



EFFECT OF 4 WEEKS OF PRANAYAMA TRAINING AND 6 MIN WALK TEST ON BLOOD PRESSURE IN HEALTHY SUBJECTS.

Physiology

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ABSTRACT

Introduction : Yoga, a mind body technique involves relaxation, meditation and a set of physical exercises performed in sync with breathing. The word "Pranayama" is made up of two words, Prana and Ayama. Prana stands for the capacity to keep body alive by air, i.e breathe and Ayama means expansion, stretching or extension and control of breath. Yoga helps to improve the cardiovascular efficiency and homeostatic control of the body. Hence we decided to study the effect of Pranayama on blood pressure 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. Blood pressure was measured by using a sphygmomanometer using palpatory and auscultatory method. Six minute walk test was conducted as per American Thoracic Society (ATS) guideline. 40 minutes yoga training 2 times per week. The training consisted of warm up for 5 min, Pranayama for 25 min and Meditation for 10 min. 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 in systolic blood pressure after 4 weeks of Pranayama training which decreased from $118.20 + 6.376$ mmHg to $114.07 + 5.693$ mmHg after Pranayama ($p < 0.001$). There was a statistically significant decrease in diastolic blood pressure after 4 weeks of Pranayama training which decreased from $76.80 + 5.268$ mmHg as compared to $72.73 + 4.968$ mmHg after 4 weeks of Pranayama training ($p < 0.001$). 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 after 4 weeks of Pranayama training ($p < 0.001$). **Discussion:** The present study revealed that there was a significant decline in both systolic and diastolic blood pressure after Pranayama. There was a significant increase in six-min walked distance after Pranayama.

KEYWORDS

INTRODUCTION

The word "Pranayama" is made up of two words, Prana and Ayama. Prana stands for the capacity to keep body alive by air, i.e breathe and Ayama means expansion, stretching or extension and control of breath. Thus, Pranayama means the art of controlling breath.

Pranayama is basically undertaken for somatic purification, regulation of prana to each body organ and optimize the cardio-pulmonary and autonomic functions 1. Pranayama is the first step towards re-orienting and improving the functioning of mind and body by learning to utilize the air we breathe. Pranayama implies correct breathing and control over prana. The purpose of Yoga breathing exercises is to supply the body with oxygen and remove carbon dioxide. This improves the blood circulation and more oxygen / prana reaches to all the parts of the body².

Six-min walk test is an inexpensive, relatively quick, safe method of assessing the functional exercise capacity in healthy subjects and in patients with moderate-to-severe heart or lung disease. It is easy to administer, better tolerated and more reflective of activities of daily living than other walk tests 3. Pranayama, an important component of intervention, leads to improvement in walking distance and decreased perceived exertion as practice of pranayama improves the ventilatory function of the lungs by using fullest capacity of lungs, reducing the oxygen debt, improving the gaseous exchange and preventing exhaustion⁴.

The slow increase in lung capacity associated with 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 and lessen sense of perceived exertion 5. Ray US (2001) also demonstrated improved aerobic capacity and decreased perceived exertion after maximal exercise after practice of Hatha yogic exercise 4. 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 practice of Hatha yogic exercise return of vitals to baseline 4,5. 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 6. With this background and the ever growing popularity and multiple studies demonstrating beneficial effects of yoga on multiple systems in the body we undertook this study to assess the effect of 4 weeks of Pranayama training on blood pressure and on the 6 minute walk test in normal healthy subjects.

Materials and Methods

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. Blood pressure was measured by standard mercury sphygmomanometer using standard guidelines. Both diastolic blood pressure and systolic blood pressure were measured. Before measurement subjects were relaxed by allowing 5 minutes to rest before the first reading. The subject sat upright with their upper arm positioned so that it was at level with their heart and feet flat on the floor. Excess clothing that might interfere with the BP cuff or constrict blood flow in the arm were removed. 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) After the subject had been at rest for 15 minutes, measurements of blood pressure were recorded. 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. Yoga training was given for 40 minutes twice per week for a period of 4 weeks. This consisted of Warm up for 5 min, Pranayama for 25 min and Meditation for 10 min. The Pranayama that were adapted for study purpose are:

Nadishuddhi: Technique: 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 off

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 practise was advised to the subjects

Kapalbhati: Technique: 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. 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.

Statistical Analysis

All the variables like systolic blood pressure, diastolic blood pressure 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, SPSS Statistics for Windows (SPSS Inc., Chicago, Ill., USA).

Results

TABLE 1

COMPARISON OF BASELINE CARDIOVASCULAR PARAMETERS BEFORE AND AFTER 4 WEEKS OF PRANAYAMA

PARAMETERS		BEFORE PRANAYAMA	AFTER PRANAYAMA
HEART RATE (Beats / min)	Mean	75.93	73.27
	S.D.	5.024	5.186
	S.E.	0.917	0.947
	T Value	9.103	
	P Value	<0.001	
	Significance	Significant	
SYSTOLIC BLOOD PRESSURE (mm of Hg)	Mean	118.20	114.07
	S.D.	6.376	5.693
	S.E.	1.164	1.039
	T Value	9.906	
	P Value	<0.001	
	Significance	Significant	
DIASTOLIC BLOOD PRESSURE (mm of Hg)	Mean	76.80	72.73
	S.D.	5.268	4.968
	S.E.	0.962	0.907
	T Value	12.003	
	P Value	<0.001	
	Significance	Significant	

TABLE 2

COMPARISON OF CARDIOVASCULAR PARAMETERS AND EXERCISE CAPACITY AFTER 6 MINUTE WALK TEST BEFORE AND AFTER 4 WEEKS OF PRANAYAMA

PARAMETERS		BEFORE PRANAYAMA	AFTER PRANAYAMA
HEART RATE (Beats / min)	Mean	105.07	98.07
	S.D.	5.842	6.422
	S.E.	1.067	1.172
	T Value	9.215	
	P Value	<0.001	
	Significance	Significant	
SYSTOLIC BLOOD PRESSURE (mm of Hg)	Mean	131.67	124.40
	S.D.	6.583	6.673
	S.E.	1.202	1.218
	T Value	10.173	
	P Value	<0.001	
	Significance	Significant	
DIASTOLIC BLOOD PRESSURE (mm of Hg)	Mean	81.60	77.27
	S.D.	5.418	4.856
	S.E.	0.989	0.887
	T Value	9.616	
	P Value	<0.001	
	Significance	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 6 minute walk test (6MWT). The exercise capacity were assessed on 6 min walk distance (6MWD). Then they were given Pranayama training for 4 weeks. Cardiovascular parameters and exercise capacity were again assessed on 6MWT. The blood pressure (Diastolic blood pressure and Systolic blood pressure) and 6 MWD were compared on 6 MWT and following results were obtained.

We observed significant decrease in systolic blood pressure after 4 weeks of Pranayama training. Significant decline in systolic blood pressure in our study is in accordance with other studies which suggested that significant change in the results after Yoga intervention. Dandekar Pradnya Deepak⁷ attributed the decrease in systolic blood pressure to balance in autonomic nervous system by Anulom Vilom pranayama and also suggested that short term practice of Anulom Vilom could lead to parasympathetic control over heart. Indla Devsana et al⁸ showed highly significant decline in systolic blood pressure as well as significant decline in diastolic blood pressure after practicing pranayama and meditations for 6 months. Vinayak and Anil⁹ showed significant reduction in both systolic and diastolic blood pressure after practicing combination of asana and pranayama for 12 weeks. Yoga practice increases vagal tone, decreases the work load on heart leading to decrease in cardiac output and hence systolic blood pressure and it also affects the hypothalamus directly and brings about decrease in blood pressure (in both systolic and diastolic blood pressure) through its influence on vasomotor centre while leads to reduction in sympathetic tone and peripheral resistance¹⁰.

Our study showed significant decrease in diastolic blood pressure after 4 weeks of Pranayama training. The findings are supported by previous studies. K Upadhyay Dhungel et al¹⁰ after 4 weeks training period found significant decrease in diastolic blood pressure indicating that regular practice of Nadishuddhi increases parasympathetic activity. T Pramanik et al¹¹ study showed fall of diastolic pressure. The result indicated that slow pace Bhramari Pranayama for 5 minutes, induced parasympathetic dominance on cardiovascular system¹¹. The following reasons may be possible for the significant decline in heart rate and blood pressure: Blood pressure and pulse rate related with cardiovascular system is controlled by autonomic nervous system. Pranayama increases cardiac output, decreases hepatic renal blood flow and increases peripheral vessels flood flow. Nadishuddhi brings a

balance in autonomic nervous system. A practitioner of yoga not only tries to breathe, but at the same time also tries to keep his attention on act of breathing, leading to concentration. These acts of concentration remove his attention from worldly worries and de-stress him. In this relaxed state, parasympathetic activity over-rides sympathetic activity. Lung inflation has been known to decrease systemic vascular resistance. This response is initiated by pulmonary stretch receptors which bring about withdrawal of sympathetic tone in skeletal muscle blood vessels leading to wide spread vasodilatation thus bringing up decrease in peripheral resistance.

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 other studies. There is paucity of data on the effect of yoga on functional capacity in literature using 6 min walk test but Akhtar et al 12 study showed the effect of yoga on 6 minute walk distance where there was a statistically significant improvement in 6 MWD. Raj et al 13 have also shown significant increase in 6MWD after Yoga. Six-min walk test is an inexpensive, relatively quick, safe method of assessing the functional exercise capacity in healthy subjects. Improvement in the distance walked in the present study is due to the beneficial effects of yoga on musculoskeletal and cardio-respiratory systems 14. 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.

CONCLUSION

Considering the findings, the present study suggests that regular practice of Yoga improves cardiovascular functions and exercise capacity as shown by fall in SBP, DBP and increase in 6MWD. In light of these facts, it can be said that Yogic practices can be adopted as a potent way of maintaining health and fitness and improvement in overall quality of life¹⁵.

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