

RESEARCH ARTICLE

Effect of the short-term practice of pranayama on the autonomic functions in 1st-year MBBS students

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ABSTRACT


Background: The present-day stress among the majority of the population across the globe is only increasing day by day. Be it school going children, young adults or elderly population, all face risk of diseases related to stress due to the lifestyle changes that have occurred in the past two decades. This has made the kind intervention of yogic practices like Pranayama an inevitable part of our lives. **Aims and Objectives:** The aim of the study was to determine the effects of various types of pranayamas (involving bhasrika, ujjayi, sheetali, anuloma viloma, and kapalbharathi) on autonomic functions of the body (blood pressure, cardiovascular parameters, and hand grip strength). **Materials and Methods:** The study was conducted on 30 (Males - 12, Females - 18) healthy volunteers (1st-year MBBS students) of same age group. Recordings of blood pressure, electrocardiography and hand grip strength (using hand grip dynamometer) were taken before starting the pranayamic practices and after 4 weeks of regular pranayamic practices. **Results:** Descriptive statistical analysis and paired *t*-test were done. The decrease in systolic, diastolic blood pressure, and heart rate was significant ($P = 0.005$, $P = 0.000$, and 0.001 , respectively). The changes in PR interval, QRS duration, and corrected QT interval were not significant. However, the hand grip strength increased significantly from 26.1 ± 7.9 to 29.0 ± 7.1 , i.e., ($P = 0.000$), in the right hand and 24.7 ± 9.05 – 26.1 ± 7.9 in the left hand ($P = 0.000$) post pranayama. **Conclusions:** Even a short-term practice of regular pranayamic exercises lasting 4 weeks caused significant decrease in blood pressure, heart rate parameters along with an increase in hand grip strength and endurance, thus indicating beneficial effects of these practices thus suggesting the requirement to make it a day to day practice in all age groups especially young adults who face constant stress in day to day activities.

KEY WORDS: Pranayama; Hand Grip; Blood Pressure; Autonomic Functions

INTRODUCTION

The present-day stress among the majority of the population is alarming not only in India but also globally. Over the past few decades, the lifestyle among the young adults has changed

drastically leading to increased stress due to increased demands and expectations to excel in academic and physical activities. The stress confronted by them gradually cause not only mental but also even physical disturbances in the body, making them prone to mental disorders such as depression and physical fatigue increasing the risk for cardiovascular problems in future. This is when the kind intervention of yogic practices come into the picture and becomes an inevitable part of our lives. Pranayama (conscious voluntary regulation of breath)^[1] is one of the most famous practices for the preparatory stages of meditation. It is derived from two Sanskrit words: Prana and Ayama combined into one word Pranayama.

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The nasal cycle is the physiological alternating congestion and decongestion of the nasal cavities in humans. It is physiological congestion of the nasal concha due to selective activation of one half of the autonomic nervous system by the hypothalamus. The congestion alternates between right and left nostril throughout the day and night.^[2] Unilateral nostril breathing activates the contralateral brain hemisphere.^[3]

Autonomic nervous system has two components - Pingala nadi (subtle energy channel of the sympathetic nervous system) corresponding to right nostril breathing, Ida nadi (parasympathetic nervous system) corresponding to the left nostril breathing, and sushumna nadi (central energy channel) corresponding to the bilateral nostril breathing.^[2]

A study by Shannahoff-Khalsa *et al.* have shown that forced right nostril breathing occluding the left nostril was found to increase heart rate.^[4] Another study claimed a number of other physiological and psychological effects of right nostril breathing such as generalized sympathetic tonus, increased temperature, and metabolic rate.^[5] Pranayama also increases hand grip strength without lateralized effects.^[6] A study showing the effects of right and left nostril breathing on cardiorespiratory and autonomic parameters done by Jain *et al.* suggested that there is a general parasympathetic dominance evoked after doing the manoeuvres.^[7]

Furthermore, another study by Shirley *et al.* conveyed that breathing selectively through either nostril could have a marked activating effect or a relaxing effect on the sympathetic nervous system. In this study, "right nostril pranayama" group showed a significant increase, of 37% in baseline oxygen consumption. The "alternate nostril pranayama" a group showed an 18% increase, and the left nostril pranayama group also showed an increase, of 24%. This increase in metabolism could be due to increased sympathetic discharge to the adrenal medulla.^[5]

However, not many studies have been done to determine the effects a sequence of various types of pranayamas together on the autonomic function tests. Therefore, in our study, we would like to review the effects of pranayama consisting of a series of different types of breathing exercises involving bhastrika, ujjai, sheetali, anuloma viloma, kapalbharathi, and meditation on cardiovascular parameters, hand grip strength, and hand grip endurance if really a short-term practice of various pranayamas can benefit the young adults so that pranayama can be included in our daily practices for a healthier life style.

MATERIALS AND METHODS

This study was conducted on 30 (Male and Female) healthy volunteers (Medical students of 1st-year MBBS of Mysore Medical College and Research Institute). An Ethical committee Clearance was obtained from the Ethical

Committee of Mysore Medical College and Research Institute. Their ages ranged from 18 to 19 years. The number of males was 12 and females 18. The protocols for pranayama were explained to them, and written consent was obtained.

All the subjects belonged to the same socioeconomic status (upper middle class). They were in a state of sound physical and mental health, nonsmokers, non-alcoholics, and not suffering from any major diseases. The subjects were asked not to practice any type of sports or other yogic techniques during this study period. After explaining the purpose of the study, a detailed history was recorded, and clinical examination was done keeping in mind following inclusion and exclusion criteria.

Study Sample

Inclusion criteria

Male and female healthy volunteers of age group 17–19 years of age were included in this study.

Exclusion criteria

History of - deviated nasal septum, tonsillitis and adenoids, nasal polyps, acute respiratory tract infection, cardiovascular disorders, hypertension, diabetes, nasal surgeries, fever, endocrine dysfunction, active sports training, and previous experience of yoga was excluded from the study.

Procedure

1. The 30 volunteers were made to practice pranayama for 30 min per day from 4 pm to 4:30 pm for 4 days a week for 4 weeks (total 16 settings) in the Department of Physiology MMCRI.
2. The subjects were advised not to consume any food or beverages within 2 h before the pranayama session.
3. All manoeuvres were done in either padmasana (sitting posture).
4. The protocol for pranayama is as follows:
 - i. Shashankasana - $5 \times 5 = 25$ times.
 - ii. After sitting in padmasana or sukhasana - 2 min of meditation.
 - iii. Ujjayi pranayama - slow breathing in and out through the mouth making a sound using vocal cords $5 \times 4 = 20$ times.
 - iv. Bhastrika pranayama - fast-paced, deep inspiration, and forced expiration without moving shoulders for 30 s (3 times).
 - v. Sitali pranayama - inspiration through the mouth by making the tongue curved so that the air taken in is cooled before it reaches the respiratory passage and normal expiration through nose $5 \times 4 = 20$ times.

vi. Nostril breathing:

- Left nostril breathing - slow inspiration through the left nostril for 4 s hold breath for 4 s and slow expiration through the left nostril for 4 s - $5 \times 4 = 20$ times
- Right nostril breathing - slow inspiration through right nostril for 4 s hold breath for 4 s and slow expiration through right nostril for 4 s - $5 \times 4 = 20$ times
- Alternate nostril breathing - slow inspiration through the left nostril for 4 s hold breath for 4 s and slow expiration through the right nostril and then slow inspiration through right nostril for 4 s hold breath for 4 s and slow expiration through the left nostril for 4 s for 4 s - $5 \times 4 = 20$ times.

vii. Kapalbharathi pranayama - fast-paced, normal inspiration followed by forceful expiration (30 s) $\times 3$ times.

viii. 2 min of concluding meditation in yoga mudra.

1. Recordings of height, weight, hand grip strength, hand grip endurance, blood pressure, and cardiovascular parameters using electrocardiography were taken both before starting the pranayama and after 4 weeks of pranayama practice.
2. The recordings were done strictly only between 1 pm and 3 pm.
Recording of various parameters:
 - a. Anthropometric parameters: Height was measured using stadiometer, weight was measured using standard weighing balance.
 - b. Blood pressure was recorded using mercury sphygmomanometer.
 - c. Hand grip strength was measured using hand grip dynamometer. Hand grip strength was recorded in seconds, and hand grip endurance was also recorded in seconds (amount of time a person can sustain a force of one-third the value of hand grip strength).
 - d. Heart rate, PR interval, QRS duration, and corrected QT interval were measured using electrocardiogram machine (Philips Page writer 100).

Statistical Analysis

- Power: $>80\%$
- Level of significance: 5% .

The results will be compared with the following statistical analysis:

1. Descriptive statistical analysis
2. N par tests
3. Paired *t*-test
4. Chi-square-test.

Using SPSS for Windows Software.

RESULTS

In Table 1, the mean anthropometric parameters were calculated. In Table 2, the cardiovascular parameters and hand grip strength, as well as hand grip endurance, were noted before and after pranayamic practices.

There was a significant decrease ($P < 0.05$) in resting heart rate and systolic blood pressure and a very significant decrease ($P = 0.000$) in diastolic blood pressure. However, there were no significant changes in PR interval, QRS duration and corrected QT interval ($P > 0.05$). Furthermore, a very significant increase ($P = 0.000$) in hand grip strength and hand grip endurance was also found.

DISCUSSION

In the present study, it was noticed that there was a significant decrease in the heart rate, systolic blood pressure, and a very significant decrease in diastolic blood pressure (decrease in peripheral resistance) post short-term pranayamic practices. There was also a very significant increase ($P = 0.000$) in hand grip strength and hand grip endurance.

These results were similar to previous other studies like the one done by Malthotra *et al.*, in 2009, which traced the effects of breathing exercises on the heart rate and it was found that left nostril breathing significantly reduces pulse rate.^[8] Similarly, a study done on immediate effects of left unilateral forced nostril breathing on cardiovascular parameters of hypertensive patients done by Balayogi *et al.* suggests that left unilateral forced nostril breathing was effective in reducing heart rate and systolic blood pressure in hypertensive patients.^[9] Another study by Rajak *et al.* also showed results similar to our study wherein there were significant changes in blood pressure.^[10] Similar to the present study results, a study by Qairunnisa *et al.* which was designed to quantify and compare the instantaneous heart rate dynamics and cardiopulmonary interactions during the sequential performance of one yogic meditation breathing patterns with different protocol also showed a significant decrease in basal heart rate in the study group practicing slow breathing exercises indicating an improvement in vagal activity (vagal tone).^[11]

Table 1: Anthropometric parameters

Parameter	Males (n=12)	Females (n=18)	Total (n=30)
Age (years)	18.08 \pm 0.28	18 \pm 0	18 \pm 0.18
Weight (kg)	59.5 \pm 5.07	57.5 \pm 8.61	58.3 \pm 7.36
Height (cm)	171.5 \pm 5.35	159.8 \pm 7.03	164.5 \pm 8.59
Body mass index (kg/m ²)	20.25 \pm 1.76	22.5 \pm 3.18	21.6 \pm 2.9

Anthropometric parameters of study group as per mean \pm SD.
SD: Standard deviation

Table 2: Cardiovascular and hand grip parameters

Parameter	Pre-pranayama	Post-pranayama	Paired t value	Standard error (pre)	Standard error (post)	P-value	Significance
Systolic blood pressure	116.66±8.27	114.26±6.57	3.004	1.51113	1.20051	0.005	S
Diastolic blood pressure	77.00±4.09	73.26±4.05	5.466	0.74	0.73	0.000	VS
Heart rate	80±2.66	73.4±5.84	3.810	2.31	1.06	0.001	S
PR interval	136.06±15.0	137.03±11.28	-0.291	2.73879	2.06029	0.773	NS
QRS duration	78.23±13.38	82.93±23.68	-1.223	2.44	4.32	0.231	NS
Corrected QT interval	375.70±24.23	362.06±26.72	2.029	4.42	4.871	0.052	NS
Hand grip strength (right)	26.10±7.90	29.06±7.20	-12.257	1.44	1.31	0.000	VS
Hand grip strength (left)	24.73±9.05	26.16±7.9	-4.285	1.65	1.44	0.000	VS
Hand grip endurance (right)	25.07±14.65	25.53±14.47	-0.703	2.67	2.64	0.000	VS
Hand grip endurance (left)	21.80±13.06	22.37±13.74	-0.983	2.48	2.51	0.000	VS

VS: Very significant ($P < 0.001$), S: Significant ($P < 0.05$), NS: Not significant ($P \geq 0.05$)

A study by Ranjita Mehrotra also stated a decrease in resting heart rate indicating that parasympathetic activity was increased while sympathetic activity was decreased with yoga practices in the subjects.^[12]

There are a certain mechanisms underlying the effects of Pranayama practice. The exact mechanism is still unknown, but certain research papers have suggested that slow deep breathing stretches the lung tissue which, in turn, produces inhibitory signals by the action of slow adapting receptors and hyperpolarizing currents. These signals which arise from the cardiorespiratory region involve vagi thus synchronizing neural elements in the brain leading to changes in the autonomic nervous system by causing parasympathetic dominance and reduced metabolism.^[13] The decrease in heart rate and blood pressure similar to the findings of Jain *et al.*^[8] can be related to an increase in the vagal tone and a decrease in cardiac sympathetic activity. The mechanism behind it could be through a neural reflex mechanism in the superior nasal meatus.^[14]

Comparing the results related to hand grip strength, a very significant increase ($P = 0.000$) in hand grip strength and hand grip endurance was also found. As the availability of energy and oxidation of glucose is believed to influence the hand grip strength proportionately, a significant increase in hand grip strength and hand grip endurance suggested that there is a decrease in oxygen requirement on practicing pranayamas.^[15] Thus, the significant increase in hand grip strength is similar to the results observed by Raghuraj *et al.*^[6]

However, the study had its own limitations of short-term practice, and thus there is definitely scope for further research on regular long-term practices of pranayamas. Furthermore, there is scope for research on effects of pranayamas on patients with cardiovascular disorders like hypertension as it has a beneficial effect of lowering blood pressure in normal healthy adults.

Thus, overall it can be suggested that even a short-term (4 weeks) practice of Pranayamas has significant

beneficial effects on cardiovascular parameters and hand grip strength.

CONCLUSIONS

In this study, it was noticed that there was a significant decrease in resting heart rate, systolic blood pressure, and a very significant decrease in diastolic blood pressure post short-term pranayamic practices. The results were similar to the previous studies done on the effect of pranayamas on the autonomic nervous system, thus making the findings more concrete. There was also a very significant increase in hand grip strength and hand grip endurance. Hence, it can be concluded that even a short-term practice of pranayamas has positive effects over the mental and physical well-being of students. Thus, incorporation of these practices in the daily curriculum can greatly influence beneficial effects on students and help them by elevating their physical strength and cardiovascular functioning by having an effect on the autonomic functions of the body.

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