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# Effect of Pranayam on selected cardiovascular parameters in pre hypertensive patients

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**Abstract**
**Background:** Hypertension is directly connected with circulation, respiration and function of vital organs. Hypertension is the most common cardiovascular disease affecting more than one billion people worldwide. Yogic exercises (Asana, Pranayama and Meditation) have beneficial effects on hypertension.
**Aims & Objectives:** Study the effect of different types of pranayam on physiological parameters in pre hypertensive (Systolic Blood Pressure 120–139 mmHg and Diastolic Blood Pressure 80–89 mmHg) patients.
**Materials & Methods:** The study was conducted on 150 hypertensive patients aged 30-50 years, They were randomized into three subgroups: subgroup 1aand 1b doing 20 and 30 min. Pranayam respectively for 3 months and control group not doing any type of pranayam. Systolic blood pressure (mmHg), diastolic blood pressure (mmHg), and heart rate (beats per minutes) and valsalva ratio of all patients were assessed at day 1stand monthly for 3 months. The data were analyzed using paired t′ test and ANOVA test by SPSS 20.0 Software (trail Version).
**Results:** In the present study, there were significant reduction in mean values of systolic blood pressure (125.36 $\pm$ 3.24), diastolic blood pressure (80.68 $\pm$ 1.11), heart rate rate (70.42 $\pm$ 2.09) and VR (1.42 $\pm$ 0.013) after 3 months of pranayam practices in study group as compared to control group in whom mean values of the systolic blood pressure (131.00 + 2.59), diastolic blood pressure (85.12 $\pm$ 1.85), and heart rate rate (77.86 $\pm$ 4.46) and VR (1.37 $\pm$ 0.45) was noted after 3 months. From the present study it was observed that a significant reduction in the systolic blood pressure, diastolic blood pressure and heart rate and increase VR in all the subjects ($p$<0.001). But this decrease is more in subjects those who are doing pranayam. The results of present study indicate that yoga has beneficial effect on reduction of high blood pressure.
**Conclusion:** We concluded that there is beneficial effect of pranayam on Prehypertensive patients in the form of decrease in SBP, DBP and HR and increase in VR as compared to control subgroup.

**Keywords:** Pranayam, hypertension, blood pressure and heart rate, valsalva ratio

## Introduction
Health is a dynamic state of complete physical, mental, spiritual and social wellbeing and not merely an absence of disease or infirmity [1]. Rapid alterations of life style within a very short span of time leads to chronic imbalance in both body and mind impending a direct effect on the physiology of mankind1. Health and holistic health is closely related, which gives importance to physical, mental, social, spiritual and sexual health as whole. Hypertension is directly connected with circulation, respiration and function of vital organs. Complementary therapy like pranayama is directly having effect on mental and physical health. So Pranayama emphasis on promotion, prevention and curative measures and helps to maintain normal blood pressure [2, 3].
According to JNC-7 (Joint National Committee 1997) the definition of hypertension is SBP as 140mmHg or higher or DBP as 90mmHg or higher or both and is estimated that it is effecting approximately 1 billion worldwide Where as <120mm of Hg as SBP and<80mm of Hg as DBP is considered as normal blood pressure [4]. It is estimated that the prevalence of hypertension in India is about 25% among urban adults and 10% in the rural areas. As per Epidemiological data support contribution of several dietary changes and other lifestyle-related factors are one of the cause in development of high blood pressure. Several clinical trials investigated the efficacy of non-pharmacological interventions and lifestyle modifications to reduce blood pressure [5].

Stress is one of such either in physical or mental form causing cardio vascular morbidity [6]. As per WHO stress is one of the major cause of disability and will become second leading cause by the year 2020 [7]. Relaxation and stress relieving methods like yoga asana, Pranayama, meditation, have been shown to be capable of lowering blood pressure, since they had beneficial effects via cardiovascular reflex control system [8]. There has been evidence that slow and regular breathing, that is Pranayama technique for a certain time every day has been known to have effect over cardiovascular reflex control system [9, 10].

Yoga is one of the most powerful drugless systems of treatment. It is having its own concept of wellness which has been scientifically understood and presented by many. Yoga can be adopted as lifestyle for promoting our physical and mental health [11].

Yoga can be modulate functions of these two limbs of Autonomic nervous system to maintain the balance and harmony by that way homeostasis of the physiological systems is maintained. The parasympathetic stimulation calming the cardiovascular activity while sympathetic stimulati increases cardiovascular activities. Specific yogasana are playing very important role in autonomic balance and by that way gives relief from hypertension and achieves other benefits in visceral function [12].

yoga and pranayama are beneficial for the treatment of cardiopulmonary diseases, autonomic nervous system imbalances, and psychologic or stress-related disorders [13]. It is known that regular practice of breathing exercises (pranayama) increases parasympathetic tone, decreases sympathetic activity, and improves cardiovascular functions [14].

A recent study on hypertension indicates that practice of slow and rhythmic pattern of breathing reduces high blood pressure and improves bar reflex sensitivity in hypertensive subjects [15]. Different types of breathing exercises have effect on autonomic balance for goodm by either decrease in sympathetic or increase in parasympathetic activity. In a study by Tells *et al*. have demonstrated that breathing through right nostril known to have result of increase in sympathetic activity where as through left nostril it decreases [16]. A study conducted on Bhramari Pranayama has proved that regular practice of this Pranayama for 5 minutes induce parasympathetic dominance on cardiovascular system. Thus gave mental relaxation and reduction of stress levels in daily life. The present study on Pranayam for lowering blood pressure is to bring internal awareness of breathing and therapeutic benefits of Pranayama over stress level by regular practice [17].

**Table 1:** JNC 7 Classification of Hypertension

| Blood Pressure Classification | Systolic, mmHg | Diastolic, mmHg |
|---|---|---|
| Normal | <120 | and <80 |
| Pre-hypertension | 120–139 | or 80–89 |
| Stage 1 hypertension | 140–159 | or 90–99 |

## Material and Method

### Inclusion criteria

1. Pre-Hypertensive patients
2. Subjects between 30-50yrs
3. Subjects giving informed and written consent.

### Exclusion criteria

1. Subject with any other pre-diagnosed cardiac disease
2. Subjects with any major pulmonary, renal, endocrinal and neurological diseases.

### Parameters measured

Measurement of Blood Pressure: Systolic and diastolic blood pressure, Heart rate and Valsalva Ratio were recorded before the study and after 3 months of study.

### Measurement of Blood Pressure

Blood pressure was be measured by auscultatory method in sitting position in the right arm with the help of Mercury sphygmomanometer (Diamond) and Littman stethoscope. Before recording the blood pressure, subjects were allowed to rest for 5 minutes in a quiet room to reduce the anxiety. The onset of sounds is taken as indicative of systolic blood pressure and disappearance of sound as indicative of diastolic blood pressure.

### Resting Heart Rate

Lead II of the ECG was selected for measuring heart rate.

### Measurement of Valsalva Ratio (HR response valsalva manoeuvre)

Subject will be made to sit comfortably in a stool with ECG leads attached and asked to exhale forcefully with closed nostrils through the mouthpiece of a mercury sphygmomanometer and to maintain pressure in the manometer up to 40 mmHg for 15 seconds. ECG recordings were taken during the manoeuvre (15 sec) and continued for 45 seconds after the manoeuvre. The ratio of the longest R-R interval after the strain to the shortest R-R interval during the strain will give the valsalva ratio. A ratio of greater than 1.45 is normal, 1.20 to 1.45 is border line and less than 1.20 is abnormal [18].

Present study was Randomized Experimental study. The study was conducted on 150 Pre Hypertensive patients aged 30-50 yrs of both sexes. Study group and control group randomly selected from Medicine OPD of SRG hospital Jhalawar. Out of 150 patients 50 Patients were control (1c) who were not doing any type of Pranayam. Rest 100 Patients were subdivided into 2 subgroups 1a and 1b, having 50 patients in each group. Patients in subgroup 1a were doing Anulom Vilom Pranayam for 10 minutes, Bhramari Pranayam for upto 3 cycles and Slow and deep breathing Pranayam for rest of the time till 20 minutes. Patients in subgroup 1b were doing Anulom Vilom Pranayam for 15 minutes, Bhramari Pranayam for uto 5 cycles and Slow and deep breathing for rest of the time till 30 minutes. Each Subgroup were compared with Control (1c) and with other groups.

### Procedure of Pranayam

Anuloma-viloma (Alternate nostril breathing) Pranayama practice the subject was asked to relax 5secs before starting and instructed to inhale through the left nostril while keeping the right nostril closed with the thumb of right hand. Retain the breath for a few seconds and exhale from the right nostril with the middle and ring fingers closing the left nostril. Then, once again inhale through the right nostril. Finally, exhale out through the left nostril while closing your right nostril with the thumb [19]. Bhramari Pranayam first directed the study group to inhale deeply through both the nostrils maximum for about 5sec and then immediately the subjects were instructed to exhale slowly through both

the nostrils for about maximum of 15sec keeping two index fingers on the external auditory canal. During exhalation the subject must chant the word "O-U Mamma" with a humming nasal sound mimicking the sound of a humming bee, so that the laryngeal wall and the inner walls of the nostril mildly vibrate. These steps complete one cycle of Bhramari Pranayam [19]. Slow and deep breathing- Breath slowly and deeply through the nose and inhale for ± 3 seconds (maximum 5 seconds), feel. Hold breath for ± 3 seconds (maximum 5 seconds). Gently exhale slowly through the mouth for 5 seconds [20].

On taking detail history, all subjects were non alcoholic, non-smokers, not taking any drug other than antihypertensive medicine and were having similar dietary habits, physical and mental activities in working and home atmosphere. Prior to the pranayam training basal readings were taken and the procedure was explained, history of fainting attack was asked, ill-fitting dentures were removed and then the subjects were made to Pranayam practice. 3 months of Pranayam Training was given to the subjects in Department of Physiology, Jhalawar Medical College, Jhalawar. in the morning hrs for 30 min between 8 AM to 10 AM.

**Subjects were advised to come empty stomach for Pranayam training**

The parameters were measured on 1st day and after 3 months of the study in both the study and control sub groups. The schedule of Pranayam training was explained to all participants and after three days practice session, the actual practice of Pranayam was introduced. Statistical analysis Statistical analysis of data is done by help of SPSS 20.0 Software (trail Version). Paired-T test and One Way ANOVA test is use in data analysis. P value <0.05 is consider as significant. One Way ANOVA: It is used to find variation between more than two groups mean. P-value of <0.05 was considered significant and a P-value of >0.05 was considered not significant. Heart rate, Systolic BP & Diastolic BP and Valsalva Ratio analyse before & after intervention in all the subgroups and all these compare with control subgroup also.

**Result**

**Table 2:** Comparison of Basal Mean of SBP, DBP, HR and VR in group – 1 (N = 150)

| Basal | Group 1a(50) Mean ± SD | Group 1b(50) Mean ± SD | Group 1c(50) Mean ± SD | F Value | P Value |
|---|---|---|---|---|---|
| SBP (mmHg) | 131.36 ± 3.34 | 131.44 ± 3.23 | 130.12 ± 2.40 | 2.997 | 0.053 |
| DBP (mmHg) | 82.96 ± 1.81 | 82.64 ± 1.48 | 83.32 ± 1.87 | 1.923 | 0.150 |
| HR (beats/min.) | 76.10 ± 3.36 | 76.64 ± 3.17 | 76.70 ± 4.30 | 0.411 | 0.664 |
| VR | 1.38 ± 0.44 | 1.38 ± 0.045 | 1.38 ± 0.04 | 0.307 | 0.736 |

Table 2 showing Basal mean SBP, DBP, HR and VR of all the subgroups. By applying ANOVA test we got P value 0.053, 0.150, 0.664, 0.736 respectively showing no statistical significance. Hence the basal parameters are almost same in all the subgroups of group 1.

**Table 3:** Comparison of Mean SBP, DBP, HR and VR before and after 3 months in subgroup – 1a (N = 50)

| subgroup 1a(50) (20 Min. Pranayam) | Basal (Mean ± SD) | After 3 months (Mean ± SD) | 't' Value | P Value |
|---|---|---|---|---|
| SBP (mm/Hg) | 131.36 ± 3.34 | 125.36 ± 3.24 | 22.386 | < 0.0001 |
| DBP (mm/Hg) | 82.96 ± 1.81 | 80.68 ± 1.11 | 11.513 | < 0.0001 |
| HR (beats/min.) | 76.10 ± 3.36 | 70.42 ± 2.09 | 19.642 | < 0.0001 |
| VR | 1.38 ± 0.44 | 1.42 ± 0.013 | 7.15 | < 0.0001 |

**Table 4:** Comparison of Mean SBP, DBP, HR and VR before and after 3 months in subgroup – 1b (N = 50)

| Group 1b (50) (30 Min. Pranayam) | Basal (Mean ± SD) | After 3 months (Mean ± SD) | 't' Value | P Value |
|---|---|---|---|---|
| SBP (mm/Hg) | 131.44 ± 3.23 | 124.12±3.3 | 31.043 | < 0.0001 |
| DBP (mm/Hg) | 82.64 ± 1.48 | 79.84±3.1 | 17.385 | < 0.0001 |
| HR( beats/min.) | 76.64 ± 3.17 | 69.74± 1.86 | 19.780 | < 0.0001 |
| VR | 1.38 ± 0.045 | 1.43± 0.032 | 8.001 | < 0.0001 |

**Table 5:** Comparison of Mean SBP, DBP, HR and VR before and after 3 months in subgroup – 1c (N = 50)

| Group 1c (50) (Not doing Pranayam) | Basal (Mean ± SD) | After 3 months (Mean ± SD) | 't' Value | P Value |
|---|---|---|---|---|
| SBP (mmHg) | 130.12 ± 2.40 | 131.00 ± 2.59 | 2.597 | 0.012 |
| DBP (mmHg) | 83.32 ± 1.87 | 85.12 ± 1.85 | 9.00 | < 0.0001 |
| HR (beats/min.) | 76.70 + 4.30 | 77.86 + 4.46 | 2.966 | 0.005 |
| VR | 1.38 + 0.04 | 1.37 + 0.45 | 1.483 | 0.14 |

Our study illustrates, there was significant decrease in mean value of SBP, DBP and HR in subgroups (1a, 1b) as compared to control subgroup which shows significant increase in these parameters. Mean VR is also significantly increased in both the subgroups in comparison to control subgroup in which VR is decreased. There is no significant difference between 1a subgroup and 1b subgroup in mean SBP, DBP, HR and VR.

**Discussion**

The reduction in HR and increased RR ratio and VR after 3 months of yoga training show parasympathetic dominance with practice of yogasanas [21, 22]. Vagal control allows more rapid adjustment in HR than does sympathetic nervous system (SNS) control, which takes longer to turn on and longer to turn off [23]. Vagal dominance is a sign that shows that stress response system has greater flexibility to respond

to challenges [24]. Underactivity of the parasympathetic nervous system leads to greater dependence on sympathetic excitation of the cardiovascular system (CVS) and other systems with negative health consequences such as hypertension, hyperarousal and over reactivity [25]. The practice of yoga increases baroreceptor sensitivity in hypertensives thereby restoring BP to normal levels [26]. The meditation element of yoga also has an effect in lowering BP as it reduces anxiety and stress.

Meditation has a balancing effect on autonomic nervous system [27]. Controlled breathing exercise in the practice of yoga (pranayama) improves vagal activity and therefore decreases baseline heart rate and blood pressure [28, 29]. Present study coincide with study done by Vinod Kathore 2019 and he find a significant difference in systolic as well as diastolic blood pressure before and after one month breathing exercises; this could highlight the effect of slow deep breathing exercises intervention among hypertensive patients [30].

Slow pace Bhramari Pranayama and Anuloma-viloma Pranayama influence the heart rate and blood pressure through the parasympathetic dominance had been reported in our previous study. Most studies also reported that Bhramari pranayama produced gamma wave indicating parasympathetic dominance89. Vibration of the nasal /laryngeal mucous membrane during exhalation along with the humming of "O-U-Mmmma" caused reflex apnoea by switching off inspiratory centre which causes bradycardia through chemoreceptor sinu-aortic mechanism [31].

## Conclusion

In the present study, we got the significant effect of Pranayam on systolic blood pressure, diastolic blood pressure, heart rate, valsalva ratio and lipid profile. In our study, we concluded that there is beneficial effect of pranayam on Prehypertensive patients in the form of decrease in SBP, DBP and HR and increase in VR as compared to control subgroup. This significant result proved that the practice of Slow and deep breathing, Anuloma-Viloma and Bhramari pranayama gives good result to maintain normal blood pressure, cardiac vagal modulation, parasympathetic dominance and also to reduce the stress level that we get in our day to day life. This method is easy to apply with no side effects, and leads to a deep physical and mental relaxation, it could be a suitable intervention during cardiac rehabilitation to shift the autonomic balance towards an increase of vagal activity and possibly decrease cardiac mortality.

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