

IMPACT OF SHORT TERM PRANAYAM TRAINING ON HEART RATE AND EXERCISE CAPACITY ON SIX MINUTE WALK TEST IN HEALTHY SUBJECTS

Dr. Pooja Agrawal¹, Dr. Rinku Garg^{1*}, Dr Anil Kumar²

¹Senior resident, Physiology, MAMC, New Delhi

^{1*} Professor, Physiology, School of Medical Sciences and Research, Sharda University, Greater Noida

²Assistant Professor, SKS hospital medical college and research Centre, Mathura

Corresponding Author: Dr Rinku Garg

E-mail: rgrinkigarg6@gmail.com

Abstract

Introduction : The practice of pranayama modulates the cardiac autonomic status and improves cardio-respiratory functions suggesting an enhanced parasympathetic and blunted sympathetic activity, leading to early return of vitals to baseline. Yoga benefits for cardiopulmonary endurance in healthy people which manifest clinically as improved lung capacity, increased oxygen delivery, decreased VO₂ and respiratory rate, and decreased resting heart rate, resulting in overall improved exercise capacity. Hence, we decided to study the effect of Pranayama on heart rate and six minute walk distance on six minute walk test in healthy subjects.

Materials and Methods: It was a longitudinal study. 30 healthy subjects of age group 18-30 years were recruited for this study. The study was conducted in the Department of Physiology, Santosh Medical College and Hospitals, Ghaziabad. Heart rate was counted by palpating the radial pulse for one full minute. Six minute walk test was conducted as per American Thoracic Society (ATS) guideline and six minute walk distance recorded. Pranayam training was given by yoga instructor two times per week for 40 days that consisted of warm up for 5 min, Pranayama for 25 min and Meditation for 10 min. Heart rate was recorded again before and after six minute walk test. Six minute walk distance noted.

Statistical Analysis: Data was entered in to MS Excel and expressed as Mean and SD. Differences between groups before and after intervention was assessed by t-test using SPSS 23.0 software.

Results: It was observed that there was a statistically significant decrease heart rate after 4 weeks of Pranayama training which decreased from 105.07 ± 5.842 beats per minute to 98.07 ± 6.422 beats per minute after six minute walk test, p < 0.001. There was a statistically significant increase in walk distance on six minute walk test after 4 weeks of Pranayama training from 526.67 + 25.795 m to 682.60 + 25.425 m, p < 0.001.

Discussion: The present study revealed that after 4 weeks of Pranayam training there was a significant decline in heart rate after six minute walk test. There was a significant increase in six-min walk distance after Pranayama. Decline in heart rate may be due to the reduced sympathetic activity and increased parasympathetic activity, leading to improvement in vagal tone. Improvement in the walked distance may be due to improved lung capacity, increased

oxygen delivery, decreased VO₂ and respiratory rate, and decreased resting heart rate, resulting in overall improved exercise capacity. So, Yoga can be considered as a non – pharmacological intervention to improve cardiovascular functions and exercise capacity.

Keywords: SPSS, VO₂, ATS

Introduction

Pranayama means the art of controlling breathe. Pranayama is basically undertaken for somatic and psychic purification, regulation of prana to each body organ and optimize the cardio-pulmonary and autonomic functions.(1)

Six-min walk test is an inexpensive, relatively quick, safe and a well tolerated method of assessing the functional exercise capacity in healthy subjects and in patients with moderate-to-severe heart or lung disease, easy to administer, better tolerated and more reflective of activities of daily living than other walk tests(2). It evaluates the global and integrated responses of all the systems involved during exercise, including the pulmonary, cardiovascular, systemic and peripheral circulation, neuromuscular units and muscle metabolism. Improvement in the walked distance in the present study is due to beneficial effects of yoga on musculoskeletal and cardio-respiratory systems. The asanas help by improving muscle strength, flexibility, power, endurance, static and dynamic stability and coordination which in turn improve physical performance and increase walking pace and stride length. Intense stretching and muscle conditioning during yoga postures also improve oxidative capacity of skeletal muscles, decrease glycogen utilization via oxidative enzymes and or increased number of mitochondria.(3)

Six-min walked distance significantly correlates with peak VO₂ and there is a definite improvement cardio-pulmonary function leading to improved walked distance. Yoga helps to improve the cardiovascular efficiency and homeostatic control of the body.(4) Through body-and-breath control, including relaxation techniques, Yoga clearly has additional benefits for cardiopulmonary endurance in healthy people which manifest clinically as improved lung capacity, increased oxygen delivery, decreased VO₂ and respiratory rate, and decreased resting heart rate, resulting in overall improved exercise capacity. (3)

Pranayama, an important component of intervention, leads to improvement in walking distance and decreased perceived exertion as practice of pranayamas improves the ventilatory function of the lungs by using fullest capacity of lungs, reducing the oxygen debt, improving the gaseous exchange and preventing exhaustion.(5) Slow increase in the lung capacity associated with well practiced yoga breathing recruits the normally unventilated lungs and helps to match ventilation to perfusion better, thereby increasing oxygen delivery to muscles. The slow breathing rates associated with yogic breathing also substantially reduce chemo reflex response to hypoxia, probably through the improved oxygen delivery to tissues and possibly the result of acquired “tolerance” to hypoxia that is produced by change in the chemo reflex threshold(3) and lessen sense of perceived exertion.

The practice of pranayamas modulates the cardiac autonomic status and improves cardio-respiratory functions suggesting an enhanced parasympathetic and blunted sympathetic activity, leading to early return of vitals to baseline.(6)

MATERIALS AND METHOD

It was a Longitudinal study. We recruited 30 healthy subjects of age group 18-30 years after informed consent. The study was conducted in the Department of Physiology, Santosh

Medical College and Hospitals, Ghaziabad. The study was approved by the ethics committee of the institution. Heart rate was counted by palpating the radial pulse for full one minute.

At the wrist, the index and middle fingers of one hand was lightly pressed just below the base of the thumb. Number of beats was counted for full one minute and noted.

Six minute walk test was conducted as per American Thoracic Society (ATS) guidelines. The six minute walk test was performed on two occasions to account for a learning effect. The best distance walked in metres was recorded. Prior to the test, lap counter was set to zero, and the timer to 6 minutes (or stopwatch to zero) The subjects were directed to the 'start line' of the walking track. Walking track was described to the subject, and then demonstrated by walking one lap by the instructor. At the end of six minute walk test, six minute walk distance and heart rate was recorded.

Yoga training was given by yoga instructor. Subjects were called two times a week for total of 4 weeks.

DESCRIPTION OF YOGA SCHEDULE:

- 40 minutes yoga training
- 2 times / week
- Duration : 4 weeks
- Description of Training
 1. Warm up (5 min)
 2. Pranayam (25 min)
 3. Meditation (10 min)

The Pranayama that were adapted for study purpose are:

Nadishuddhi Technique: Purpose of the Nadishuddhi is to balance mental energy and physical energy, to bring harmony between body and mind.

Method: It was instructed to subjects to block the right nostril with the right thumb with mild pressure and left nostril with the right middle and ring fingers. The rest two fingers were free and the palm stayed above the nose. Subjects began, closing the right nostril with the thumb, inhaling from the left nostril. After inhalation, closing the left nostril with the middle and the right finger, lifting the thumb the right nostril and exhalation is done. Then inhaling with the right and exhaling with the left nostril. This made one round. The second round began with the right nostril inhalation and so on.

Duration / repetitions : Subjects started with three minutes, resting after each minute and build to a five minutes non-stop practice. A maximum of 8- 10 minute practice was advised to the subjects.

Kapalbhati Technique: Kapalbhati is highly energetic abdominal breathing exercises.

Method : Subjects sat down in comfortable crossed leg position with back straight, hands resting on knees. Quick exhalation and natural inhalation was done followed by each other. Focus was on forceful exhalation. Exhalation from nose with full strength was done by quickly contracting the abdominal muscles. The air was pushed out of lungs by contraction of the diaphragm. After exhalation, inhalation proceeded but inhalation didn't involve any effort.

Inhalation was done by just relaxation and the lungs automatically expanding and getting filled with air.

Mental focus: It was suggested to concentrate in between the eyebrows, and imagining that all negative energy, negative conditioning, ill feelings are exiting their system with the out breath.

Duration / repetitions: Subjects started with 15 breaths. After completing 15 quick exhalation and natural inhalation, subjects inhaled and exhaled deeply. This was one round. Subjects practiced 3 such rounds.

Bhramari Technique: Breathing in and out with the nose was done.

Method : Ears were closed with the thumbs and index fingers placed just above the eyebrows at the sinuses and remaining three fingers on the eyes with finger tips slightly pressing the ridge of the nose on each side and inhale deeply. While exhaling, a humming sound was tried to be emitted. While inhaling air, the soft palate was pressed a little so as to obstruct the air flow. Since the palate is soft and flexible, it starts vibrating and a particular sound is generated. With continuous practice, the hoarse and odd vibrating sound turns melodious similar to the beautiful tone of the humming bee, gradual, at a constant pace without any ups and downs, clear and pleasing to the ears, termed as Bhramari Naad (sound of female humming bee).

Mental focus: Subjects were asked to concentrate in the center of the eyebrows and visualize light in the center feeling that the body, mind and soul are radiating with light.

Duration / repetitions: Subjects practiced Bhramari for 5 minutes.

Parameters viz heart rate and six minute walked distance were recorded again before and after six minute walk test.

STATISTICAL ANALYSIS

All the variables like heart rate and six minute walked distance were recorded both before and after 4 weeks of yogic intervention and again before and after six minute walk test with 4 weeks of yogic intervention. All values were entered in to MS Excel. The values were tested for normality and statistically and expressed as Mean and SD. They were further analysed for significance by using t-test using the software SPSS 23.0.

RESULTS :

Table 1: Baseline Heart Rate Before and After Pranayama

PARAMETER	BEFORE PRANAYAMA		AFTER PRANAYAMA		SIGNIFICANCE
	MEAN	SD	MEAN	SD	
Heart Rate (Beats / min)	75.93	5.024	73.27	5.186	S*

*Significant – p<0.001

Table 2: Heart Rate Before and After Pranayama after six minute walk test

PARAMETER	BEFORE PRANAYAMA AFTER 6MWT		AFTER PRANAYAMA AFTER 6MWT		SIGNIFICANCE
	MEAN	SD	MEAN	SD	
Heart Rate (Beats / min)	105.07	5.842	98.07	6.422	S*

*Significant

Table 3: Six minute walk distance Before and After Pranayama

PARAMETER	BEFORE PRANAYAMA		AFTER PRANAYAMA		SIGNIFICANCE
	MEAN	SD	MEAN	SD	
SIX MINUTE WALK DISTANCE (meters)	526.67	25.795	682.60	25.425	S*

*Significant

DISCUSSION

The present study was conducted among 30 healthy subjects of 18-30 years of age who had never done any kind of Pranayama training. The cardiovascular parameters were assessed before and after six minute walk test. The exercise capacity were assessed on six minute walk test. Then they were given Pranayama training for 4 weeks. Cardiovascular parameters and exercise capacity were again assessed on six minute walk test following results were extracted.

Our study showed significant decrease in heart rate after 4 weeks of Pranayama training. The findings supported by the studies of Pandya NH et al,(7) Udapa et al,(6) Pal et al,(8) Subbalakshmi et al,(9) Singh et al(10) and Indla Devsana et al(11) showed significant decline.

Pranayama breathing has been shown to alter the autonomic activity. Raghuraj et al(12) have reported that slow pranayama (Nadishuddhi) increases parasympathetic activity whereas fast pranayama (Kapalbhati) increases the sympathetic activity. Subbalakshmi et al(9) observed statistically significant reduction in heart rate after Nadishuddhi.

Udapa et al(6) and K Upadhyay Dhungel et al(13) showed significant reduction in pulse rate after short term Yoga training. Bal Baljinder et al(14) showed statistically significant reduction in pulse rate after regular practice of Yoga and it was attributed to increased vagal tone and decreased sympathetic activity.

Pal et al(8) study results coincided with our findings. It showed slow breathing produced significant decrease in heart rate. Singh et al too showed significant decline in heart rate after Nadishuddhi pranayama for 6 weeks. Indla Devsana et al(11) showed significant reduction in the heart rate in the subjects practicing yoga.

We observed significant increase in six minute walk distance on six minute walk test after 4 weeks of Pranayama training. Significant increase in six minute walk distance in our study is in accordance with findings of Akhtari et al(15) and Raj et al(16). There is paucity of data on the effect of yoga on functional capacity in literature using 6 min walk test

Six-min walk test is an inexpensive, relatively quick, safe and a well tolerated method of assessing the functional exercise capacity in healthy subjects. Improvement in the walked distance in the present study is due to beneficial effects of yoga on musculoskeletal and cardio-respiratory systems. The asanas help by improving muscle strength, flexibility, power, endurance, static and dynamic stability and coordination which in turn improve physical performance (exercise endurance) and increase walking pace and stride length. Intense stretching and muscle conditioning during yoga postures also improve oxidative capacity of

skeletal muscles, decrease glycogen utilization via oxidative enzymes and or increased number of mitochondria.

CONCLUSION

Lifestyle modifications like yogic practices, meditation, relaxation, dietary changes have ultimate aim of physical and mental well being. Yogic practices decrease the risk of disease directly or indirectly by promoting health and fitness. Time and again, Pranayamic breathing techniques are increasingly being used effectively for fitness, prevention and therapeutic purposes, either alone or as an adjunct therapy. It may obviate the need of drug therapy or may decrease the dosage or reduce the number of drugs needed. It may be assumed that Yoga adjunctively with conventional therapy may lead to quicker control as well as decrease in therapy dosage and duration. Making Yoga a part and parcel of our day to day routine may condition the cardiac and respiratory system, increase in exercise capacity, leading to prevention and onset of diseases like Asthma, COPD and Hypertension more importantly in the latter stages of life.

REFERENCES

1. Bhandari R, Bhandari C, Acharya B, Pandya P, Singh K, Katiyar V, et al. Implications of Corporate Yoga: A Review. In 2012.
2. ATS Committee on Proficiency Standards for Clinical Pulmonary Function Laboratories. ATS statement: guidelines for the six-minute walk test. *Am J Respir Crit Care Med.* 2002 Jul 1;166(1):111–7.
3. Ja R. Psychophysiologic effects of Hatha Yoga on musculoskeletal and cardiopulmonary function: a literature review. *J Altern Complement Med N Y N* [Internet]. 2002 Dec [cited 2023 Jan 5];8(6). Available from: <https://pubmed.ncbi.nlm.nih.gov/12614533/>
4. Harinath K, Malhotra AS, Pal K, Prasad R, Kumar R, Kain TC, et al. Effects of Hatha yoga and Omkar meditation on cardiorespiratory performance, psychological profile, and melatonin secretion. *J Altern Complement Med N Y N.* 2004 Apr;10(2):261–8.
5. Aerobic capacity & perceived exertion after practice of Hatha yogic exercises. [Internet]. [cited 2023 Jan 9]. Available from: <https://read.qxmd.com/read/12040766/aerobic-capacity-perceived-exertion-after-practice-of-hatha-yogic-exercises>
6. Udupa K, Madanmohan null, Bhavanani AB, Vijayalakshmi P, Krishnamurthy N. Effect of pranayam training on cardiac function in normal young volunteers. *Indian J Physiol Pharmacol.* 2003 Jan;47(1):27–33.
7. Pandya NH, Goswami T, Trivedi RS. Effect of yoga on pulse rate and blood pressure. *Indian J Clin Anat Physiol.* 2020 May 15;7(1):12–5.
8. Pal GK, Velkumary S, Madanmohan null. Effect of short-term practice of breathing exercises on autonomic functions in normal human volunteers. *Indian J Med Res.* 2004 Aug;120(2):115–21.
9. Subbalakshmi N, Saxena S, D'souza uj. Immediate effect of “nadi -shodhana pranayama” on some selected parameters of cardiovascular, pulmonary, and higher functions of brain. In 2005 [cited 2023 Jan 9]. Available from: <https://www.semanticscholar.org/paper/IMMEDIATE-EFFECT-OF-%27NADI-SHODHANA-PRANAYAMA%27-ON-OFF-Subbalakshmi-Saxena/e8bd3d7f2982353dfea082e31a8701d63f1856e9>
10. Singh S, Kyizom T, Singh KP, Tandon OP, Madhu SV. Influence of pranayamas and yoga-asanas on serum insulin, blood glucose and lipid profile in type 2 diabetes.

- Indian J Clin Biochem. 2008 Oct;23(4):365–8.
11. Devasena I, Narhare P. Effect of yoga on heart rate and blood pressure and its clinical significance. In 2011 [cited 2023 Jan 9]. Available from: <https://www.semanticscholar.org/paper/Effect-of-yoga-on-heart-rate-and-blood-pressure-and-Devasena-Narhare/ff3af445026df2712f2fcd4a7b5d8d4e38516157>
 12. Raghuraj P, Ramakrishnan AG, Nagendra HR, Telles S. Effect of two selected yogic breathing techniques of heart rate variability. *Indian J Physiol Pharmacol.* 1998 Oct;42(4):467–72.
 13. Upadhyay Dhungel K, Malhotra V, Sarkar D, Prajapati R. Effect of alternate nostril breathing exercise on cardiorespiratory functions. *Nepal Med Coll J NMCJ.* 2008 Mar;10(1):25–7.
 14. Baljinder B, Parminder K. Effects of Kapalbhathi on Peak Expiratory Flow Rate and Pulse Rate. 2009
 15. Akhtar P, Yardi S, Akhtar M. Effects of yoga on functional capacity and well being. *Int J Yoga.* 2013 Jun;6(1):76.
 16. Raj. Yoga-based pulmonary rehabilitation for the management of dyspnea in chronic obstructive pulmonary disease: a randomized controlled trial. In 2017 [cited 2023 Jan 9]. Available from: <https://www.semanticscholar.org/paper/Yoga-based-pulmonary-rehabilitation-for-the-of-in-a-Raj/00cffff409e89aafe8437e49f2da6faa1373d27c>