

# EFFECT OF SUKHA PRANAYAMA AND BHASTRIKA PRANAYAMA ON CARDIOVASCULAR AUTONOMIC FUNCTIONS AMONG YOUNG HEALTHY INDIVIDUALS

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## ABSTRACT

### BACKGROUND

Practice of Yoga causes several changes in normal physiology. Meditation has positive short and longterm rewards which include a balance of the parasympathetic and sympathetic functions. Cardiovascular autonomic functions are quantified by changes in the heart rate (HR) and blood pressure (BP) in response to some of the physiological stimuli and different types of Pranayamas is known to alter the autonomic function.

### OBJECTIVES

To assess the effects of Sukha Pranayama and Bhastrika Pranayama on cardiovascular autonomic functions in normal healthy medical students.

### MATERIALS AND METHODS

50 male and female young healthy volunteers studying at PES Institute of Medical Sciences and Research, Kuppam belonging to age group of 17-22 years were included for the study. Parasympathetic activity was assessed by observing the heart rate changes to immediate standing from lying down position, heart rate changes during deep breathing and heart rate changes during Valsalva manoeuvre using Biopac Student Lab MP30 device. Sympathetic activity was assessed by observing blood pressure changes on immediate standing from lying down position and blood pressure changes during sustained hand grip using sphygmomanometer before and after yoga.

### RESULTS & CONCLUSION

The baseline heart rate and blood pressure response to immediate standing showed a tendency to decrease possibly due to increased vagal tone and decreased sympathetic discharge thereby indicating practice of yogasanas and pranayamas would benefit the young population as it would prepare them in overcoming stress by modulating and optimising sympathetic activities in stressful situations.

### KEYWORDS

Yoga, Autonomic functions, Young adults, Pranayama.

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**INTRODUCTION:** Yoga is a scientific way of life existing in India from ancient times. It brings about functional harmony between body and mind to lead a happy and healthy life. Practice of Yoga causes several changes in normal physiology. Meditation has positive short and longterm rewards which include a wakeful hypometabolic physiological state and a balance of the parasympathetic and sympathetic functions.<sup>[1]</sup> Life force in an individual is symbolised by breathing. Breath is a dynamic bridge between the body and mind.

Pranayama is a natural way of cleansing breath and has been suggested as a route to healthy body and mind.<sup>[2]</sup> Patanjali, first exponent of Yoga, described Pranayama as the gradual unforced cessation of breathing. A person who practices pranayama not only tries to breathe but at the same time tries to keep his attention on the act of breathing leading to concentration. This act of concentration removes his attention from worldly worries and reduces stress.<sup>[3]</sup>

The cardiovascular system is influenced by both the divisions of autonomic nervous system (ANS). Cardiovascular autonomic functions are quantified by changes in the heart rate (HR) and blood pressure (BP) in response to some of the physiological stimuli.<sup>[4]</sup> Different types of Pranayamas like Sukha Pranayama and Bhastrika Pranayama are known to alter the autonomic function.<sup>[5]</sup> Practice of these Pranayamas at slow rate increases oxygen consumption and metabolic rate<sup>[6]</sup> and other slow breathing

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exercises reduce chemoreflex response to both hypoxia and hypercapnia but increase baroreflex sensitivity.<sup>[7]</sup>

Thus, this study was designed to assess the effects of Sukha Pranayama and Bhastrika Pranayama on cardiovascular autonomic functions in normal healthy medical students.

**MATERIALS AND METHODS:** The study included 50 male and female young healthy volunteers studying at PES institute of Medical Sciences and Research, Kuppam belonging to age group of 17-22 years based on the following inclusion and exclusion criteria.

**Inclusion Criteria:** Healthy young volunteers of 1<sup>st</sup> year MBBS at PESIMSR, Kuppam, in the age group 17-22 willing to participate in the study.

**Exclusion Criteria:**

- H/O smoking or tobacco consumption in any form.
- H/O yoga or meditation practice previously and active sports training.
- H/O cardiovascular disorders, diabetes mellitus, bronchial asthma or any medical illness.
- H/O major surgeries.
- H/O any acute or recent illness.

The study was conducted on 50 male and female young healthy volunteers aged between 17-22 years in the research lab of Department of Physiology, PESIMSR Kuppam, from September 2011 to March 2012 after obtaining the ethical clearance from the Institutional Ethics Committee. The cardiovascular autonomic functions were assessed before the beginning the yoga training, after 90 days and after 180 days of yoga training.

The procedure was explained to the individual subjects and informed written consent was taken from all subjects included in the study. Subject's clinical history and personal details were taken according to the standard proforma and were examined for their general physical health. Height was measured in cm and weight in kg. BMI was calculated for each subject. After a brief general physical examination, the cardiovascular autonomic function tests were performed using Biopac Student Lab MP30 device. Due care was taken to remove the factors which could interfere with the results of the tests. The different manoeuvres were demonstrated to the subjects and they were trained to perform the tests.

Parasympathetic activity was assessed by observing the heart rate changes to immediate standing from lying down position, heart rate changes during deep breathing and heart rate changes during Valsalva manoeuvre. Sympathetic activity was assessed by observing blood pressure changes on immediate standing from lying down position and blood pressure changes during sustained hand grip. Then, the subjects were made to perform Sukha pranayama and Bhastrika pranayama every day for one hour for up to 6 months. Then, the cardiovascular autonomic function tests were performed using Biopac Student Lab MP30 device in the same manner as before.

**Procedure of Sukha Pranayama:** Sukha Pranayama is an easy and free breathing process.

The air is breathed in through each nostril separately. The thumb and the middle two fingers are used for holding the nose. The individual is made to sit in the Padmasana or Ardhapadmasana posture. Then, the thumb is used to close the right nostril and the other two fingers the left. First the air is expelled through the left nostril. Then slowly the air is breathed in fully through the same nostril. During this process, the movement of the air should not make any audible sound. Then the air is expelled or breathed out from the right nostril fully without any audible sound. The process is repeated for 5 minutes.

**Procedure of Bhastrika Pranayama:** The Bhastrika Pranayama is practiced in the yogic posture. The mudra used for this pranayama is called Dhyanamudra. The individual is made to sit in this posture keeping the hand with the mudra on both the knees and asked to breathe air slowly keeping the eyes closed. Normally the neck should be in line with the trunk. The air should fill both the lungs fully and then the air is breathed out without any audible sound. This process is repeated for 5 minutes.

**RESULTS:** The majority of the subjects belonged to 17 years' age group both in males (68.0%) and females (80.0%). The differences in the age distribution between gender is also not statistically significant ( $P=0.45$ ; NS). The mean baseline heart rate significantly decreased from 74.8 to 70.5 per min ( $P < 0.001$ ; S) after 3 months of yoga and further decreased to 68.6 per min ( $P < 0.001$ ; S) after 6 months of yoga. However, decrease in the heart rate from 70.5 per min. after 3 months of yoga to 68.6 per min. after 6 months of yoga was not statistically significant  $P=0.06$ ; NS.

The mean heart variation (the difference between the maximum and minimum heart rates) during were not significantly altered after 3 months and 6 months of yoga therapy compared to before yoga therapy. The 30:15 ratio (the longest R-R interval at about 30 beats to shortest R-R interval at 15 beats used to assess heart rate response to immediate standing and Valsalva ratio (ratio of longest R-R interval during phase IV to shortest R-R interval during phase II) were not significantly altered after 3 months and 6 months of yoga therapy compared to before yoga therapy. (Table 2)

The mean systolic blood pressure significantly dropped from 113.1 mmHg to 104.9 mmHg ( $P < 0.001$ ; S) after 3 months of yoga and further dropped to 99.2 mm Hg ( $P < 0.001$ ; S) after 6 months of yoga. Similarly, the mean diastolic blood pressure significantly dropped from 70.5 mm Hg to 66.8 mm Hg ( $P < 0.001$ ; S) after 3 months of yoga and further dropped to 61.0 mm Hg ( $P < 0.001$ ; S) after 6 months of yoga. Thus, within 3 months of yoga therapy, there was significant reduction in both systolic as well as diastolic blood pressure levels which further significantly reduced after 6 months of yoga therapy. The DBP rise after hand grip exercise; however, was not significantly altered after 3 months of yoga and 6 months of yoga therapy ( $P=0.81$ ; NS). (Table 3)

(Years)	Male (%)	Female (%)	Total (%)
17	17(68.0)	20(80.0)	37(74.0)
18	7(28.0)	5(20.0)	12(24.0)
20	1(4.0)	0(0.0)	1(2.0)
<b>Total</b>	<b>25(100.0)</b>	<b>25(100.0)</b>	<b>25(100.0)</b>

**Table 1: Age Distribution by Gender Age**

$\chi^2=1.57$ ;  $P=0.45$ ; NS

Heart Rate Parameter (Mean±SD)	Before Yoga. <sup>(1)</sup>	3 Months After Yoga. <sup>(2)</sup>	6 Months After Yoga. <sup>(3)</sup>	P Value
Baseline (HR/min)	74.8±5.19	70.5±5.01	68.6±5.11	1 vs 2: $P<0.001$ ; S 2 vs 3: $P=0.06$ ; NS 1 vs 3: $P<0.001$ ; S
Immediate standing (30:15) R-Ratio	1.46±0.18	1.47±0.18	1.50±0.18	1 vs 2: $P=0.78$ ; NS 2 vs 3: $P=0.40$ ; NS 1 vs 3: $P=0.26$ ; NS
Deep breathing E: I Ratio	26.2±6.11	26.6±5.93	24.9±5.60	1 vs 2: $P=0.74$ ; NS 2 vs 3: $P=0.13$ ; NS 1 vs 3: $P=0.27$ ; NS
Valsalva Ratio (VR)	1.57±0.13	1.58 0.12	1.61±0.13	1 vs 2: $P=0.70$ ; NS 2 vs 3: $P=0.23$ ; NS 1 vs 3: $P=0.12$ ; NS

**Table 2: Heart Rate Changes before Yoga Compared to 3 Months and 6 Months after Yoga**

Blood pressure parameter (Mean± SD)	Before Yoga. <sup>(1)</sup>	3 months after Yoga. <sup>(2)</sup>	6 months after Yoga. <sup>(3)</sup>	P Values
Systolic Blood Pressure (mm of Hg)	113.1±7.65	104.9±5.05	99.2±3.95	1 vs 2: $P<0.001$ ; S 2 vs 3: $P<0.001$ ; S 1 vs 3: $P<0.001$ ; S
Diastolic Blood Pressure (mm of Hg)	70.5±6.42	66.8±4.71	61.0±3.03	1 vs 2: $P<0.001$ ; S 2 vs 3: $P<0.001$ ; S 1 vs 3: $P<0.001$ ; S
Fall in SBP on standing	4.36±4.60	7.20±4.53	11.08±2.03	1 vs 2: $P=0.002$ ; S 2 vs 3: $P<0.001$ ; S 1 vs 3: $P<0.001$ ; S
DBP rise with Hand grip.	19.40±8.28	20.04±1.73	19.80±2.07	1 vs 2: $P=0.70$ ; NS 2 vs 3: $P=0.65$ ; NS 1 vs 3: $P=0.81$ ; NS

**Table 3: Blood Pressure Changes before Yoga Compared to 3 Months and 6 Months after Yoga**

**DISCUSSION:** The ancient science of yoga makes use of voluntary regulation of the breathing to make respiration rhythmic and to calm the mind. This practice of pranayama is an art of controlling the breath. Yogic exercise involves physical, mental and spiritual task in a comprehensive manner.<sup>[8]</sup> When the life force is disrupted, it results in physical, mental, emotional and spiritual disharmonies. Pranayama helps in bringing conscious awareness to breathing and the reshaping of breathing habits and patterns.<sup>[9]</sup>

Yoga reduces stress and pain and increases reported levels of happiness, self-confidence and<sup>[10]</sup> Yogic interventions have been found to be beneficial in treating various clinical conditions which include hypertension, cardiovascular disorders,<sup>[11]</sup> pain syndromes and

musculoskeletal diseases,<sup>[12]</sup> respiratory disorders such as asthma, congestive obstructive pulmonary disease<sup>[13]</sup> and various immunological disorders.<sup>[14]</sup>

The impact of medication on cardiorespiratory synchronisation with respect to breathing oscillations and modulation of heart rate induced by respiration was investigated. Studies showed that meditation techniques characterised by slow breathing could result in very prominent and regular oscillations in the LF band of HRV.<sup>[15]</sup>

In our study, the cardiovascular autonomic function tests were carried out before and after the practice of two selected pranayama procedures namely Sukha pranayama and Bhastrika pranayama among healthy young volunteers of 1<sup>st</sup> year MBBS belonging to the age group of 17-22.

The volunteers after yoga practice showed autonomic equilibrium between sympathetic and parasympathetic nervous system. The autonomic nervous system plays a major role in bringing about adaptation of human body to environmental changes, thereby modulating the sensory, visceral, motor and neuroendocrine functions. Pranayama increases frequency and duration of inhibitory neural impulses by activating pulmonary stretch receptors. Sympathetic tone in skeletal muscle blood vessels is decreased leading to widespread vasodilatation causing decrease in peripheral resistance and thus decreasing the diastolic blood pressure.<sup>[16]</sup>

In our study, the regular practice of yogasanas over a period of six months showed significant increase in parasympathetic activities. The baseline heart rate and blood pressure showed a tendency to decrease. These effects are possibly due to increased vagal tone and decreased sympathetic discharge since parasympathetic tone had a gradual build up in yoga volunteers.

It has been suggested that well performed slow yogic breathing decreases sympathetic activity during altitude induced hypoxia, by increasing oxygenation without altering minute ventilation. In slow and deep breathing, oxygenation of blood increases without changing minute ventilation as alveolar ventilation increases.

**CONCLUSION:** The observations of our study strongly indicate that there is decrease in sympathetic activity after yoga practice of 3 months and still better decrease in sympathetic activity after six months of yoga practice. Since the young individuals are invariably exposed to professional, social and environmental stress, the practice of such pranayamas would benefit the young population as it would prepare them in overcoming stress by modulating and optimising sympathetic activities in stressful situations thereby immediately restoring equilibrium and avoiding intervention of inhibitory parasympathetic system.

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