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# A study to compare the effectiveness of inspiratory muscle training versus alternative nostril yoga breathing on blood pressure, resting heart rate and quality of life in essential hypertension: A pilot study

**Dr. Yagnik Dave**
PhD Scholar, Saurashtra University & Assistant Professor, Faculty of Physiotherapy, Marwadi University, Rajkot, Gujarat, India
Corresponding author email: yagnik.dave93@gmail.com

**Dr. Dinesh Sorani**
I/C Principal, Government Physiotherapy College, Jamnagar, Gujarat, India.
Email: soranidinesh@gmail.com

**Dr. Mital Patel**
HOD Anatomy, Government Medical College, Jamnagar, Gujarat, India.
Email: drmitalpatel72@gmail.com

***Abstract*---**Background: Great wellbeing is a pre-essential of human useful and improvement measure. Raised BP stays the main source of death around the world, representing 10.4 million passings each year. Many research has demonstrated the positive effects of inspiratory muscle exercise (IME) on cardiac autonomic function, indicated by reduced sympathetic modulation and increased vagal modulation in young smokers, as well as hypertensive and heart failure patients. Alternate nostril yoga breathing (ANYB) is one of the effective breathing techniques which involve breathing through one nostril at a time while closing the other nostril manually. The normal nasal cycle consists of alternating phases of congestion and decongestion of nasal tissue based on the predominance of parasympathetic or sympathetic tone in the autonomic nervous system. Method: Ethical approval was obtained from the SAFE SEARCH INDEPENDENT ETHICS COMMITTEE. N=30 Essential Hypertensive patients age between 35 to 55, both male and female included in this pilot study and the further study continues with more sample. After taking consent the patients were divided randomly into two groups. Group A Inspiratory muscle training (15) and Group B (15) Alternative nostril yoga breathing. Both

groups received treatment for 4 weeks and 5 days/week. Pre and post-measurement were taken that includes Blood pressure, resting heart rate, and QoL (MINICHAL). Result: Mean age-wise distribution of patients 49 and SD ± 4.2. During pre-measurement, there was no significant difference between the two groups for SDB, DBP, RHR, and QoL but post means treatment value of SBP (t=-3.062, p=<0.05) mmHg, RHR (t=-2.61,p=<0.05) bpm, QoL (t=-2.12, p=<0.05) and in both group A and group B, but more significant improvement was found in SBP, RHR and QoL in group A compared to group B. However DBP showed no significant difference between Group A and Group B (t=0.46, p>0.05) mmHg. The result suggested Group B that is IMT is more effective. Conclusion: This study concludes that both the study group has significant improvement in the SBP, RHR, and QoL, but patient receiving Inspiratory muscle training has a more beneficial effect in SBP, RHR, and QoL, while there is no significant difference found in DBP between the two-groups.

***Keywords*---**essential hypertension, alternative nostril yoga breathing, inspiratory muscle training.

## Introduction

Raised blood pressure stays the main source of death around the world, representing 10.4 million passing each year. While exploring worldwide figures, an expected 1.39 billion individuals had hypertension in 2010. BP patterns show a reasonable shift of the greatest BPs from major league salary to low-pay districts, with an expected 349 million with hypertension in HIC (High-level income countries) and 1.04 billion in LMICs (low-and middle-income countries). [1] High blood pressure (BP) is ranked as the 3rd most important risk factor for attributable burden of disease in South Asia (2010). In an analysis of worldwide data for the global burden of hypertension, 20.6% of Indian men and 20.9% of Indian women were suffering from HTN in 2005.[2]

Hypertension is classified as essential (primary) and secondary, the cause of primary hypertension, which accounts for the majority (95%) of cases and is unknown (idiopathic). However, there are many factors leading to primary/essential hypertension, they are called “Risk factors”. These risk factors of essential or primary hypertension could be the result of genetic and environmental factors like more sodium intake in the diet, alcohol consumption, obesity, physical inactivity, age, and psychological stress.[3,4] The common causes of secondary hypertension are endocrine and structural disorder like congenital adrenal hypertension, Cushing syndrome, deoxycorticosteriod producing tumor, renin-secreting tumor, Little’s syndrome, and aldosteronism.[5]

Hypertension and its complications like stroke, congestive heart failure, kidney failure, and heart attack are largely responsible for morbidity and mortality in all age groups. It also creates social, personal, and financial issue, the cost of which is enormous. Drugs remain the mainstay of hypertension management.[5] However, antihypertensive drugs are not without their side effects and long-term

complication. Alternative non-pharmacological management includes various approaches like a low salt diet, meditation, relaxation, biofeedback, and therapeutic exercise to control blood pressure.

Respiratory muscles, like other skeletal muscles, which can be trained. Both the structure and the functional characteristics of respiratory muscles may be modified in response to increased imposing loads. studies have demonstrated beneficial effects of inspiratory muscle exercise (IME) on cardiac autonomic function, indicated by reduced sympathetic modulation and increased vagal modulation in young smokers, as well as hypertensive and heart failure patients.[6] Inspiratory muscles training (IMT) is a technique specifically designed to improve the performance of the respiratory muscles (RM) that may be affected or reduced in a variety of cardio-respiratory conditions. Inspiratory muscle training (IMT), which applies an external resistance to the respiratory musculature, has demonstrated beneficial effects in patients with cardiovascular and respiratory disease.[7,8]

Voluntary regulated breathing techniques or various pranayama techniques have been used either alone or in combination with other kinds of interventions to reduce stress-related disorders and conditions like hypertension. [9] The majority of physicians now recommend yoga and pranayama to patients at risk for heart diseases, as well as those with back pain, arthritis, depression, and other chronic diseases. The beneficial effects of different pranayama are well-reported and have a sound scientific basis. Alternate nostril yoga breathing (ANYB) is one of the common breathing technique and involves breathing through one nostril at a time while closing the other nostril manually by use of a finger and thumb.[10] The resting heart rate and resting blood pressure are vital parameters that should be maintained within physiological limit throughout life. Alteration can lead to secondary complications.

The instruments created to assess Health-Related Quality of Life, Mini-Cuestionario de Calidade de Vida em la Hipertensión Arterial (MINICHAL) were recently adapted for Brazil. The Brazilian version of MINICHAL showed evidence of reliability and validity and proved to be able to discriminate normotensive individuals from hypertensive patients.[11] The use of a self-reported questionnaire in a native language would make research and clinical management more effective. So, the Gujarati version of MINICHAL–QoL demonstrated good reliability and validity.

**Methodology**

Ethical approval was obtained from the “SAFE SEARCH INDEPENDENT ETHICS COMMITTEE”. Prior registration was done in the Clinical trial registry – India (CTRI/2021/06/034466). The patients were selected based on inclusion and exclusion criteria from in and around Rajkot city.
Inclusion Criteria: Stage 1 and stage 2 hypertensive without any changes in medications for at least 2 months preceding the study. Both gender males and females aged between 35 to 55 years with BMI between 18.05 to 29.09 kg/m$^2$.
Exclusion criteria: Secondary hypertension due to liver, heart, renal failure. A personal habit such as tobacco chewing, smoking, and alcohol consumption.

Having disease of respiratory tract e.g. history of tuberculosis, chronic obstructive airway disease respiratory tract infections. Athletes, regular pranayama practitioners, and patients undergoing any other form of exercise. Any kind of recent cardiovascular events, pulmonary diseases, diabetes mellitus, neuropathies, cardiac arrhythmias. Autoimmune diseases. Use of oral contraceptives, neuroleptics/anti-arrhythmic drugs. Nasal abnormalities such as nasal polyps. Unconscious patients.

The 30 patients were selected based on inclusion and exclusion criteria in and around Rajkot city for this pilot project and after this it will continue for further with more sample inclusions. The patients were divided randomly into two groups, Group A and B. Each patient was given a "Patient information sheet" in their understandable language and it was explained properly about the purpose of the study. The patients signed the "Informed consent form" prior to participation in the study. Blood pressure, resting heart rate, and Gujarati version of MINICHAL–QoL[17] were measured pre and post-intervention.

**Group A - Inspiratory muscle training (N=15)**

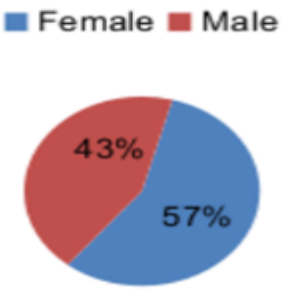
The patients performed IMT for 15 minutes (one-minute training followed by one-minute rest), once per day, 5 days per week, for 4 weeks using the Threshold Inspiratory Muscle Trainer (Philips, Respironics). During treatment time, patients were instructed to maintain diaphragmatic breathing exercises (12-15 breath/min) while patients in comfortable half-lying and knee slightly flexed and supported by a pillow. The Inspiratory load was set at 30% of maximal static inspiratory pressure (PImax), and the training loads were increased weekly by 5% of PImax during all study periods.[12,13]

**Group B - Alternative nostril yoga breathing (N=15)**

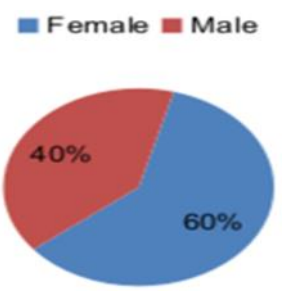
The patient was in a comfortable sitting position (padmasan, sukhasan). ANYB breathing technique involves through both left and right nostrils alternately in that the thumb and the ring finger of the right hand are used to manipulate the nostrils during the application of treatment. The breathing is initiated by occluding the right nostril with the right thumb and exhaling through the left nostril, then inhaling through the left nostril with the right nostril occluded, then exhaling via the right nostril with the left nostril occluded at a time by use of the right ring and little fingers. ANYB given for 5 days per week for 4 weeks and one min treatment and one min rest were given.[14]

**Results**

Statistical analyses were performed using SPSS version 25.0 by IBM Company for Microsoft Windows. All the analysis followed the intention-to-treat principle. The different variables were analyzed at baseline using descriptive statistics, and the distribution of the data was examined using the test of normality Shapiro-Wilk test. After confirming the distribution of all variables parametric paired and unpaired t-test were used.




Gender distribution Group A




Gender distribution Group B

Graph: 1 showing gender distribution in Group A and B

| Parameters | Mean ± Std. Deviation | | T | P | RESULT |
|---|---|---|---|---|---|
| | Pre | Post | | | |
| SBP (mm Hg) | 145.46 ± 2.96 | 141.26 ± 3.12 | 9.70 | <0.05 | S |
| DBP (mm Hg) | 88.26 ± 3.51 | 88.06 ± 3.50 | 1.79 | >0.05 | NS |
| HR (bpm) | 82.06 ± 5.14 | 77.20 ± 5.51 | 18.93 | <0.05 | S |
| QoL(MINICHAL) | 19.76 ± 2.62 | 16.00 ± 2.71 | 20.50 | <0.05 | S |

Table 1: Intra group comparison of SBP, DBP, RHR and QoL in the study for Group ANYB

| Parameters | Mean ± Std. Deviation | | T | P | RESULT |
|---|---|---|---|---|---|
| | Pre | Post | | | |
| SBP (mm Hg) | 145.80 ± 3.68 | 140.00 ± 4.60 | 19.78 | <0.05 | S |
| DBP (mm Hg) | 89.20 ± 2.99 | 89.06 ± 2.76 | 1.43 | >0.05 | NS |
| HR (bpm) | 81.26 ± 7.02 | 75.33 ± 6.74 | 18.67 | <0.05 | S |
| QoL(MINICHAL) | 20.60 ± 3.57 | 16.13 ± 3.48 | 16.28 | <0.05 | S |

Table 2: Intra group comparison of SBP, DBP, RHR and QoL in the study for Group IMT

| Parameters | Mean ± Std. Deviation | | T | P | RESULT |
|---|---|---|---|---|---|
| | GROUP A | GROUP B | | | |
| SBP (mm Hg) | 4.20 ± 2.36 | 5.80 ± 1.60 | -3.06 | <0.05 | S |
| DBP (mm Hg) | 0.20 ± 0.61 | 0.13 ± 0.50 | 0.46 | >0.05 | NS |
| HR (bpm) | 4.86 ± 1.40 | 5.93 ± 1.74 | -2.61 | <0.05 | S |
| QoL(MINICHAL) | 3.76 ± 1.00 | 4.46 ± 1.50 | -2.12 | <0.05 | S |

Table 3: Between group comparison of SBP, DBP, HR and QoL values for Group A and Group B

**Discussion**

Group A received ANYB and Group B received IMT for 5 days per week for 4 weeks. Measurements of RHR, SBP, DBP, and QoL were taken pre and post-treatment intervention in both groups. Researchers have stated that respiratory and cardiovascular systems share similar control mechanisms, thus alterations in

one system will modify the functioning of the other. In essential hypertension, sympathetic overactivity is associated with generalized enhancement of the excitatory pathways, leading not only to sympathetic vasoconstriction but also chemoreflex activation and ultimately increases. Therefore, any modification in the respiratory control would also produce changes in cardiovascular function.

In the study done by Upadhyay-Dhungel K et al (2013), it was founded that the airflow through one nostril is greater than next at any point of given time which later switches to another, it is called the “nasal cycle”. The nasal cycle in the individual lasts for 30 minutes to 2-3 hours commonly. A nasal cycle is a phenomenon of the alternating congestion and decongestion response of erectile tissue of nasal turbinate and septum of two nostrils, which effectively altered the unilateral nasal resistance and was existent on account of prevailing sympathetic or parasympathetic tone. Sympathetic activation causes vasoconstriction ultimately it will decrease air resistance allowing greater passage of air while parasympathetic activation causes vasodilatation and it will increase nasal resistance and will decrease the airflow. Thus the alteration may reach the transition point where airflow may be transiently equal bilaterally. A similar effect will be produced during alternate nostril breathing or ANYB.[14]

A study done on nasal airflow proposed a flip-flop mechanism according to which the peripheral control of nasal airflow via the autonomic nervous system is well documented, and involves the vasoconstrictor, which are commonly sympathetic nerves that supply the large veins in the turbinates. The asymmetry in brain activity with the sympathetic tone extends to the brainstem region, where left and right oscillators cause reciprocal changes in nasal airflow.[15] Another mechanism for the effect of nasal airflow on brain activity is that inspired air stimulates cold receptors in the nasal mucosa innervated by the trigeminal nerve, providing the sensation of nasal airflow. A nasal airflow stimulus such as unilateral forced nostril breathing stimulates trigeminal nerve endings on one side of the nose Trigeminal neurons transmitting temperature signals synapse in the spinal trigeminal nucleus and then cross the midline, travelling upto the thalamus through the brainstem. Via the brain stem reticular formation, a nasal airflow stimulus could lead to enhanced arousal and brain activity in both cerebral cortices. Studies have intimated that the greatest stimulating effect occurs in the hemisphere contra-lateral to the nasal airflow stimulus.[15]

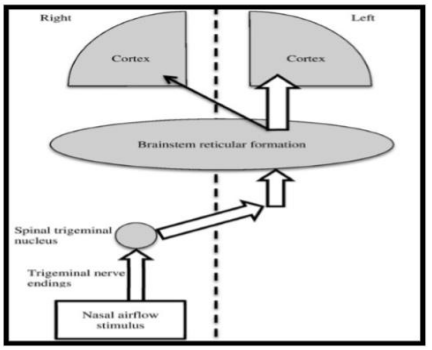



Figure-1: Model to explain the influence of nasal airflow on brain activity[15]

The study was done by Janaína Barcellos Ferreira et al, (2011) and they founded that the application of an 8-week IMT protocol with a 30% PImax load was able to reduce daytime arterial blood pressure. This important activity is noticed by the generalized alteration which occurs in cardiovascular control in conjunction with respiratory pattern modification. This relationship is likely related to baroreceptor and chemoreceptor sensitivity and interaction and its influence on the mechanisms of blood pressure control. Respiratory modulation and enhanced baroreflex activity as well as inspiratory muscle fatigue, generate an increase in the metaboreflex, which increases peripheral sympathetic activity. Thus, improvement in the respiratory muscle function by application of IMT, increase fatigue resistance and reduces the sympathetic outflow. In addition, compare the effects of slow and fast breathing on sympathetic/parasympathetic modulation in hypertensive patients, it has been reported an improvement in parasympathetic activity after slow breathing.[16-19]

**Conclusion**

This study concludes that both the study group has significant improvement in the SBP, RHR and QoL, but patient receiving Inspiratory muscle training has more beneficial effect in SBP, RHR and QoL, while there is no significant difference founded in DBP between the two groups.

**References**


1. A Price, R Eccles Nasal airflow and brain activity: is there a link? The Journal of Laryngology & Otology 7 April 2016.
2. Anaína Barcellos Ferreira, Rodrigo Della Méa Plentz. Inspiratory muscle training reduces blood pressure and sympathetic activity in hypertensive patients: A randomized controlled trial. International Journal of Cardiology. 166 (2013) 61–67.
3. Anchala R, Kannuri NK, Pant H, Khan H, Franco OH, Di Angelantonio E, et al. Hypertension in India: A systematic review and meta-analysis of prevalence, awareness, and control of hypertension. J Hypertens. 2014;32(6):1170–7.
4. Bhatnagar, A., Tripathi, Y., & Bhatnagar, S. (2022). Effect of lifestyle interventions on oxidative stress in elderly hypertensive and in normal individuals. *International Journal of Health Sciences*, *6*(S7), 1969–1983. https://doi.org/10.53730/ijhs.v6nS7.11736
5. Bhosale, A., Khedkar, S., Khade, S. K., & Reddy, M. M. (2022). Study of serum uric acid levels in essential hypertension. *International Journal of Health Sciences*, *6*(S7), 3528–3536. https://doi.org/10.53730/ijhs.v6nS7.12511
6. Dave Y, Sorani D, Patel M. Cross cultural adaptation, translation, validation and reliability analysis of Gujarati version of hypertension quality of life questionnaire (MINICHAL). Int J Health Sci Res. 2021; 11(10):10-16. DOI: https://doi.org/ 10.52403/ijhsr.20211003
7. Feriani DJ, Coelho-Júnior HJ, Scapini KB, de Moraes OA, Mostarda C, Ruberti OM, et al. Effects of inspiratory muscle exercise in the pulmonary function, autonomic modulation, and hemodynamic variables in older women with metabolic syndrome. J Exerc Rehabil. 2017;13(2):218–26

8. Ferreira JB, Plentz RDM, Stein C, Casali KR, Arena R, Lago PD. Inspiratory muscle training reduces blood pressure and sympathetic activity in hypertensive patients: A randomized controlled trial. Int J Cardiol [Internet]. 2013;166(1):61–7.
9. Ghiya S. Alternate nostril breathing: a systematic review of clinical trials. Int J Res Med Sci. 2017 Jul 26;5(8):3273.
10. Mohamed N, Badr H, Mohamed AR. Effect of Inspiratory Muscle Training on.pdf. 2014;14(3). Available from: http://www.setantacollege.com/wp-content/uploads/Journal_db/Effect of Inspiratory Muscle Training on.pdf
11. Mounirsalamamohamed A, Ahmed H, Abdeen A, Shaban GM, Ahmed W, Sayed E. Inspiratory Muscle Training Versus Slow Deep Breathing on Blood Pressure in Essential Hypertensive Patients. 2017;10(5):349–55.
12. Oussama MN, Mohamed Sayed, et al. 2005 Clinical Guidelines for the management of hypertension. EMRO technical series. 2005; 1390(8)-117.
13. Schulz RB, Rossignoli P, Correr CJ, Fernández-Llimós F, De Toni PM. Validation of the short form of the spanish hypertension quality of life questionnaire (MINICHAL) for Portuguese (Brazil). Arq Bras Cardiol. 2008;90(2):139–44.
14. Sikiru L, Okoye C. Therapeutic Exercise and Hypertension. African Res Rev. 2008;2(3):249–61.
15. Telles S, Sharma SK uma., Balkrishna A. Blood pressure and heart rate variability during yoga-based alternate nostril breathing practice and breath awareness. Med Sci Monit Basic Res. 2014;20:184–93. (12)
16. Unger T, Borghi C, Charchar F, Khan NA, Poulter NR, Prabhakaran D, et al. 2020 International Society of Hypertension Global Hypertension Practice Guidelines. Hypertension. 2020;75(6):1334–57.
17. Upadhyay Dhungel K, Malhotra V, Sarkar D, Prajapati R. Effect of alternate nostril breathing exercise on cardiorespiratory functions. Nepal Med Coll J. 2008;10(1):25–7.
18. Whitworth JA. 2003 World Health Organization (WHO)/International Society of Hypertension (ISH) statement on management of hypertension. Vol. 21, Journal of Hypertension. 2003. p. 1983–92.
19. ZM H, SH M, BS I, RA M, MH H. Effect of Inspiratory Muscle Training on Cardiac Parameters of Exercise Tolerance Test in Chronic Heart Failure Patients. Egypt J Occup Med. 2016;40(2):171–84.