

# THE INFLUENCE OF THE 2:1 YOGIC BREATHING TECHNIQUE ON ESSENTIAL HYPERTENSION

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**Abstract :** In 2:1 breathing exhalation is twice of inhalation. The study was performed to study the influence of 2:1 yogic breathing technique on patients of essential hypertension. 30 patients of essential hypertension between ages of 20-50 years were selected. After a rest of 15-20 minutes in a comfortable sitting posture their baseline physiological parameters recorded on a digital polygraph were, Electromyogram (EMG), Galvanic skin response (GSR), Finger tip temperature (FTT), Heart rate(HR) and Respiratory rate(RR). Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were recorded by automated digital Sphygmomanometer. Then they were guided to do 2:1 breathing maintaining respiratory rate of around 6/min. Subjects were then instructed to do 2:1 breathing twice a day for 5-7 minutes for next 3 months. Subjects reported back weekly for recording of BP. The physiological parameters of the subjects were assessed again by polygraph at the end of three months of practicing 2:1 yogic breathing. The mean fall of SBP over 12 weeks was 12 mm Hg (8%) and DBP was 7 mm Hg (7%). P value < 0.001 in both. After practicing 2:1 breathing for 3 months there was statistically significant reduction of SBP, DBP, HR RR, EMG, GSR and rise in FTT. The study showed that 2:1 breathing technique caused a comprehensive change in body physiology by altering various parameters that are governed by the autonomic nervous system. It is an effective modality for management of essential hypertension.

**Key words :** 2:1 breathing    essential hypertension    respiratory rate

## INTRODUCTION

Essential hypertension remains major modifiable risk factor for cardiovascular

disease despite important advances in our understanding of its pathophysiology and the availability of effective treatment strategies (1). Factors increasing blood pressure are

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known as hypertensinogenic factors, these are obesity, insulin resistance, high alcohol intake, high salt intake, ageing, sedentary lifestyle, stress, low potassium intake and low calcium intake (2).

As studied from etiology, it is seen that lifestyle changes and stress became the most important factors precipitating essential hypertension, and therefore one of the most important management modalities is change of lifestyle. Researchers and physicians all over the world now recommend a yogic lifestyle. It keeps a person physically, mentally and spiritually healthy. There are innumerable studies showing the control of hypertension by various yogic and pranayamic breathing techniques. Breathing is considered to be a regulator of the autonomic nervous system and consequently of mental processes as Swami Rama stated "controlling the breath and thus calming the nerves is a prerequisite to controlling the mind and the body" (3).

Heart rate increases during inspiration and decreases during expiration, this is known as sinus arrhythmia. Recordings from cardiac autonomic nerves reveal that neural activity increase in sympathetic fibers during inspiration and increases in vagal fibers during expiration. Sinus arrhythmia is exaggerated when vagal tone is enhanced (4). It is known that regular practice of breathing exercises (pranayama) increases parasympathetic tone, decreases sympathetic activity, improves cardiovascular and respiratory functions, decreases the effect of stress and strain on the body and improves physical and mental health. Slow pranayamic breathing improves vagal activity and therefore decreases baseline heart rate and

blood pressure. This is associated by improving vagal tone and by decreasing sympathetic discharge (5). Improvement in both sympathetic and parasympathetic reactivity may be the mechanism that is associated in those practicing the slow breathing exercises (6). One of the variant of such a pranayama is 2:1 breathing which is a type of yogic exercise where exhalation is twice the duration of inhalation. In this exercise the breath is not held. This exercise helps the person to relax, eliminates waste gases from the body and increases stamina and endurance (7). During last few decades, researchers have recognized the significance of the relationship between breathing exercises and autonomic system. Daily slow breathing exercise lowered BP and increased baroreflex sensitivity (8). This study was undertaken to find a non-pharmacological method for managing essential hypertension using 2:1 yogic breathing, as this pranayama is an easy to do exercise and less time consuming, suitable for a modern day man.

## MATERIALS AND METHODS

The study was carried out in the Department of physiology, Himalayan institute of medical sciences, Swami Ram Nagar. 54 patients from the medicine OPD volunteered for the study, 38 of them were selected for the study based on inclusion criteria. 8 patients dropped out in the follow up. Therefore finally 30 patients were included in the study, after obtaining written informed consent.

### Inclusion criteria

- Males and females between ages of 20 – 50 years.

- Subjects who are newly diagnosed of having essential hypertension in pre-hypertensive stage and stage 1, according to JNC 7 Classification.
- Not taking treatment.
- No past history of any chronic illness like chronic renal failure, uncontrolled diabetes mellitus.

#### Exclusion criteria

- Significant co-morbidity like angina, uncontrolled diabetes mellitus, chronic renal failure, stroke, obesity.

#### Study protocol

Subjects were interviewed the previous day and detailed description of the protocol was explained to them. Ethical clearance was taken by ethics committee. The subjects were instructed to avoid tea, coffee or smoking at least 6-8 hours before measurement of base line parameters. The subjects reported in the Department of physiology between 9 AM to 10.00 AM. After a rest of 15-20 minutes in a comfortable sitting posture in a thermo neutral zone, their baseline/resting physiological parameters recorded on a digital polygraph (Medicaid systems, Chandigarh) were, 1) Electromyogram (EMG) (2) Galvanic skin response (GSR) 3) Finger tip temperature (FTT) ( 4) Heart rate (HR) (5) Respiratory rate (RR). Systolic blood pressure (SBP) and diastolic blood pressure (DBP) was recorded by automated digital Sphygmomanometer (National). These parameters were recorded simultaneously. Recording technique by this apparatus was non-invasive and painless, using electrodes and specialized sensors placed on the skin

with non-allergic conductive gel. Electrodes for EMG were placed on the forehead skin overlying frontalis muscle. The muscle action potential was recorded with skin surface electrodes, in millivolts (mV).

GSR, which is a measure of galvanic conductance of the skin, was measured by applying the GSR sensors of the digital polygraph to the palmer surface of tips of index and ring fingers of the right hand. Recording of GSR was done in kilo mho ( $K\Omega$ ) (mho is inverse of ohm). Fingertip temperature was measured in degrees Fahrenheit ( $^{\circ}F$ ) by thermal sensor of the digital polygraph placed on palmer surface of tip of right middle finger. Heart rate sensors are photoplethysmographic sensors, which was tied to palmer surface of right thumb tip. Respiratory sensors are strain gauge, consists of long Velcro straps that is stretched around the chest or abdomen. Regularity of breathing and the pattern of breathing were also noted over the graphic pattern.

After the baseline recording of above parameters, subjects were then guided by the investigator, to do 2:1 breathing, maintaining respiratory rate of around 6 per minute. The 2:1 breathing is a type of yogic breathing technique in which exhalation is twice of inhalation. Subjects was asked to inhale while counting 1, 2, 3, 4 and exhale while counting 1, 2, 3, 4, 5, 6, 7, 8. There was no pause between inhalation and exhalation. The training was done at the same time everyday for a period of one week. Subjects were then instructed to do 2:1 breathing exercise twice a day for 5-7 minutes for next three months.

Subjects reported back weekly for recording of blood pressure. The physiological parameters of the subjects were assessed again by digital polygraph at the end of three months of practicing 2:1 yogic breathing.

#### Statistical analysis

Wilcoxon Signed Ranks Test was used for analysis of non-normally distributed data. The initial baseline data and data obtained after three months of practicing 2:1 breathing were analyzed by SPSS software to compare the differences between the means. To see trends of blood pressure over 12 weeks during training period was done by repeated measures ANOVA (Analysis of variance).

## RESULTS

The results are summarized in Table I. The mean age of the subjects was  $43 \pm 7$  years. The mean fall of SBP over 12 weeks was 12 mm Hg (8%) and DBP was 7 mm Hg (7%). P value  $< 0.001$  in both. HR ( $P < 0.001$ ), EMG ( $P < 0.001$ ), GSR ( $P < 0.001$ ), and RR ( $P < 0.001$ ) declined to a much greater extent with very highly statistical significance and FTT ( $P < 0.001$ ) rose more significantly.

TABLE I: Effect of 12 weeks training of 2:1 yogic breathing technique on various parameters (n=30).

Parameters	Pre-Training	Post- training
SBP (mmHg)	149 $\pm$ 10	137 $\pm$ 8***
DBP (mmHg)	96 $\pm$ 6	89 $\pm$ 4***
HR (beats/min)	84	79 $\pm$ 3***
EMG (mV)	8 $\pm$ 2	6 $\pm$ 2***
GSR (K $\Omega$ )	1648 $\pm$ 437	1079 $\pm$ 526***
RR (breaths/min)	20 $\pm$ 2	17 $\pm$ 2***
FTT ( $^{\circ}$ F)	89 $\pm$ 1	90 $\pm$ 1***

"P" value \*  $< 0.05$  (significant); \*\*  $< 0.01$  (highly significant); \*\*\*  $< 0.001$  (very highly significant).

## DISCUSSION

2:1 yogic breathing technique produces beneficial effect on the autonomic nervous system (9). Slow breathing (6 breaths/min) and regulation of respiratory cycle is the most important step in controlling afferent vagal nerve fibers to attain control of autonomic nervous system (10). Slow breathing increases baroreceptor sensitivity, it shows strong tendency to improve the autonomic nervous system through enhanced activation of the parasympathetic system (11). The results of 2:1 yogic breathing technique can be compared to reports available on various other breathing techniques (pranayama) as they are fairly similar. This exercise affect, the sympathetic and parasympathetic components of autonomic nervous system, thereby affecting the vital physiological functions that govern heart rate, blood pressure, respiration, temperature, muscle tension and sweating.

Swami Rama stated that 2:1 yogic breathing technique is therapeutic for the mind and for the breathing functions. It is very good for the heart, nervous system, and brain (9).

2:1 yogic breathing technique reduces both SBP and DBP reinforcing the observation of other studies on breathing exercises done for 8 weeks (12-14). Pal et al had studied autonomic nervous system functions in 30 healthy male subjects. These subjects practiced slow breathing for 3 months regularly and showed improved mental and physical health and reduced stress. The decreased blood pressure was associated with increased vagal tone and reduced sympathetic activity (5).

Diastolic blood pressure is reflection of peripheral resistance, regulated by sympathetic activity. Yogic breathing at rate of 6 breaths per minute increases baroreflex sensitivity and reduces sympathetic activity and chemoreflex activation (15). Slow pace pranayama increases frequency and duration of inhibitory neural impulses by activating pulmonary stretch receptors during above tidal volume inhalation as in Hering Bruer reflex, which bring about withdrawl of sympathetic tone in skeletal muscle blood vessels, leading to widespread vasodilatation, thus causing decrease in peripheral resistance thus decreasing the DBP (11).

The reduction in the heart rate in subjects of essential hypertension in the present study corroborates with the observations of Selvamurthy et al who studied the effect of various yogic breathing techniques on heart rate (16). Grossman et al observed that prolonged exhalation and other yogic slow breathing techniques promote calmness and parasympathetic dominance. Heart rate slowing during exhalation is the result of greater parasympathetic activity during exhalation (17). EMG is an indicator of sympathetic activity, denoting skeletal muscle tension. Stress is manifested clinically as increased muscle tension. EMG is found to be raised in the event of stress. In present study after practicing 2:1 yogic breathing technique there was reduction in EMG, signifying reduced tension and relaxation. Other research workers had similar findings after slow breathing (6 breaths/min) exercise (18). Slow abdominal breathing combine with EMG biofeedback is an effective intervention to manage prehypertension, the possible

mechanism is that they reduce sympathetic activity and enhance vagal activity (19).

The estimation of GSR is useful in monitoring of the sweat gland activity and hyperhydrosis. Anxiety, a potent component of stress related disorders, triggers a sympathetic response leading to sweating, which is followed by a rise in electrodermal conductance of the skin. Skin conductance is measured by GSR (20). Other research workers also found the effectiveness of stress management training and GSR biofeedback training in treatment of essential hypertensive, they found that 8 weeks training period of stress management exhibited reliably lowered systolic blood pressure and diastolic blood pressure (21).

The rate of respiration is a direct indicator of sympathetic and parasympathetic activity. In the presence of stress, the rate of respiration becomes high because of an increase in the sympathetic trigger rate. On the other hand, when the person is relaxed, the rate of respiration is slow. Hypertensives have an increased inspiratory drive due to increase sympathetic discharge (22). Yogic breathing technique decreases the activity of sympathetic nervous system to the bronchioles and increases parasympathetic input. Both systems together act on the smooth muscle encircling airways, causing them to constrict, and thereby increases the resistance to airflow. This coincides with the fact that we make use of less alveolar ventilation when we are relaxed (23). The reduction in rate of respiration in subjects of essential hypertension are similar with the findings of Gopal et al who also observed decrease rate of respiration in subjects trained in pranayama (24).

Fingertip temperature as an indicator for sympathetic responses. Infrared thermography demonstrated that various stimuli triggering the sympathetic nervous system induce decrease in cutaneous microcirculation, most prominently in fingertip skin (25). Peripheral body temperature responds to the sympathetic tone. When the sympathetic system is activated, skin (especially in the hands and feet) becomes cold because its blood supply is diminished by vasoconstriction, and it becomes clammy because sweat glands flood the surface of body with moisture, which evaporates, further reducing the skin temperature. FTT rise after practicing 2:1 yogic breathing technique similarly seen with other yogic breathing techniques as it calms down the sympathetic nervous system, thereby decreasing muscle tone in the smooth muscle that encircles the arteries and arterioles, allowing these vessels to dilate. The blood supply to the skin thereby increases and skin temperature shows a rise (23).

2:1 yogic breathing technique like other breathing techniques causes a change in body physiology by altering various parameters

that are governed by the autonomic nervous system.

### Conclusion

2:1 yogic breathing technique like other breathing techniques causes a change in body physiology by altering various parameters that are governed by the autonomic nervous system. Since stress is one of the most important precipitating factors of essential hypertension, practice of 2:1 breathing can be helpful in patients of essential hypertension by lowering of blood pressure directly and also reducing stress levels in the body as shown by various stress parameters in the present study. We recommend that future studies include large group of patients. However the study may be extended to patients who are borderline, primary essential and secondary hypertensive as well.

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