yoga or breathing exercises

Outcome Measures

Pulmonary Function Parameters

- Forced Vital Capacity (FVC)
- Forced Expiratory Volume in 1 second (FEV_1)
- Peak Expiratory Flow Rate (PEFR)

Oxygenation Parameters

- Resting oxygen saturation (SpO_2)
- Post-exertional SpO_2 (after 6-minute walk test)

Intervention Protocol

Participants underwent an integrated yogic breathing program consisting of:

- Slow diaphragmatic breathing
- Thoracic expansion breathing
- Controlled pranayama techniques

Duration: 20 minutes per session
Frequency: 5 sessions per week
Total duration: 6 weeks
All sessions were supervised initially to ensure correct technique.

Procedure

Baseline measurements of pulmonary function and oxygen saturation were recorded. Participants then performed a standardized 6-minute walk test, following which post-exertional SpO_2 was measured. After completing the six-week yogic breathing program, all assessments were repeated using identical procedures and equipment.

Statistical Analysis

Data were analysed using paired t-tests to compare pre- and post-intervention values. Statistical significance was set at $p < 0.05$.

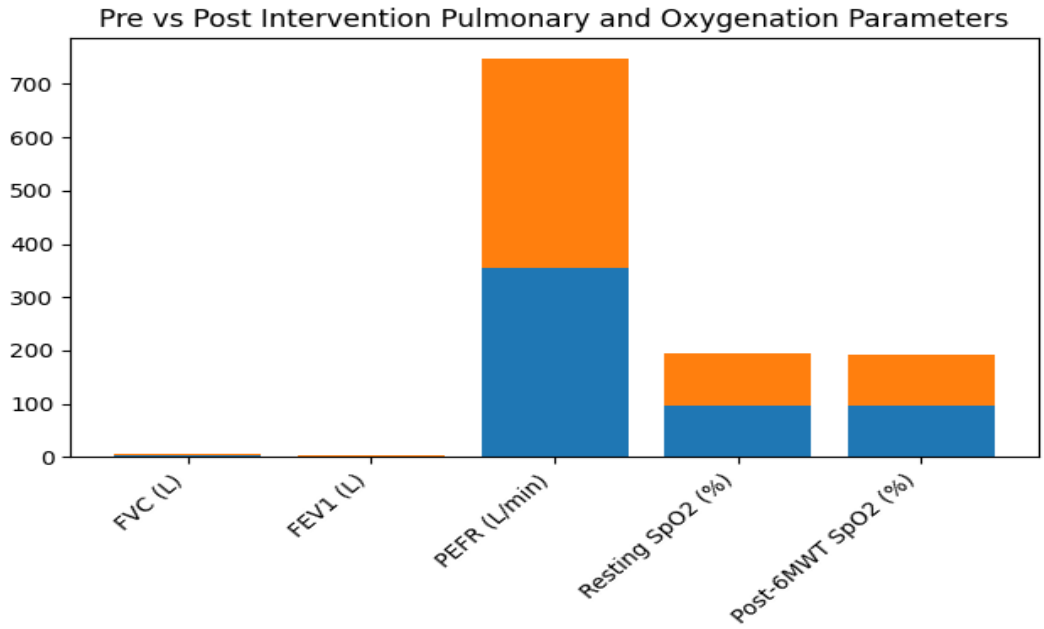

Figure 1 shows the graphical representation of pre- and post-intervention changes.

Results

Post-intervention analysis revealed statistically significant improvements in pulmonary function parameters, including FVC, FEV_1, and PEFR. Resting oxygen saturation demonstrated a modest but consistent increase, while post-exertional SpO_2 showed a significant improvement, indicating enhanced ventilatory efficiency and oxygen utilization following the yogic breathing intervention.

Table 1 presents the comparison of pulmonary function and oxygen saturation parameters before and after the integrated yogic breathing intervention.

Parameter	Pre-Intervention (Mean ± SD)	Post-Intervention (Mean ± SD)	p-value
FVC (L)	2.71 ± 0.34	3.02 ± 0.31	<0.001
FEV1 (L)	2.18 ± 0.29	2.46 ± 0.27	<0.001
PEFR (L/min)	356 ± 42	392 ± 39	0.00
Resting SpO2 (%)	97.1 ± 0.8	98.0 ± 0.6	0.004
Post-6MWT SpO2 (%)	95.6 ± 1.2	97.4 ± 0.9	<0.001

DISCUSSION

The present study evaluated the effects of an integrated yogic breathing program on pulmonary function and oxygen saturation in sedentary adult women. The findings demonstrated statistically significant improvements in pulmonary function parameters, including forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), and peak expiratory flow rate (PEFR), along with improvements in both resting and post-exertional oxygen saturation following six weeks of yogic breathing practice.

Sedentary lifestyles are known to be associated with shallow breathing patterns, reduced diaphragmatic excursion, and decreased chest wall mobility, which may negatively impact ventilatory efficiency and pulmonary mechanics [1,2]. In the present study, the observed improvement in FVC and FEV_1 suggests enhanced lung expansion and improved airflow dynamics, likely due to increased respiratory muscle recruitment and better coordination of breathing patterns achieved through controlled yogic breathing techniques.

The significant increase in PEFR observed post-intervention indicates reduced airway resistance and improved expiratory muscle performance. Similar findings have been reported in earlier studies, where regular practice of pranayama resulted in improved airflow rates and lung volumes in healthy individuals. [3,4,10] Slow and deep breathing techniques are known to promote bronchodilation and improve airway patency by reducing sympathetic overactivity and optimizing respiratory muscle function [5].

Improvements in resting oxygen saturation observed in the present study, although modest, are clinically relevant, as even small increases in SpO_2 may reflect enhanced alveolar ventilation and improved ventilation–perfusion matching [1,9]. More notably, the significant improvement in post-exertional oxygen saturation following the six-minute walk test suggests enhanced ventilatory reserve and improved oxygen utilization during physical activity. This finding indicates better adaptation of the respiratory system to increased metabolic demand, which is particularly important in sedentary populations.

The physiological mechanisms underlying these improvements may include increased tidal volume, reduced respiratory rate, improved diaphragmatic efficiency, and decreased dead space ventilation associated with slow, controlled breathing patterns [3,5]. Additionally, yogic breathing practices have been shown to improve autonomic balance by reducing sympathetic tone and enhancing parasympathetic activity, thereby improving cardiorespiratory efficiency and oxygen delivery [6].

The results of the present study are consistent with previous research demonstrating beneficial effects of yogic breathing on pulmonary function and respiratory efficiency [3–6,10]. However, the current study specifically contributes to the existing literature by highlighting these benefits in sedentary adult women, a population that is often underrepresented in respiratory intervention studies despite being at increased risk for reduced ventilatory efficiency due to physical inactivity.

Despite the positive findings, certain limitations must be acknowledged. The absence of a control group limits the ability to attribute observed changes solely to the intervention. Additionally, the relatively small sample size and short duration of intervention may restrict the generalizability of the results. Future studies employing randomized controlled designs, larger sample sizes, and longer follow-up periods are recommended to further validate these findings and explore long-term effects.

Conclusion

Integrated yogic breathing practices significantly improve pulmonary function and oxygen saturation in sedentary adult women. Such practices may be effectively incorporated into preventive and rehabilitative programs aimed at enhancing respiratory efficiency and overall cardiopulmonary health.

Clinical Implications

- Useful for sedentary individuals to improve respiratory efficiency
- Can be incorporated into physiotherapy and wellness programs
- Low-cost and easily implementable intervention

Limitations

- Small sample size
- Lack of control group
- **Short intervention duration**

Future Recommendations

Future studies should include randomized controlled designs, larger sample sizes, and long-term follow-up to validate and extend these findings.

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