

Original research article

Impact of 12 weeks of yoga training on breath holding time in healthy individuals: A controlled prospective study**Dr. Deepa H S¹, Dr. Basavaraj R²****¹Assistant Professor, Dept. of Physiology, SS Institute of Medical Science (SSIMS&RC), Davangere, Karnataka, India.****²Associate Professor, Dept. of Physiology, Vijayanagar Institute of Medical Sciences, Ballari, Karnataka, India.****Corresponding Author: Dr. Basavaraj R****Abstract**

This study evaluates the effect of Yoga on breath holding time in healthy individuals. This comparative study included 80 healthy subjects from both genders (40 males and 40 females) in the age group of 30-60 years. Subjects meeting the study inclusion- exclusion criteria were selected for the study and they were asked to attend at least 5 Yoga classes per week for duration of 12 weeks. Participant's age, weight, height, & body mass index were recorded. Breath holding time after expiration and breath holding time after inspiration were recorded before & after twelve weeks of Yoga practice. Subjects served as their own control to minimize the confounding factors and to make the study more reproducible. To compare the changes in breath holding time before and after Yoga training, Student's paired 't' test was used. Statistical analysis showed that there was highly significant ($p < 0.001$) increase in Breath holding time after expiration and Breath holding time after inspiration after 12 weeks of Yoga practise. The response was similar in both the genders. Our results showed that regular practice of Yoga for minimum of 12 weeks is beneficial in improving breath holding time in healthy individuals. Highly significant increase in BHT exp & BHT insp indicates that Pranayama produces a wakeful hypo metabolic state of the body characterized by decreased consumption of O₂ and decreased CO₂ production. This study has shown that adding comprehensive yoga-based exercises to the daily life especially in middle age improves the lung function.

Keywords: Yoga, Breath holding time after expiration, breath holding time after inspiration, Healthy individuals .

Introduction

Breathing is an automatic process that occurs throughout the life. Automatic breathing is produced by rhythmic discharge of motor neurons that innervate & drive the muscles of respiration. Breathing can be voluntarily inhibited for some time but eventually the voluntarily control is overridden. The point at which breathing can no longer be voluntarily inhibited is called breaking point.¹ Breath-holding is an unstable state with changes occurring in many interrelated variables. The breath-holding test is simple and rapid. The simplest objective measure of breath-holding is its duration. The maximal duration of voluntary apnoea varies from subject to subject and depends on chemical and non-chemical stimuli.² Breath-holding time has been shown to be reduced by anything that increases feedback from diaphragm afferents (any tonic diaphragm activity and possibly arterial hypoxia and hypercapnia) or that increases the central respiratory rhythm (arterial hypoxia or hypercapnia, or decreasing lung volume or increased metabolic rate).³

Breath-holding test has been tested in some clinical scenarios and has proved to be of clinical utility.^{4,5,6}

Yoga & breath holding time:

Makwana et al in 1988 conducted a study on short term Yoga practice on ventilatory function tests of 25 male volunteers. There was an improvement in respiratory functions in the form of lowered respiratory rate, increased BHT, increased forced vital capacity and improvement in tidal volume.⁷ Practice of forced breathing involving only a phase of deep inhalation and forceful exhalation without a phase of breath holding as practiced in 'pranayama' also prolongs breath holding time and improves ventilatory functions of the lung.⁸ Joshi et al (1992) conducted study on seven male and seven female participants who underwent a one hour daily Yoga program for a total of 12 days and they studied the effect of two weeks Yoga program on pulmonary function and have shown increase in breath holding time.⁹

Austin DM et al (2008) conducted a simple breathing exercises in which 4 weeks of nadi shodhana pranayama on 20 healthy young men proved there was an increase in breath holding time and decrease in both systolic and diastolic BP. This shows that there was a decrease in autonomic performance those who are practicing regular pranayama.¹⁰ Bhargava R et al (1998) in their study conducted on the persons who are undergoing regular practice of raja Yoga. They have shown there was an increase in breath holding time, increase in cardiovascular parameters and decrease in lipid profile.¹¹ Sonya AO et al in 1998 conducted a study on breath holding time among obese and non-obese subjects, from their study they concluded there was an inverse relationship was found between body fat and breath holding time.¹² This present study was planned to evaluate the effect of 12 weeks of yoga training on Breath-holding time in healthy volunteers of Davanagere city.

Materials and Methods:

This comparative study included 80 healthy subjects, 40 males and 40 females of age group 30-60 years. Subjects were selected randomly from a group of participants visiting the Yoga centre in Davanagere who were not practicing Yoga but keen on learning. Subjects were required to attend a minimum of five Yoga classes per week with duration of 1 hour for a total of twelve weeks. Subjects served as their own control to minimize the confounding factors and to make the study more reproducible.

Inclusion criteria

- Healthy individuals of 30-60 years from both the sexes freshly joining to Yoga.

Exclusion criteria

- Age below 30 years and above 60 years
- History of active sports training
- Previous experience of Yoga training.
- Smokers and alcoholics
- Subjects with history of tuberculosis, asthma, diabetes mellitus, hypertension and other cardiovascular diseases
- History of major surgery in the recent past, subjects on chronic medication, with any muscular disorder

Method of collection of data

- The subjects were explained about the importance and procedure of the study. Participants read and signed informed consent form before recording of any of the study parameters.
- The subjects who satisfied inclusion and exclusion criteria were selected after taking a

detailed clinical history as in the proforma. Participants underwent detailed general and systemic examination. The subjects were asked not to change their life style during the 12 weeks of the study and were instructed not to perform any other physical exercises if they were not doing the same regularly.

➤ The study involved non-invasive procedures with no financial burden on the subjects. Sufficient time was given (15 min) for the subjects to mentally & physically relax before recording the parameters. Following parameters were recorded in each subject. All data of individual subject were entered in proforma for each subject.

Recording of anthropometrical parameters:

➤ Height (Ht in cms) measured with subject, standing without shoes, nearest to 0.1 cm error by using a Standard Height measuring Scale.

➤ Weight (Wt in kg) measured with subject, wearing minimum clothing, nearest to 0.1 kg error by using a standard weighing machine.

➤ Body Mass Index (BMI) in kg/m^2 : It is calculated using a Quetelet's index.¹³

Body mass index = weight (kg)/Height (m)²

Breath holding time:

During the recording of breath holding time the subject was instructed to sit comfortably on the chair.

Breath holding time after expiration:

- Subject was asked to breath out fully; the nose clip was applied tightly on the nose and lips were tightly closed. Care was taken to avoid any leakage of air from the mouth and the nose during inspiration or expiration .

- The subject was told to maintain the breath holding as long as he could. If subject felt it difficult to maintain the breath holding, immediately he was asked to take the hand from the chest.

- The time in seconds up to which the subject was able to hold his/her breath was considered.

Breath holding time after inspiration:

- Subject was asked to take a deep breath (Inhale) and the nose clip was applied tightly on the nose and lips were tightly closed. Care was taken to avoid any leakage of air from the mouth and the nose during inspiration or expiration.

- The subject was told to maintain the breath holding as long as he could. If he felt it difficult to maintain the breath holding, immediately he was asked to take the hand from the chest. The time in seconds up to which the subject was able to hold the breath was considered.

Scoring: Breath holding capacity was recorded with the help of a stop watch three times for each subject. The final values were taken from the best of the 3 readings.

All the subjects were given yoga training by a qualified instructor for a period of twelve weeks, minimum of five Yoga classes per week for one hour daily between 5.30 am to 6.30 a.m. The schedule consisted of:

1. Warm-up exercises – 5 minutes
2. Prayer (suryanamaskara) – 10 minutes
3. Asanas – 20 minutes
4. Pranayama -10 minutes
5. Meditation -10 minutes

6. Shavasana – 5 to 10 minutes

After 12 weeks of Yoga training once again parameters were assessed.

Statistical methods

This study is pre-post study; where in the effect of 12 weeks of Yoga training on BHTexp and BHTinsp were evaluated in normal healthy individuals.

Results on continuous measurements are presented on Mean \pm SD. Significance is assessed at 5 % level of significance. Student 't' test (two tailed, dependent) has been used to find the significance of study parameters before & after Yoga practice.

- p value >0.05 is taken as not significant
- p value <0.05 is taken as significant
- p value <0.01 is taken as highly significant¹⁴

Statistical software: The Statistical software namely SPSS 20th version was used for the analysis of the data and Microsoft Word and Excel have been used to generate graphs, tables etc.

Results

80 healthy subjects, 40 males and 40 females of age group 30-60 years who practiced Yogasana, under the guidance of an instructor for 12 weeks were analysed for the results. The results obtained were expressed as mean \pm standard deviation.

Analysis of basic characteristics of subjects:

Age of the subjects ranged from 30-60 years, the mean age (years) was 45.84 ± 9.59 years, mean weight (kg) was 59.63 ± 4.59 , mean Height (m) was 1.6 ± 0.06 & mean BMI (kg/m^2) was 23.25 ± 1.33 (Table 1).

Table 1: mean and SD of age, weight, height and BMI of the subjects studied

Variables	Sample (N=80)	
	Mean	SD
Age (years)	45.84	9.59
Weight (Kg)	59.63	4.59
Height (m)	1.6	0.06
BMI (kg/m^2)	23.25	1.33

Effect of yoga on breath holding time:

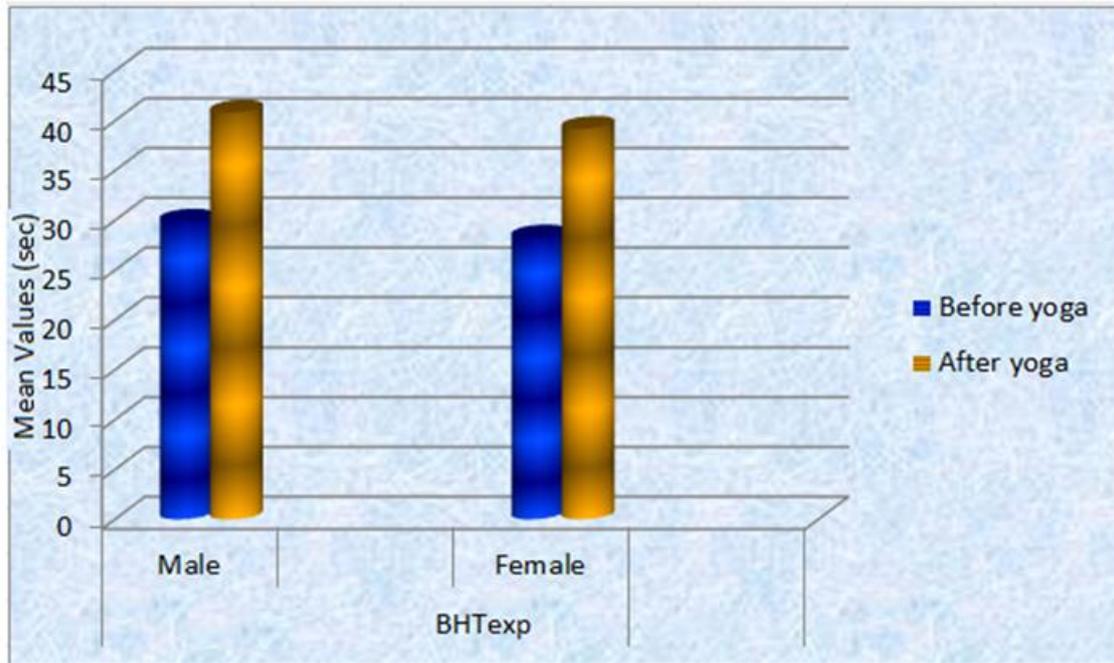
Breath Holding Time after Expiration:

The mean BHTexp (sec) before Yoga practice was 29.1 ± 2.94 and it increased significantly to 40.01 ± 2.98 ($p < 0.001$) after 12 weeks of Yoga practice. The decrease in the mean BHTexp was significant in both the genders. In males, mean BHTexp increased from 29.9 ± 2.80 to

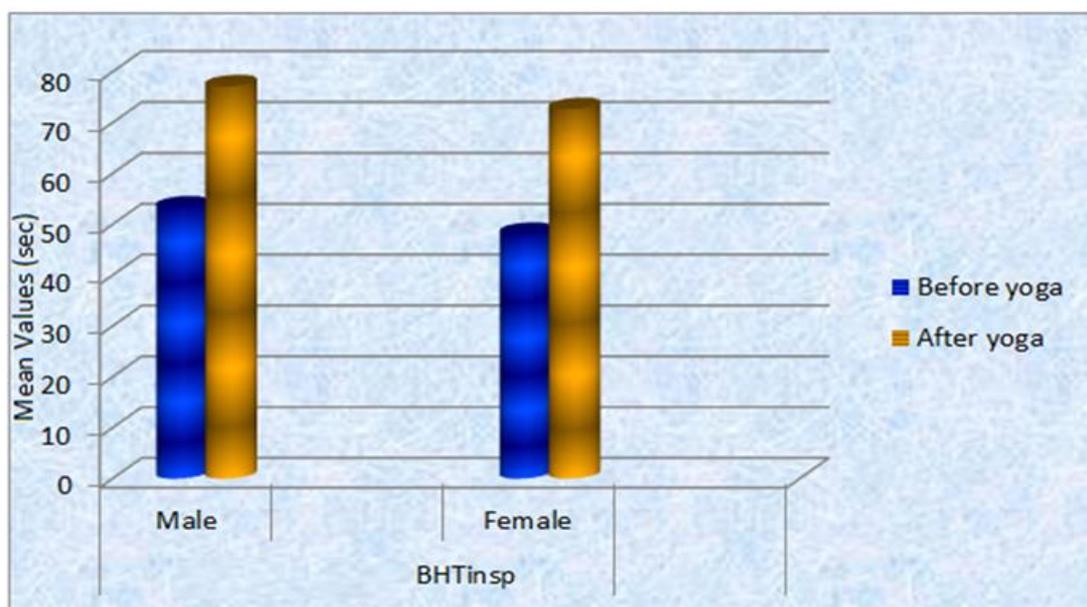
40.83 ± 3.01 ($p < 0.001$) and in females, it increased from 28.3 ± 2.89 to 39.2 ± 2.75 ($p < 0.001$) (Graph-1).

Breath Holding Time after Inspiration:

Similar results were observed in BHT_{insp}. The mean BHT_{insp} (sec) increased to 74.91 ± 4.93 from the baseline value of 50.73 ± 4.69 . There was significant increase in BHT_{insp} in both the genders after 12 weeks of regular Yoga practice. In males, mean BHT_{insp} increased to 77.15 ± 4.9 from the baseline value of 53.33 ± 4.3 ($p < 0.001$) and in females, it increased to 72.68 ± 3.87 from 48.13 ± 3.49 ($p < 0.001$) (Graph-2).



Graph 1: Effect of yoga on BHT_{exp}



Discussion:

There was a significant increase in breath holding time after twelve weeks of Yoga training. In our study BHT_{insp} was greater than BHT_{exp}. Similar results were obtained in other studies. Madan Mohan et al (1992) conducted a study on effect of Yoga training on breath holding time after inspiration and after expiration in 27 students. They were given Yoga training for 12 weeks. Results showed that Yoga practice for 12 weeks resulted in significant increase in breath holding time.¹⁵ Vyas r et al in 2002 in their study found that short term practice of pranayama breathing improves the ventilatory functions of the lungs and also prolongs the breath holding time.^{16,17}

Telles et al 2007, conducted a study of the effect of 3 months of Yoga practice and found an increase in breath holding time, a decrease in blood pressure and rapid decrease in blood glucose, plasma cholesterol, and increased urinary levels of 17-keto steroids.¹⁸

Breath holding time depends on the initial lung volume, training & will power of the subject. Greater lung volume decreases the frequency & amplitude of the involuntary contractions of respiratory muscles & reduces the discomfort of breath holding. As a result, it is easy to hold breath at total lung capacity than near residual volume. Improvement in BHT may be due to practice of Yoga which makes stretch receptors to withstand more stretching.¹⁹ Also the sensitivity of the respiratory centre to carbon dioxide is reduced as reported in the study involving Deep-sea divers and SCUBA (Self-contained under water breathing apparatus) divers who practice breath-holding maneuvers.²⁰ Hence respiratory centre can withstand higher carbon dioxide concentrations in the alveoli and the blood. With training subject can exercise voluntary control on the respiratory muscles overriding the excitatory stimuli to respiratory centres. In addition there is gradual acclimatization of receptors to the increased concentrations of carbon dioxide.²¹ Similar findings were observed in other studies.^{22,23}

Along with this, improved cardiorespiratory endurance might be responsible for prolongation of BHT in Yoga trained subjects. Also, Yoga training might alter the responsiveness of medullary &/or systemic arterial chemoreceptors with consequent prolongation of BHT.

Study limitations

- Present study observed the effects of Yoga practice for 12 weeks, it remains to be seen how long these changes persist after discontinuation of the Yoga practice.
- This study was limited by its sample size

Conclusion:

Present study proved that regular practice of Yoga for minimum of 12 weeks significantly improves Breath holding time and this improvement is appreciable in both genders. Highly significant increase in BHT_{exp} & BHT_{insp} indicates that Pranayama produces a wakeful hypo metabolic state of the body characterized by decreased consumption of O₂ and decreased CO₂ production. Results of the study helps in incorporation of Yoga as part of our lifestyle in promoting health especially in middle aged individuals. Also Yoga can make an appreciable contribution to primary prevention and management of lifestyle diseases.

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