



EFFECT OF PRANAYAMAS ON PHYSIOLOGICAL FUNCTIONAL ABILITIES (OBSERVATIONAL STUDY ON YOGIC BREATHING PRACTICES)

Prof. GRR. Chakravarthy

M.D. (Ay), M.A.(Astro), Ph.D.

M.Sc. (yoga therapy),

D.H.A, D. yoga, PG. DPT

Prof. SJS Ayurveda College, Chennai

Abstract:

Pranayama is the fourth part of Pathanjali's Ashtanga yoga. As such Pranayama is supposed to be practiced after attaining perfection in asanas and then followed by Prathyahara. Ironically 'Ashtanga yoga' is meant for attaining Moksha as per the classical text of yoga, the practitioner's have to go through Ashtanga yoga starting from 'Yama' and reaching to 'samadhi' however practice of certain asanas and Pranayama's makes the practitioner to have good health. Based upon this asanas and pranayamas are being practiced to maintain health and to acquire health from ill health. Thus it is believed to evolve therapeutic yoga from classical Ashtanga yoga. In this study practice of types of Pranayama which have the influence over functional abilities of the group of people is studied. It is only a subjective observational study but not involving statistical analysis. So, in the observed points shows the improvement in functional abilities of the person who practiced pranayamas.

KEYWORDS: Pranayama, shithali, sithkari, Bhramari, Bhastrika, physiology, walking, jogging, climbing the staircase, cycling.

INTRODUCTION:

Pranayama is the fourth part of Ashtanga yoga, after successful completion of asana practices though it is considered a physical practice, one can achieve perfectness in mental abilities also .In this study it is confined to observe physiological abilities like

1. Walking
2. Jogging
3. Climbing the staircase
4. Cycling

Pranayamas are of yogic breathing practices constitute volitional control of breathing. While considering the scientific aspects of yoga in the beginning, we have already noticed that it is quite

possible to influence the vital systems of body by means of Pranayama. The result is thus establishment of a steady state of these systems and organs like heart, restricting needless reactions of stress stimuli which mobilize unutilizable energetic sources, and prevent a consequent damage. Hence Pranayama is very helpful for regulating cardiac, respiratory and nervous functions, and such others.

AIM : It is to have a comparative study among four types of Pranayama on physiological functional abilities for four groups of people.

OBJECTIVE: It is to deduce recommendations for the practice of Pranayama in maintenance of health and thereby to achieve efficiency in Day to day abilities

REVIEW OF LITERATURE

In pranayamas, as mind is passively attached to the pranayamic process, mind becomes calm, quiet and tranquil because of slow, smooth, prolonged breathing. Thus vital systems like the cardiovascular, avert needless reactions on stress stimuli. In hypertension, Pranayama exerts their effect and relieves hypertension to some extent. Mental stress is easily relieved. Pranayama is quite different from simple deep breathing because it has got more effect on the nervous system than that of respiratory one.

By Pranayama, lung circulation is favourably influenced thereby influencing by the lung ventilation: perfusion ratio. As a result, the cardiac output is increased by about 20%.

Vital capacity of the lungs is the amount of air that one can exhale in a deep exhalation. It is about 3.5 litres. Vital capacity/weight of the body is called as vital index. Vital index is considerably increased through a regular practice of Pranayama.

It has been observed that significant increase of 157ml. in vital capacity and an average increase of 15 seconds in the breath holding time is achieved by three weeks practice of Pranayama. Thus Pranayama serves the purpose of increasing the oxygen consumption with minimum physical exertion. This is definitely beneficial for the cardiovascular function.

After 6-7 rounds of pranayamic breathing, the CO₂ level in the expired and alveolar air increases gradually. This helps one to get acclimatized to higher CO₂ concentrations in alveolar air and blood, thereby improving Cerebral circulation and brings about some sort of mental tranquility. Thus mental strain is definitely relieved and cardiac function is improved.

Increased oxygen consumption over normal breathing is seen in kapalbhati (12%), Bhastrika (18.5%) and ujjayi (24.5 %) pranayamas. This indicates that pranayama fills the lungs to comfortable capacity.

A marked slowing of the heart during Hypoxia with uddiyana and jalandhar bandhas is also observed. In nine observations, the maximum period during the heart stoppage maneuver was 3.0 to 5.6 seconds. This was not an accidental happening but a regular phenomenon which indicated a semi voluntary control over the Heart function.

The chief purpose of Pranayama is to increase the consumption of oxygen with the minimum of physical exertion, under conditions, probably favourable to storage of oxygen. This purpose is definitely served by Pranayama by increase in vital capacity, by increase in breath holding time and by reducing the basal metabolism providing conditions favourable for oxygen storage.

As Pranayama has a greater beneficial effect on the nervous system, mind becomes calm and quiet and mental tranquility is sought. Mental tranquility reduces the mental stress and strain. This is certainly beneficial in cases of psychosomatic disorders created by the monster of civilisation of this modern stress-age.

Basically Pranayama involves three phases:

1. Puraka (Inhalation)
2. Kumbhaka (breath holding or hypoxia)
3. Rechaka (Exhalation)

I. PURAKA (INHALATION) : During the puraka or inhalation stage of Pranayama, the contraction of the abdominal muscles improves the tone of the abdominal viscera by affecting its circulation resulting into a well controlled secretion of the pancreas and adrenal glands leading to endocrinal equilibrium .

II. KUMBHAKA (BREATH HOLDING OR HYPOXIA):- During the stage of kumbhaka, Myocardium is stimulated as at high altitudes. Also, during the stage of kumbhaka is associated with jalandhara bhandha, pressure on the carotid bodies in the neck increases the pressure on the carotid sinuses in the brain, leading to increased discharge of impulses along the mechano receptors which in turn produces a stimulation of parasympathetic nervous system resulting into para sympathetic dominance over sympathetic. It results in quietening of the mind as indicated by the L-Rythm in E.E.G.

III. RECHAKA (EXHALATION):-

During the Rechaka stage, smooth and prolonged breathing results in a calm, quiet and tranquil mental stage.

Here are the classical types of Pranayama, taken for the practice by 4 groups of subjects for this study.

1. SITKARI PRANAYAMA: (Folded- up –tongue)

सित्कां कुर्यात्तिथा वक्त्रे प्राणेनैव विजृम्भिकां ।

एवमथ्यासयोगेन कामदेवो द्वितीयकः ॥¹

a) Procedure: 1) Sit in padmasana.

2) Fold the tongue backwards and press the tip of the tongue over the centre of the root (hard palate).

3) Breath –in slowly through the mouth for a period of ten counts duration.

4) Close the mouth and breath-out slowly through the nostrils for the same duration.

5) Repeat this procedure for ten rounds.

b) Duration : Ten rounds .

c) Effects : 1) Oral cavity is stimulated by the cooling effect.

2) Other effects of Pranayama are sought.

d) Benefits : 1) Circulation in the oral cavity is improved.

2) Other benefits of pranyama are achieved.

2. SHITALI PRANAYAMA (Beak –tongue):

जिह्वया वायुमाकृष्य पूर्वत्कुं भसाघनं ।

शनकैज्जगिरंप्प्राभ्यां रेचयेत्पवनं सुधिः ॥²

जिह्वया वायुमाकृष्य उदरे पूरयेच्छनैः ।

क्षणं च कुम्भकं कृत्वा नासाभ्यां रेचयेत् पुनः ॥⁵

a) Procedure : 1) Sit in padmasana.

2) Slightly protrude the tongue and fold its sides to form a sort of a tube, resembling the beak of the bird.

3) Breath –in slowly through the mouth for a period of ten counts duration.

4) Close the mouth and breath-out slowly through the nostrils for the same duration.

5) Repeat this procedure for ten rounds.

b) Duration : Ten rounds.

c) Effects : 1) Oral cavity is stimulated by the cooling effect.

2) Teeth and gums are especially stimulated and Dental health is maintained.

3) Other effects of Pranayama are sought.

- d) Benefits : 1) Circulation of the oral cavity improved.
 2) Diseases of the teeth and gums are averted and also cured to some extent.
 3) Other benefits of Pranayama are achieved.

3. BHASTRIKA PRANAYAMA : (cleansing through hyperventilation)

भस्त्रैव लौहकाराणां यथाक्रमेण सम्भ्रमेत् ।

तथा वायुं च नासाभ्यामुभाभ्यां चालयेच्छनैः ॥⁶

ऊर्वोरुपरि संस्थाप्य शुभे पादतले उभे ।

पद्मासनं भवेदेतत्सर्वपापप्रणाशनम् ॥

Note : Some yogic texts regard bhasrika as one of the kriyas or cleansing processes while Gheranda samhita includes Bhasrika in the Pranayamas by the name of BHASTRIKA KUMBHAKA.

- a) Procedure : 1) Sit in padmasana
 2) Inhale slowly, deeply as long as possible.
 3) With the mouth closed, exhale forcibly through the both nostrils in a series of sixty expulsions at a stretch within one minute.
 4) Repeat this procedure for total three rounds or one hundred and eighty expulsions .
- b) Duration : Sixty rounds in one minute.
- c) Effects : 1) Over 18.5% increase in oxygen consumption over normal breathing is noted.
 2) Due to rapid expulsions, impure air is thrown out to its maximum.
 3) Forceful Exhalations clear tone up the respiratory tract.
 4) The abdominal muscles are toned up and the abdominal viscera is stimulated.
- d) Benefits : 1) Respiratory tract is kept healthy.
 2) Beneficial in chronic nasal disorders and respiratory disorders.
 3) Digestion is Improved.
 4) Mental fatigue is removed and one feels fresh.
 5) Beneficial in tension headache, sleeplessness etc.

4. BHRAMARI PRANAYAMA : (Bee –humming)

वेगाद्धौषं पूरकं भृङ्गनादं रेचकं मंदमंदम् ।

यौगीन्द्राणामेवमभ्यासयोगाच्चित्ते जाता काचिदानंदलीला ॥⁴

अर्धरात्रे गते योगी जन्तूनां शब्दवर्जिते ।

कर्णौ पिधाय हस्ताभ्यां कुर्यात् पूरककुम्भकम् ॥⁷

- a) Procedure : 1) Sit erect in padmasana .
 2) Breath –in slowly and deeply as long as possible.
 3) Breath-out slowly, by producing a humming sound of a bee, for a long duration.
 4) Repeat this procedure for ten rounds.
- b) Duration : Ten rounds.
- c) Effects : 1) By the Humming sound produced during exhalation , through typical sound vibrations, there is specific vibratory effect over the different tissues of the body, especially on the brain.
 2) Other effects of Pranayama are sought.
- d) Benefits : 1) Mind becomes calm and quiet.
 2) One feels fresh and healthy.
 3) Beneficial in sleeplessness, high blood pressure etc.,

Equipment and requirements

1. Shygmomonometer
2. Stethoscope
3. Stop watch
4. Atlas cycle (plain)
5. Aquafresh mineral water bottles
6. Lemons
7. Red flags (paper)
8. Pens
9. Papers

DAILY PRACTICES OF PRANAYAMA:-

A systematic pattern of pranayamic practices to be carried on daily is given here. This pattern is well developed, since long, in the yoga courses conducted by Vivekananda Kendra, kanyakumari, India. The author finds by experience that this pattern with some changes is the most scientific pattern suitable for everyone in his daily yogic practices.

The whole pranayamic practices take about thirty minutes a day. As indicated in the beginning, these practices are to be followed after yogasanas. however, for the sake of convenience, pranayamic practices can be separately carried out in the morning or evening on an empty stomach.

The duration of each pranayamic procedure can be best measured by serially on seconds i.e., one count per second.

FIVE RULES: For carrying out any Pranayama, the following five rules should be followed -

- 1) Sit erect in padmasana , easy posture or on a chair or bench.

- 2) Relax yourself with smile on the face and lightly close the eyes.
- 3) The breathing – in breathing –out must be slow steady and deep.
- 4) MEDITATION –All the concentration should be on the pranayamic process.
- 5) RELAX – After each Pranayama, relax quietly for a while

Procedure of study conducted

- There are 4 groups of people involved in this study.
- Each group followed one kind of Pranayama for 6weeks
- All the people are instructed to follow similar life style
- Data regarding physiological functions are noted
- Physiological abilities of the people are noted and improved functional abilities are compared .
- Only sphigmo monometer is used for reading of blood pressure.
- Readings are taken when the subjects are under full resting condition.
- Readings are taken for all at lying down position.
- A strict supervision is there during practice about the method and duration of Pranayama
- No special supplements and drinks are allowed during the study period
- No additional practices which influence physiological abilities are allowed
- No medical interventions are allowed other than their routine medicines prescribed .
- Total 80 subjects are entertained and there are only 40 subjects stood for the study
- No other yogic procedures like Nauli, Neti, Kapalabhati are allowed
- Subjects are not allowed to have emotional out breaks
- Subjects are allowed to go with practice of asanas which they used to do.
- Subjects are allowed to stick to their concerned profession only.

DATA ANALYSIS

Group A before practice (sitkari)

s.no	Age	Sex	Heart rate	Rate of respirstion	Blood pressure
1	55	M	78	21	152/90
2	57	M	76	24	145/80
3	55	M	68	20	130/80
4	50	F	76	21	128/86
5	49	M	80	24	120/80
6	58	M	76	22	120/80
7	51	F	72	22	120/86
8	52	M	74	21	126/86
9	45	M	74	20	130/86
10	50	F	74	21	120/80

Group A after 6weeks of practice

s.no	Age	Sex	Heart rate	Rate of respirstion	Blood pressure
1	55	M	74	20	124/84
2	57	M	76	21	120/84
3	55	M	68	20	124/86
4	50	F	72	22	128/90
5	49	M	72	20	126/80
6	58	M	76	21	126/84
7	51	F	74	22	128/88
8	52	M	76	21	124/80
9	45	M	72	20	126/82
10	50	F	74	21	120/80

Group B before practice (shitali)

s.no	Age	Sex	Heart rate	Rate of respirstion	Blood pressure
1	54	M	74	22	128/80
2	60	M	78	21	130/80
3	49	F	68	20	140/90
4	55	M	74	22	130/84
5	54	F	68	21	150/90
6	56	M	80	26	156/90
7	48	M	76	22	140/86
8	43	M	68	20	130/90
9	40	M	74	22	120/80
10	48	M	68	26	138/86

Group B after 6 weeks of practice

s.no	Age	Sex	Heart rate	Rate of respirstion	Blood pressure
1	54	M	78	22	128/86
2	60	M	76	22	126/88
3	49	F	72	21	128/86
4	55	M	72	22	120/80
5	54	F	74	21	130/80
6	56	M	72	22	126/82
7	48	M	74	22	128/80
8	43	M	76	21	124/80
9	40	M	74	22	126/86
10	48	M	72	21	128/88

Group C before practice (Bhastrika)

s.no	Age	Sex	Heart rate	Rate of respirstion	Blood pressure
1	60	F	80	26	138/90
2	55	M	72	22	120/84
3	50	M	66	20	110/76
4	56	M	70	20	118/78
5	49	M	78	24	120/80

6	56	M	74	24	128/86
7	40	F	66	20	120/70
8	49	F	76	22	130/90
9	50	F	74	24	138/90
10	55	M	70	20	140/90

Group C after 6 weeks practice

s.no	Age	Sex	Heart rate	Rate of respiration	Blood pressure
1	60	F	68	22	128/86
2	55	M	68	21	126/86
3	50	M	76	22	130/78
4	56	M	78	24	128/88
5	49	M	74	22	128/84
6	56	M	72	22	130/78
7	40	F	76	21	128/80
8	49	F	74	22	124/82
9	50	F	72	21	130/80
10	55	M	74	21	130/84

Group D before practice (Bhramari)

s.no	Age	Sex	Heart rate	Rate of respiration	Blood pressure
1	56	F	76	21	130/90
2	49	M	74	22	142/90
3	46	M	72	22	140/90
4	59	M	72	24	150/86
5	55	F	80	24	148/90
6	53	M	78	20	138/86
7	55	M	74	22	140/90
8	56	M	74	22	132/86
9	55	F	72	24	130/78
10	49	F	72	22	134/82

Group D after 6 weeks of practice

s.no	Age	Sex	Heart rate	Rate of respiration	Blood pressure
1	56	F	74	22	128/86
2	49	M	76	22	130/78
3	46	M	74	21	128/76
4	59	M	68	20	118/70
5	55	F	72	21	126/86
6	53	M	74	22	128/80
7	55	M	72	21	130/78
8	56	M	70	20	130/78
9	55	F	76	22	130/88
10	49	F	74	24	128/80

Observations on physiological abilities before and after Pranayama practices:

Walking: A physiological activity for locomotion. It is to have brisk walk for the study

Jagging: A simple physiological activity which involves quick movement of lower extremities

Climbing staircase: It is also a physiological activity which involves a little strain for calf muscles

Cycling: It is an adopted functional activity involves total body.

Conduct of study

- These are four physiological functional activities considered and tested for their betterment after the practice of pranayamas. A. sitkari, B. shitali, C.bhastrika, D. bhramari
- It is only one constraint considered as a point of improvement is onset of **fatigue**, which is an indicator of consumption of oxygen for completion of activity.
- If the time taken for fatigue onset is improved, it shows that oxygen requirement time is prolonged.
- Time is measured with stop watch by an observer
- Subject is instructed to indicate with red flag as soon as fatigue onsets
- Similar phenomina are adopted before and after practice.
- Climbing the staircase is done at one building only for everybody throughout the study.
- Care is taken so that the subjects are not deviating from the given instructions
- All the abilities for everybody is conducted at morning without any solid diet.
- 50ml of lemon water is only given for all, irrespective of their weight and height, before conduct
- All the activities are done without interruption for any reason and for any body
- Per day only one activity is given for each subject
- For cycling similar standard model is given for all.

RESULTS

Walking

S.No	groups	aT for F before	aT for F after	% of improvement	aD before	aD after	% of improvement
1	A	35 min	50 min	50	1.75km	2km	40
2	B	35 min	45 min	55	2.25km	2.75km	45
3	C	40 min	50 min	45	2km	2.75km	50
4	D	20 min	30 min	40	1.25km	1.75km	40

Jagging

S.no	groups	aT for F before	aT for F after	% of Improvement	aD before	aD after	% of improvement
1	A	10min	14min	65	2km	2.75km	60
2	B	12min	16min	60	2.5km	3km	45

3	C	12min	15min	55	2.5km	3km	50
4	D	14min	17min	55	2km	2,5km	55

Climbing Stair case

S.no	groups	aT for F before	aT for F after	% of Improvement	aD before	aD after	% of improvement
1	A	4 min	5min	55	65 steps	80steps	60
2	B	5min	7min	60	60steps	85steps	60
3	C	5min	7min	55	65steps	90steps	55
4	D	6min	7min	40	50steps	60steps	45

Cycling

S.no	groups	aT for F before	aT for F after	% of Improvement	aD before	aD after	% of improvement
1	A	20 min	35min	30	1.75km	2.5km	35
2	B	25min	35min	35	2km	2,5km	40
3	C	25min	35min	35	2km	2.5km	40
4	D	20min	35min	40	2.5km	2.5km	30

✓ a= average ; T=time ; F=fatigue ; D=distance

DISCUSSIONS

- In this study it is aimed to have a comparison in bringing the efficiency un physiological abilities after practicing 4 types of pranayamas namely sitkari, shitali, bharastrika and brahmari.
- There are 4 groups of people given 4 types of pranayamas as said above , for the period of six weeks.
- Each group of people practiced the given type of Pranayama in a way described above, which is accepted as standard method given in classical text of practice, and is approximately followed by contemporary organizations.
- There were 80 people totally engaged in the study , but finally the subjects who stood as per the instructions, and they were 40 in number divided into 4 groups.
- Each group of subjects have practiced the given Pranayama, before which all the physiological parameters are recorded, such as HR, RR, and BP. and then after practice also
- Blood pressure for all is recorded with sphygmomanometer only.
- Each subject is asked to do with physiological functional activity individually and the readings are noted before and after practice of pranayamas.
- Final number of subjects considered are 40, for whome activities are noted.

- For walking, each person is asked to start from a given point and is instructed to notify the onset of fatigue, by rising red flag, and the starting time and ending time are noted by stop watch.
- All the functional activities are recorded in similar way before and after practice of types of pranayamas.
- In all the groups almost a notable no of subjects have shown the improvement in their functional abilities, which is indicated as increase in onset of fatigue.
- It is only a simple arithmetic way followed to analyze the collected data to compare the improvement in functional abilities of the different groups of people.
- It is only a comparative study of each group before and after practice of Pranayama, but not comparison between two types of Pranayama practiced.
- Thus the study is purely subjective, and no invasive methods are involved and no statistical interventions are entertained.
- The study is not done to emphasize improvement in lung capacity, nor to show improvement in any pathological situations.
- The study is confined to observe a simple improvement in functional abilities after Practice of pranayamas

CONCLUSIONS

- ❖ It is to conclude that practice of asanas and Pranayama which are parts of Ashtanga yoga, have got a great impact on physical and physiological entities of human beings
- ❖ In this study, the improvement in functional activities of the people involved after practice of pranayamas, is noted.
- ❖ After 6 weeks of practice of respective type of Pranayama, the time taken for onset of fatigue is delayed which indicate the improvement of oxygen absorption in each cycle of breathing.
- ❖ It is observed that almost all the types of pranayamas have almost similar benefit in terms of improvement in functional abilities.
- ❖ However, the study is confined to have subjective observations only, but not to show any thing about pneumo mechanics nor of aero dynamics of respiratory physiology.
- ❖ It is to conclude that the present study is proved to have subjective improvement in functional abilities, those who have practice of Pranayama.

References:

1. Hatha yoga pradipika translated by Pancham sing Ref: 2 chapter, 54 shloka, 3rd edition, 1980,by oriental books reprint corporation, Newdelhi , pp-23
2. Ibid: 2 chapter, 57 shloka, 3rd edition,1980,by oriental books reprint corporation, Newdelhi, pp-24
3. Ibid: 2 chapter, 59 shloka, 3rd edition, 1980, by oriental books reprint corporation, Newdelhi, pp-24.

4. Ibid: 2 chapter, 68 shloka, 3rd edition, 1980, by oriental books reprint corporation, Newdelhi, pp-25.
5. Gheranda samhita edited by Goswami prahlad giri Ref: 5 chapter, 73shloka, 1st edition, 2001, by krishnadas academy, Varanasi, pp-84.
6. Ibid: 5 chapter, 85 shloka, 1st edition, 2001, by krishnadas academy, Varanasi, pp-85.
7. Gheranda samhita edited by Goswami prahlad giri Ref: 5 chapter, 78shloka, 1st edition, 2001, by krishnadas academy, Varanasi, pp-86.
8. Book reffered – THE YOGA SCIENCE FOR EVERYONE, by Dr. Ravindranath R. Javalgekar, 2nd edition, 2005, by Chaukhambha Sanskrit sansthan, Varanasi.
