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Effect of Short Term Pranayama on Perceived Stress, Sleep Quality, Heart Rate, and Blood Pressure

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Abstract

Background: Pranayama (breathing exercises), involves manipulation of breath, consists of three phases: "Puraka" (inhalation), "kumbhaka" (retention) and "rechaka " (exhalation) that can be either fast or slow. Among all yogic practices pranayama is simplest to learn and to practice regularly in daily life. So a study was conducted to explore whether pranayama practiced alone over a short duration, has any tangible effect on stress, sleep, and cardiovascular parameters

Objectives: To evaluate the effect of short term practice of pranayama on Perceived Stress, Sleep Quality, Heart rate & Blood Pressure.

Materials and method: 40 healthy subjects in the age group of 19-61 years were recruited in pranayama centers, prior to enrollment in pranayama course. Their HR, BP were recorded and they answered Perceived Stress Scale & Pittsburg Sleep Quality Questionnaire on the 1st day of enrollment. Then they practiced pranayama under supervision for 20 days, at the end of which HR, BP were recorded and they answered the same questionnaires. Data was statistically analyzed using students 't' test, with P value <0.05 taken to be statistically significant.

Results: Practicing pranayama for 20 days significantly ($p<0.05$) decreased stress, systolic & diastolic blood pressure, improved sleep quality. Heart rate changes were insignificant ($p=0.9$).

Conclusion: Pranayama alone when practiced even over a short term, significantly reduces perceived stress, improves sleep quality, and decreases blood pressure.

Keywords: *Pranayama, Heart Rate, Blood Pressure, Perceived Stress Scale, Pittsburgh Sleep Quality Index*

Introduction

Stress can be considered as a state of mental or emotional strain or tension resulting from adverse or demanding circumstances.[1] Exposure to stressful stimuli is perceived as a threat to an organism's homeostasis and elicits a variety of physiological adaptation, encompassing endocrine, autonomic and behavioral aspects[2]. Studies have shown that perceived stress negatively affects cardiovascular function by raising blood pressure (BP) and diminishing cardiovascular reactivity in the subjects. Stress also adversely affects sleep quality

Increasing body of evidence points to the benefit of Yoga in reducing stress, and indirectly reversing several of its ill effects. Yoga is also being advocated as an adjunct to pharmacotherapy of disorders like hypertension and dyssomnias[1]

Yoga encompasses a wide range of practices, including physical exercises, breathing exercises, meditation, and relaxation exercises. Yoga provides various physical and mental health benefits including reduction of stress, anxiety, depression, somatic and mental hyper-arousal, improves sleep quality[3]

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Pranayama also called as breathing exercises, involves manipulation of breath that is a dynamic bridge between body and mind. "Pranayama" is a Sanskrit word constructed of two separate words, "Prana" and "Ayama". Prana can be translated as breath, respiration, life, vitality and energy. Ayama can be translated as restraint, control and regulation. Put together Pranayama means regulation of breath and/or energy. Pranayama consists of three phases: "Puraka" (inhalation), "kumbhaka" (retention) and "rechaka " (exhalation) that can be either fast or slow.[1]

Among all yogic practices pranayama is simplest to learn and to practice regularly in daily life. So present study was conducted to explore whether pranayama practiced alone (independently of other yogic practices) has tangible health benefits, particularly over stress, sleep, and cardiovascular parameters. If so, whether these effects are observable after short duration of practice.

Objectives

To evaluate the effect of short term practice of pranayama on Perceived Stress, Sleep Quality, Heart rate, and Blood Pressure**.**

Methodology

Clearance for the study was obtained from ethics committee of Bangalore Medical College & Research Institute.

This was an interventional study for which subjects were recruited from a particular organization in Bengaluru, which imparts training in yogic practices through multiple yoga centers across the city. One particular course offered by these centers was chosen which typically lasts for twenty days and comprises of training and practice of Pranayama only.

Subjects were chosen according to pre-set criteria, as listed below:

Inclusion Criteria:

1. Apparently healthy individuals
2. Subjects who had not practiced pranayama or other forms of Yoga yet in their lifetime.

Exclusion Criteria:

1. Subjects with sleep disorders.
2. Subjects with anxiety disorders.
3. Smokers, alcoholics or subjects with any substance abuse.
4. Subjects with endocrinal disorders.
5. Subjects with history of hypertension & cardiovascular disorders.
6. Subjects with respiratory disorders.
7. Subjects on continuous medication for any condition.

Written consent was obtained from willing participants. General and medical history was taken.

Physical examination was done. 40 subjects were finally enrolled in the study. The sample included both male and female subjects, ranging in age, from 19 to 61 years. First assessment of the subjects was done, at the time of joining the Pranayama course, before the actual training and practice started.

Subjects were asked to relax for 10 minutes following which HR & BP were recorded. Three readings each of HR & BP were recorded 10 minutes apart and average of two closest values was considered. BP was recorded using sphygmomanometer and stethoscope. Each subject was asked to answer "Perceived stress scale" and "Pittsburgh Sleep Quality Index" questionnaires.

Perceived stress scale

PSS is the most widely used psychological questionnaire for measuring the perception of stress. Questions asked are of general nature, relatively free of content specific to any sub-population group and enquire about feelings and thoughts to measure the "degree to which situations in one's life is appraised as stressful" especially, over last 1 month. Total score ranges from 0 to 40. Score of 0-13 is considered low stress, 14-26 is moderate stress & 27-40 is severe stress.[4]

The Pittsburgh Sleep Quality Index (PSQI)

The Pittsburgh Sleep Quality Index (PSQI) is a self-rated questionnaire designed specifically to measure sleep quality and sleep disturbances in clinical

populations. The PSQI asks subjects to rate sleep quality and disturbances over the month preceding test administration. The PSQI questionnaire consists of 19 items eliciting information on usual sleep habits, nature of sleep disturbances, suspected causes for sleep disturbances, use of sleep medication, overall sleep quality, daytime sleepiness, and vitality. Global score of >5 is considered poor sleep & <5 is good sleep[5].

Subjects then began a course in which they practiced pranayama under supervision, 2 hours per day from 6PM to 8 PM, for the next 20 days. Pranayama was taught to the subjects by trained instructors and further practice was also done under their supervision. The sessions involved practice of various types of Pranayama like anuloma viloma, mudra pranayama, meru dhanda, dhavthi, kapala bhathi & each session was structured to incorporate these techniques for fixed durations of time over 7 cycles. So all the subjects practiced similar techniques for similar duration of time, ensuring uniformity.

At the end of this period, the subjects underwent repeat assessment. Their heart rate, BP were recorded using the same procedure as earlier, and they answered earlier mentioned questionnaires.

The Pre and post Pranayama data was converted to mean and standard deviation, which were statistically analyzed using students 't' test. P value <0.05 was considered statistically significant.

Results

40 subjects with 15 females and 25 males were included in the study. Mean age of subjects was 37 ± 10 yrs

Table 1: Comparison of Perceived stress, Sleep quality, heart rate, and BP in 40 subjects before & after the course of pranayama

Parameter	Before course of pranayama	After course of pranayama	P value
PSS score	17.02 ± 5.73	7.2 ± 6.65	0.01
PSQI score	5.5 ± 3.27	3.9 ± 2.75	0.01
Heart rate (bpm)	78.87 ± 9.12	79 ± 8.05	0.93
SBP (mmHg)	128.15 ± 17.76	117.15 ± 10.36	<0.001
DBP (mmHg)	80.05 ± 9.96	76.1 ± 5.54	0.01

SBP: Systolic Blood Pressure

DBP: Diastolic Blood Pressure

PSS: Perceived Stress Scale

PSQI: Pittsburgh Sleep Quality Index

Practicing pranayama for 20 days significantly ($p<0.05$) decreased stress, systolic & diastolic blood pressure, improved sleep quality. Heart rate changes were insignificant ($p=0.9$).

We also observed that before beginning the course, 11(27.5%) participants perceived low stress, 27(67.5%) perceived moderate stress & 2(5%) perceived high stress. But after practicing pranayama for 20 days 32(80%) participants perceived low stress, 7(17.5%) perceived moderate stress & 1(2.5%) perceived high stress as seen by PSS scores.

16(40%) participants reported poor sleep & 24(60%) reported good sleep before practicing pranayama. After the course of pranayama 6(15%) participants reported poor sleep & 34(85%) reported good sleep as seen by PSQI scores.

Discussion

Our study reveals that practicing pranayama even for a relatively short duration of 20 days significantly decreased stress, SBP, DBP & improved sleep quality. It did not have significant effect on heart rate.

The mechanisms by which Pranayama brings about these effects is not yet clear, as the pathophysiological basis of stress and its ill effects, is itself not yet fully understood. From available literature, the following may be construed.

Psychosocial stresses of our modern life precipitates various cardiovascular and other disorders by distorting basic neuro-endocrine mechanism. The psychosocial stresses activate limbic system & hypothalamus which controls the autonomic nervous system. When this system is stimulated, increase in output of both adrenaline & nor-adrenaline occur, both from sympathetic fibres as well as from adrenal medulla causing increase in heart rate, systolic and diastolic blood pressures. Chronic exposure to psychosocial stimuli will result in the development of increase in blood pressure, coronary thrombosis and heart failure. In addition to the activation of sympatho-adreno-medullary system, exposure to psychosocial stresses also activates the hypothalamus centre governing pituitary adrenal axis. An increased secretion of corticotrophin releasing hormone from hypothalamus which stimulates the release of adrenocorticotrophic hormone from anterior pituitary which in turn stimulates adrenal cortex. Hence psychosocial stressful situation activates hypothalamo-pituitary-adrenal gland axis, glucocorticoid and aldosterone levels increase in the plasma causing salt and fluid retention which increases blood volume and blood pressure imposing severe strain on the heart. The harmful effects of these stresses on bodily systems can be reduced effectively by enhancing the adaptive mechanisms of our body[6]

Bodhe et al, in their study, have explained that a significant decrease in systolic blood pressure (SBP) observed in their study to be due to following reasons: decrease in Sympathetic tone, increase in parasympathetic tone, decrease in stress (reduced baseline glucocorticoid level), increase in plasma melatonin level, and relaxation of mind.[7]

Satyanand et al, in their study proved that practice of anuloma-viloma and Bhramari pranayama gives good result to maintain normal blood pressure and also to reduce the stress level that we get in our day to day life[8]

Some studies have proved that regular practice of Pranayama for 5 minutes which causes mental relaxation and reduction of stress levels in daily life also induces parasympathetic dominance on cardiovascular system.

Resting HR is mainly determined by parasympathetic nervous system (PNS) and DBP is a function of peripheral vascular resistance (PVR) which is mainly determined by sympathetic nervous system (SNS). Decrease in DBP represents increase in parasympathetic and decrease in sympathetic activity following pranayama.

Sharma et al in their study have explained that, Pranayamic breathing interacts with the nervous system affecting metabolism and autonomic functions. During above-tidal inspiration, stretch of lung tissue produces inhibitory signals by action of slowly adapting stretch receptors and stretch of connective tissue (fibroblasts) localized around the lungs generates hyperpolarization currents, which are propagated through neural and non-neural tissues and both of them cause synchronization of neural elements in heart, lungs, limbic system and cortex. Inhibitory current synchronizes rhythmic cellular activity between cardiopulmonary center and central nervous system and also regulates excitability of nervous tissues indicative of state of relaxation.

Hyperpolarization of tissues manifests itself in parasympathetic like change. Synchronization within the hypothalamus and the brain stem is mainly responsible for the parasympathetic response. Modulation of the nervous system and decreased metabolic activity is indicative of the parasympathetic state.[1]

Pranayama can be either slow or fast. More beneficial effects are seen with slow pranayamic breathing which can be due to the reason that slow breathing has been found to increase baroreflex sensitivity , reduce sympathetic activity and chemo-reflex activation in healthy subjects.

Furthermore, strongest cardio-ventilatory coupling is seen when there is decreased breathing frequency like slow pranayamic breathing. Increase in parasympathetic activity decreases resting HR and decrease in sympathetic tone in skeletal muscle blood vessels decreases peripheral vascular resistance resulting in decrease in DBP, MAP, reduced work load on heart and improved tissue perfusion.[1]

Our study demonstrates that practicing pranayama decreased stress levels as perceived by the subjects, improved sleep quality, reduced both systolic and diastolic blood pressures. These changes were observable after practice of Pranayama alone, independent of other yogic practices, and after a relatively short duration of

twenty days. Implications of this finding are large.

Pranayama is easy to learn and practice. It does not require any material infrastructure. It is not physically demanding, so it can be practiced by persons of all age groups and even by those who may have physical limitations to engage in other types of exercise. These factors make pranayama easy to incorporate into daily routine. It can be used a tool to improve general wellbeing and may be very well used as an adjunct to treatment of a host of medical conditions.

Conclusion

Pranayama alone when practiced even over a short term, significantly reduces perceived stress, improves sleep quality and decreases blood pressure.

Limitations: Though the good results were obtained with 40 subjects the study should be reproduced with larger sample size. Stress levels and Sleep quality were assessed only by self- reporting by subjects. Tools like polysomnography and serum markers of stress, may be used for a more objective measurement.

Conflict of Interest: Nil

Source of Funding: Self

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