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The Therapeutic Effects of Nadi Shodhana Pranayama on Pulmonary Functions: A Case Series

Dr Manisha Khatri[1], Dr. P. C. Mangal[2]

[1]Ph. D. Scholar, PG department of Kriya Sharir, Shri Krishna Ayush University, Kurukshetra, Haryana

[2]Professor PG department of Kriya Sharir, Shri Krishna Ayush University, Kurukshetra, Haryana

Abstract: ***Background: Nadi shodhana Pranayama or alternate nostril breathing is a traditional yogic breathing technique that balances energy and enhances respiratory functions. While several studies have demonstrated potential therapeutic benefits of Pranayama but specific research on its effects in healthy individuals is limited. This case series potentiates the impact of Nadi shodhana Pranayama on pulmonary functions in healthy volunteers. Objective: To assess the effect of Nadi shodhana Pranayama on pulmonary functions through parameters such as Forced vital capacity (FVC), Forced expiratory volume in one second (FEV_1), Forced expiratory volume in one second / Forced vital capacity (FEV_1/ FVC) and Peak expiratory flow rate (PEFR) in healthy individuals. Methodology: Seven healthy volunteers were instructed to practice Nadi shodhana Pranayama for 20 minutes daily over a period of 6 weeks. Pulmonary function tests (PFTs) were conducted at baseline and post intervention using spirometry. Subjective experiences regarding overall well - being and breathing were also noted. Results: All participants showed improvement in pulmonary function during post intervention. FVC, FEV_1 and PEFR showed significant increases indicating enhanced lung capacity, improved air flow, increased oxygen absorption and more efficient respiratory apparatus. Conclusion: The findings suggest the Nadi shodhana Pranayama significantly enhances pulmonary functions in healthy volunteers. If integrated into daily routine it may act as preventive measure to improve health and well - being. While the results are promising yet large scale studies and randomised controlled trials are recommended to explore its long term benefits in diverse populations.***

Keywords: Nadi shodhana Pranayama, Pulmonary function, spirometry, Alternate nostril breathing, FVC, FEV_1, FEV_1/FVC, PEFR

1. Introduction

The regulation of the breath is called Pranayama. The word Pranayama is formed of two words - Prana i. e. life force and Ayama i. e. dimension. The Pranayama is therefore meant to give dimension to the life force. The three components of Pranayama are pooraka (inspiration); rechaka (expiration) and kumbhaka (retention). The control of pooraka and rechaka is a preliminary stage in Pranayama, designed to improve overall health and vitality and to prepare the practitioner for later stages which involve kumbhaka. The various Pranayama are obtained by modulating the processes of these three components.

Out of the nine main classical Pranayama, Nadi shodhana is the first one to the described in the classical yogic texts. The word Nadi means energy channel and Shodhana means to cleanse or to purify. Nadis are subtle flows of energy just as electricity, radio waves and laser beams are subtle flows [1] Nadis are not physical, measurable or dissectible structures within the body, but channels of energy which underlie and sustain life and consciousness. Doctor Hiroshi Moto Yama pioneered his research to verify the existence of the Nadis and found subtle voltages of electromagnetic currents flowing within close proximity to the nervous system. [2]

Therefore, Nadi shodhana is a practice where by the pranic channels are purified and regulated by alternating the inhalation and exhalation between the left and right nostrils called alternate nostril breathing (ANB) thus influencing the left (ida) and right (pingla) nadi which correspond to the sympathetic and parasympathetic nervous system. [3] This leads to control of oscillations of the body - mind network bringing balance and harmony through - out the system. Researchers suggest that Nadishodhana Pranayama modulates sympatho vagal balance with improved respiratory functions. In this case series we explore the therapeutic effects of Nadi shodhana Pranayama on pulmonary function in apparently healthy individuals

Objective

To assess quantitatively the effect of Nadi shodhana Pranayama on pulmonary functions through pulmonary function tests in apparently healthy individuals.

2. Methodology

Sample size and Source:

Seven apparently healthy individuals of either sex who voluntarily gave their consent to perform Nadi Shodhana Pranayama were selected from the campus of Institute for Ayurveda Studies and Research, Kurukshetra.

Inclusion criteria:

- Individuals of age group 20 to 30 years irrespective of sex were selected.
- The individuals who never performed breathing exercises before were selected.

Exclusion criteria:

- Individuals with severe respiratory diseases, recent surgeries or other major health issues were excluded.

Intervention

The participants were trained in Nadi shodhana Pranayama. The Pranayama was practiced for 20 minutes daily for 6 weeks. Each session of alternate nostril breathing began with equal inhalation and exhalation using ratio 1: 1. The pair of inhalation and exhalation made one round. We practiced 10 rounds in initial weeks. After perfecting the ratio of 1: 1 it

was changed to 10 rounds in ratio of 1: 2. Gradually the time duration of inhalation and exhalation was also increased.

Parameter measurements

The measured values of FVC, FEV_1, FEV_1/FVC, PEFR were recorded from digital spirometer monitor (Medicaid). Three consecutive readings were taken and the best value was noted. Then the participants practiced Nadi shodhana Pranayama for 20 minutes each day for 6 weeks. After 6 weeks the assessment parameters were again measured.

Volunteer information such as age, sex, height, weight, race, and smoking status was entered in the spirometer. Predicted normal value was calculated based on these parameters. Then the subject was asked to sit in a straight position and take a deep breath as possible. Then quickly position the mouth piece into mouth and blast out the air as hard and as fast as possible. The manoeuvre was repeated three times taking the best value. The air exhaled in one second following a deep inhalation is counted as FEV_1 and greatest total amount of air that is forcefully breathed out after breathing in as deeply as possible is counted as FVC. The test score was then compared with predicted value.

Statistical analysis:

All the values obtained before and after performing Nadi shodhana Pranayama were expressed as mean ±SD. The student paired t test was used to compare parameters. P value of less than 0.05 indicates a significant difference.

3. Results

Table: Intragroup comparison of pre - post test values of FVC % in studied population

FEV1 %	N	Mean	Std. Dev %	Mean	Sum	df	T value	P value
BT	7	72.85714	4.793703	24	2380	6	3.188214	.01888*
AT	7	96.85714	21.94427					

Difference Scores Calculations
Mean: 24
$\mu = 0$
$S^2 = SS/df = 2380/ (7 - 1) = 396.67$
$S^2_M = S^2/N = 396.67/7 = 56.67$
$S_M = \sqrt{S^2_M} = \sqrt{56.67} = 7.53$

T - value Calculation
$t = (M - \mu) /S_M = (24 - 0) /7.53 = 3.19$
Significance Level: 0.05
*The result is significant at p <.05.

Table: Intragroup comparison of pre - post test values of **FEV1** % in studied population

FEV1 %	N	Mean	Std. Dev %	Mean	Sum	df	T value	P value
BT	7	80.5	103.3333	30.29	1667.43	6	4.80661	.00298*
AT	7	139.3736	125.211					

Difference Scores Calculations
Mean: 30.29
$\mu = 0$
$S^2 = SS/df = 1667.43/ (7 - 1) = 277.9$
$S^2_M = S^2/N = 277.9/7 = 39.7$
$S_M = \sqrt{S^2_M} = \sqrt{39.7} = 6.3$

T - value Calculation
$t = (M - \mu) /SM = (30.29 - 0) /6.3 = 4.81$
Significance Level: 0.05
*The result is significant at p <.05.

Table: Intragroup comparison of pre - post test values **PEFR** % in studied population

PEFR %	N	Mean	Std. Dev %	Mean	Sum	Df	T value	P value
BT	7	76.42857143	11.89065831	14.57	257.71	6	5.88244	.00107*
AT	7	91	12.50142849					

Difference Scores Calculations
Mean: 14.57
$\mu = 0$
$S^2 = SS/df = 257.71/ (7 - 1) = 42.95$
$S^2_M = S^2/N = 42.95/7 = 6.14$
$S_M = \sqrt{S^2_M} = \sqrt{6.14} = 2.48$

T - value Calculation
$t = (M - \mu) / SM$ = (14.57 - 0) /2.48 = 5.88
Significance Level: 0.05
*The result is significant at p <.05.

Table: Intragroup comparison of pre - post test values of **FEV1/FVC** % in studied population

FEV1/FVC %	N	Mean	Std. Dev %	Mean	Sum	df	T value	P value
BT	7	107.5714	5.394631	3.29	329.43	6	1.173205	.28517**
AT	7	110.8571	6.706683					

Difference Scores Calculations
Mean: 3.29
$\mu = 0$
$S^2 = SS/df$ = 329.43/ (7 - 1) = 54.9
$S^2_M = S^2/N$ = 54.9/7 = 7.84
$S_M = \sqrt{S^2_M} = \sqrt{7.84} = 2.8$

T - value Calculation
$t = (M - \mu) / SM$ = (3.29 - 0) /2.8 = 1.17
Significance Level: 0.05
**The result is *not* significant at p <.05.

4. Discussion

This case series suggests that regular practice of Nadi shodhana Pranayama can have a beneficial effect on pulmonary function even in healthy individuals. All participants showed significant improvements in FVC, FEV_1 and PEFR which are key indicators of lung function. Additionally subjective improvements such as improved focus and concentration, greater emotional stability, increased energy levels and better sleep were reported by the participants. The increase in FVC among participants reflects enhanced lung capacity. This is due to strengthening of respiratory muscles by regular practicing breathing exercises [4, 5, 6, 7] FEV_1 might be increased due to mucociliary clearance and a rise in PEFR demonstrates an improvement in the ability to forcefully expel the air from lungs.

According to Sameer Mondal in 2024, the proposed mechanism behind the improvement may include [8]

1) Activation of mechanoreceptors and chemoreceptors in the respiratory system - Involvement of lung stretch receptors (Hering - Breuer) reflex and pulmonary connective tissue (fibro blasts) stretching has been postulated. These contribute to inhibitory influence and hyper polarization currents which lead to decreased metabolic activity indicating parasympathetic activity activation. [9]
2) Activation of chemoreceptors decreases levels of interleukins and monocyte chemotactic proteins. Also the salivary nerve growth factor could be cajoled. [10]
3) Activation of mechanoreceptors and chemoreceptors in the circulatory system send the information to pons and medulla for re - arrangements of respiro - circulatory information processing and adjustment.
4) Activation of brain respiro - circulatory control centre - In ANB regular breathing pattern has been changed and rearranged, so pons and medullary centres slow down their electrical and chemical information system to re adjust the situation. Therefore, after completion of pranayama the standard breathing rate is lower. Also this centre relays information to hind, mid and higher brain for further adjustments.

The strength of the study is that it focuses primarily on Nadi shodhana Pranayama which allows for a more detailed understanding of specific benefits associated with it contrary to other studies which involve multiple pranayama techniques. The selection of healthy volunteers in the study suggests that Nadi shodhana Pranayama could be embodied into regular routines to enhance respiratory health. Moreover, it is a non - invasive technique which demonstrates potential preventive value.

5. Conclusion

In the present study Nadi shodhana Pranayama for 6 weeks brought significant improvement in respiratory parameters such as FVC, FEV_1, FEV_1/FVC, PEFR in healthy individuals. These enhancements suggest that Nadi shodhana Pranayama can optimise lung capacity, strengthen the respiratory muscle and increase the air flow even in individuals without any pre - existing respiratory ailment. Since it is a non - invasive and cost effective practice to adopt, it can be integrated into daily routine as a preventive measure to improve health and well - being.

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