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Effect of alternate nostril breathing (Anuloma Viloma Pranayama) on blood pressure, pulse rate and body mass index (BMI) in hypertensive subjects

Charu Mishra[1], Nikhil Gupta[2*], Shobhit Shakya[3]
[1] Department of Physiology, Era's Lucknow Medical College & Hospital, Era University, Lucknow, Uttar Pradesh, India
[2, 3] Assistant Professor, Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow, Uttar Pradesh, India

Abstract
Background: Yogic techniques have been seen to improve an individual's overall personal development involving body, mind and soul. Evidences suggest that alternate nostril breathing i.e. pranayama technique for a certain time everyday affects cardiovascular reflex control system and also helps in controlling excessive weight.
Material and Methods: 40 hypertensive subjects in the age group of 35-70 years were subjected to alternate nostril breathing exercise sitting in Padmasana position for 10 minutes everyday.
Results: Alternate nostril breathing exercise reduced the sympathetic activity and increased the parasympathetic activity leading to improvement in vagal tone as shown by statistically significant decrease (P<0.001) in systolic blood pressure, diastolic blood pressure and pulse rate.

Keywords: alternate nostril breathing, Padmasana, pulse rate, blood pressure

Introduction
Yogic techniques are known to improve one's overall personal development encompassing body, mind and spirit. Anuloma-Viloma Pranayama is known to be a part of yogic techniques. Patanjali, foremost exponent of yoga described Pranayama the gradual unforced cessation of breathing. Pranayama is derived from two Sanskrit words- PRANA (life) and YAMA (Control). Yoga combines scientific technique of right behavior (Yama-Niyama), proper posture (Asana), life force control (pranayama), interiorization of mind (pratyahara), concentration (Dhyana), developing intuition (Dharna) and ultimate realization (Samadhi) [1, 2].
According to Joint National Committee 2008, a rise in systolic blood pressure >= 140 mmHg and a rise in diastolic blood pressure>= 90 mmHg is estimated to effect approximately 1 billion people worldwide [3]. It is estimated that prevalence of hypertension in India is about 25% among urban adults and about 10% in rural areas [4].
There has been evidence that slow and regular breathing that is Pranayama technique for a certain time everyday has been known to have effect over cardiovascular reflex control system. A few studies showed pulse rate dropped significantly after anuloma viloma pranayama [1, 2, 5].Recent studies on hypertension indicate that practice of slow and rhythmic pattern of breathing reduces high blood pressure and improves bar reflex sensitivity in hypertensive subjects [3, 6].
Obesity and being overweight is a widespread social disease. In the present era of modernization, human life is being more and more sedentary. Also excessive body weight is associated with various diseases particularly cardiovascular diseases, type 2 diabetes mellitus, obstructive sleep apnea, certain cancers and osteoarthritis [7]. Certain studies showed that Body Mass Index improved after yogic training [8] whereas a few studies showed a decrease in Body Mass Index [9] while a few others showed no change at all [10].

As quoted by great physician Charak:

Sama mamsapramanastu samsamhanao narah
Dridhendriyo vikranam na balena abhibhuyate

Means person having proportionate musculature and compactness of the body possess very strong sensory and motor organs and as such they are not overcome by the onslaught of disease [11]. Yoga helps to control oneself more effectively whether to lose weight or to gain it. It leads life to a self-disciplined, self-regulatory and self-conscious approach helping the individual to control over the unnecessary patterns of improper diet and lifestyle.
Hence, this study was carried out to observe the effect of yogic exercises i.e anuloma-viloma paranayama and padmasana on blood pressure, pulse rate and body mass index in hypertensive subjects.

Material and Methods
Study Area and Population
This longitudinal study was carried out in Era's Lucknow Medical College, department of Physiology in collaboration with department of General Medicine. The study was conducted after taking ethical clearance from institutional ethical committee. Study subjects were patients attending medicine opd of Era's Lucknow Medical College. 40 subjects were selected who acted as their own control. Written and informed consent was taken for participating in the study from the subjects.

Inclusion Criteria
Patients with Hypertension [12] BMI >23.9kg/m^2 [13] between 35 to 70 years

Exclusion Criteria

Subjects with chronic ailments like osteoarthritis, smokers, alcoholics, diabetes mellitus, thyroid disorders and those on steroids were excluded from the study.

After considering the inclusion and exclusion criteria, baseline values of systolic and diastolic blood pressures were recorded using a sphygmomanometer after a 5 minute rest in a sitting position with feet on floor and arm supported at heart level. Pulse rate was recorded manually. Baseline values of standing weight in kilogram was recorded using digital weighing scale and standing height in meters was recorded using measuring tape. Body Mass Index was calculated using the Quetelet formula:

$$\text{BMI} = \text{weight (kg)} / \text{height}^2 \text{ (m)}$$

Every participant was assessed after Anulom viloma Pranayama (Alternate nostril breathing) in Padmasana. The study design was explained to participants and a written informed consent was obtained. The Pranayama technique was clearly demonstrated and explained to the study participants. First, everyone had to sit comfortably in *Padmasana* keeping the head, neck, and trunk straight, with eyes closed. All subjects had to keep the body still during the breathing practice. Anuloma-viloma (Alternate nostril breathing) Pranayama was practiced and the subject was asked to relax for 5secs before starting and was instructed to inhale through the left nostril while keeping the right nostril closed with the thumb of right hand. Breath was retained for a few seconds and was exhaled from the right nostril with the middle and ring fingers closing the left nostril. Then, once again inhalation through the right nostril followed by exhalation through the left nostril while closing the right nostril with the thumb. This was one round anuloma-viloma Pranayama and was practiced for 10 minutes. The *Pranayama* was conducted in well-ventilated room. The subjects were required to perform these exercises for 4 weeks. The systolic and diastolic blood pressures, pulse rate and weight were again recorded at the end of 4 weeks. The dose of anti hypertensive drugs that the subjects were taking was kept constant throughout the 4 week regimen.

Statistical Analysis

The data so collected was statistically analyzed using Statistical Package for Social Sciences (SPSS) version 20.0. To observe and compare blood pressure, pulse rate and body mass index, paired student's t test was applied. The confidence limit of the study was 90% hence a 'p' value of less than 0.05 was considered to be statistically significant.

Result

40 hypertensive subjects both males and females in the age group of 35-70 years were selected as cases. Table 1 shows the average BMI which was found to be 27.45±5.12 kg/m^{2,} average systolic blood pressure was 148.40±9.36 mmHg, average diastolic blood pressure was 92.83±7.73 mm Hg and average pulse rate was found to be 89.33±7.26 beats/ minutes. The baseline blood pressures, pulse rate and BMI were compared before and after practicing alternate nostril breathing exercise in the selected group members. Table 2 shows that in the cardiovascular parameters, highly statistically significant decrease in SBP (t= 10.22, P<0.001), DBP (t= 7.82, P<0.001) and pulse rate (t= 7.40, P<0.001) were observed while a decrease in BMI was also observed (t= 12.71, P<0.001) which was also highly statistically significant

Discussion

Pranayama is a type of yogic breathing exercise. Breathing is the important autonomic function that can be consciously controlled, through which we influence the involuntary nervous system, i.e. establishing the rhythms of breathing which influences the involuntary nervous system and is the key to bring the sympathetic and parasympathetic nervous system into harmony [14].The present study was carried out to study the effect of Alternate Nostril Breathing(Anuloma Viloma Pranayama) on blood pressure, pulse rate and BMI. In the present study, a decrease in SBP and DBP was observed after the yogic exercise regimen of four weeks which was found to be highly statistically significant (P<0.001). This was found in accordance with the studies conducted by Vungarala Satyananda *et al.* in 2014 [4] who also found a significant decrease in both systolic and diastolic blood pressures (P<0.01). A study conducted by K. Upadhyay Dhungel *et al.* in 2008 **[5]** stated that a statistically significant decrease in DBP and pulse rate (P<0.001) was observed after alternate nostril breathing exercise which corresponded to our study, however, they noted an insignificant decrease in SBP which was contrary to our study. Varun Malhotra *et al.* in 2012 [1] found a statistically significant decrease in the pulse rate (P<0.001) following practice of alternate nostril breathing exercise which again corresponded to our observation (P<0.001).Our study showed a significant decrease in BMI (P<0.001) which was in contradictionto the study done by Aloke Sen Bormon in 2016 **[7]** and Chen *et al.* in 2009 [8] who observed a significant increase in BMI (P<0.001). However, our results corresponded to the findings of McIver *et al.* (2009) [15] and Telles *et al.* in 2010 [16] who observed a decrease in BMI. This may be attributed to an improved metabolism of various cells of the body. The decrease in the cardiovascular parameters may be attributed to a decrease in sympathetic activity and enhancement of the parasympathetic system that causes an increase in the vagal tone that causes a decrease in SBP and a decrease in peripheral resistance due to widespread vasodilation ultimately leading to a decreased DBP.

Table 1: Mean blood pressures, pulse rate and BMI in the study group

Parameter	Mean±SD
SBP (mm Hg)	148.40±9.36
DBP (mm Hg)	92.83±7.73
Pulse Rate (beats/min)	89.33±7.26
BMI (kg/m^2)	27.45±5.12

Table 2: Effect of Alternate Nostril Breathing exercise on SBP, DBP, Pulse Rate and BMI

Parameter	N	Before Pranayama (Mean±SD)	After Pranayama (Mean±SD)	t value	p value
SBP (mm Hg)	40	148.40±9.36	142.85±8.43	10.22	0.000
DBP (mm Hg)	40	92.83±7.73	89.15±6.43	7.82	0.000
Pulse Rate (Beats/min)	40	89.33±7.26	84.18±4.46	7.40	0.000
BMI (Kg/m^2)	40	27.45±5.12	26.68±4.90	12.71	0.000

Conclusion

It can be concluded that pranayama has beneficial effects on cardiovascular functions and cardiac autonomic reactivity if practiced for a longer duration. In this study, we observed a significant improvement in SBP, DBP, pulse rate and BMI on hypertensive subjects practicing alternate nostril breathing exercise for 4 weeks. This significant result proved that practicing this yogic exercise on routine basis gives positive results in maintaining blood pressure and pulse rate and also helps to reduce body weight thereby improving the BMI. Hence, this simple exercise can be prescribed to hypertensive patients with proper monitoring along with appropriate medical therapy that can aid in improving their quality of life.

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