INTERNATIONAL
AYURVEDIC
MEDICAL JOURNAL

IAMJ

Research Article ISSN: 2320 5091 Impact Factor: 4.018

PHYSIO-CLINICAL STUDY OF PRANAYAM W.S.R. TO VITAL CAPACITY

Pallvi Pandey[1], Smriti Pandey[2], Kiran Mishra[3], Anuj Verma[4]

[1]MD Scholar Final Year; [2]Lecturer; [3]Lecturer;
P.G. Department of Kriya Shareer, SAC, Lucknow, Uttar Pradesh, India;
[4]MD Scholar Final Year, P.G. Department of Kaya Chikitsa, SAC, Lucknow, Uttar Pradesh, India

Email: dr.pallavi.pandey.bams@gmail.com

Published online: September, 2018

ABSTRACT

Introduction: *Pranayam* is defined as the combination of three breath exercises *purak* (inhalation), *kumbhaka* (retention) and *rechak* (exhalation). *Pranayam* is a practice that helps to control the breathing voluntarily. **Aim:** The present study was done to evaluate the effects of *pranayam* on V.C. and O.S in healthy individuals divided into three groups on the basis of age. **Material and Methods:** Subjects fulfilling the inclusion and exclusion criteria underwent 30 minutes of daily *pranayam* session for 15 days. Parameters were assessed before and after *pranayam* session of 15 days. The parameters were analyzed by paired t-test. **Results:** There was significant increase in *vital capacity* and *oxygen saturation* in all three groups compared to *pre pranayam* practice. **Conclusion:** The study showed the beneficial effect of *pranayam* on lung parameters and makes the respiratory system to function at its best.

Keywords: *Yoga, Pranayam, Lung parameters, Vital capacity, Oxygen saturation.*

INTRODUCTION

Thousands of years ago *yoga* originated in *India*, *yoga* is an ancient discipline designed to bring balance and health to the physical, mental, emotional, and spiritual dimensions of the individual[1].The great Indian philosopher *Maharshi Patanjali* described *yoga* in his *Yoga sutra* as cessation of fluctuation of mind[2]. According to him, *Yama, Niyama, Asana, Pranayam, Pratyahara, Dharana, Dhyan, Samadhi* are eight limbs of *yoga***.** *Pranayam* is the fourth disciple of *Astang Yoga*[3].

The word *Pranayam* is derived as (*Pran+Ayama*). *Prana* meaning life force (noted particularly as *prana*) and *ayama* means to expand, to restrain, or to control. So the *pranayam* is translated "*extension of prana" or "breath control"*[4]. *Pranayam* is defined as the combination of three breath exercises *purak* (inhalation), *kumbhaka* (retention) and *rechak* (exhalation) performed during *samdhya*[5].

Maharshi Patanjali's Yoga sutra states that *pranayam* is the pause in the movement of inhalation

and exhalation when that is secured. *Pranayam* is a practice that helps to control the breathing voluntarily. It teaches you to change the depth, rate and pattern of breathing.

REVIEW OF LITERATURE:

In present study under literary section part all the scattered description about *prana, prana vata, pranavaha srotas, yoga and pranayam* was collected and arranged in systematic manner.

MATERIAL AND METHOD-

The ethical clearance for the study was obtained from the institutional ethical committee (No. IEC/AYM/052/2016). The healthy subjects were selected for the study. The health of the subjects was assessed by knowing their past, present, family and personal history and by the thorough examination general systemic examination. An informed consent form was signed by all the subjects. The subjects were advised not to perform any other physical exercise during 15 days of *pranayam* sessions. The study was carried out on total 100 healthy subjects. The subjects has been divided into three groups on the basis of age, first group (16-30years), second group (31-45years) and the third group (46-60years).The subjects below 16 years and above 60 years, subjects with any systemic disorders and pregnant or lactating mother were excluded. 43 subjects were registered in group A, 32 subjects were registered in group B and 25 subjects were registered in group C.

Subjects were advised to perform *pranayam* for 15 days for a time period of 30 minutes each day at *P.G. Department of Kriya Sharir, State Ayurvedic College Lucknow*. The parameters like *vital capacity*, *oxygen saturation, pulse rate, respiratory rate, breath holding time and blood pressure* were measured before performing *pranayam* and after doing *pranayam* for 15 days.

Pulse rate is the speed of the heartbeat measured by the number of contractions of the heart per minute (bpm).The *breath holding* is measured by asking the subject to pinch his/her nostrils with the thumb and forefinger, and hold his/her breath after quiet inspiration. Note the time for which the breath can be held. The *respiratory rate* is measured when a person is at rest and involves counting the number of breaths for one minute by counting how many times the chest rises. The blood pressure is measured by using *sphygmomanometer.* The *vital capacity* is measured by *spirometer*. The subject is asked to take the deepest breath they can, and then exhale into the sensor as hard as possible, for as long as possible, preferably at least 6 seconds. During the test, soft nose clips have been used to prevent air escaping through the nose. The *oxygen saturation* was measured by *pulse oximeter*. A sensor device is placed on a thin part of the subject's body, usually a fingertip or earlobe.

The subjects were asked to perform four types of *pranayam* namely *anulom vilom pranayam, kapalbhati pranayam, bhramari pranayam and shitali pranayam* combined for a period of 30 minutes in the morning. The schedule of the session was –

Table A:

S.N.	Name	Time Period
1.	*Prayer and Omkar citation*	2 min
2.	*Asanas*	10 min
3.	*Pranayam(Anulom-vilom,Kapalbhati,Bhramari,Shitali)*	30 min

The obtained data was then subjected to various statistical analyses, it is decoded and discussed on the basis of available references and appropriate justification is given.

OBSERVATIONS:

Table 1: Effect of Pranayam on Pulse rate, Breath holding time, Respiratory Rate, SBP and DBP-Group A-

Test	Sample Size	Mean Before	Mean After	Mean Difference	SD+-	t	P
Respiratory rate	43	18.2	17.5	-0.7	0.61	5.2	Significant
Breath holding time	43	34.5	45.6	11.1	9.66	4.3	Significant
Pulse Rate	43	78.4	74.2	-4.2	3.63	6.1	Significant
SBP	43	118.4	114.8	-3.6	3.14	2.1	Not Significant
DBP	43	76.4	78.6	2.2	1.91	2.2	Not Significant

Group B-

Test	Sample Size	Mean Before	Mean After	Mean Difference	SD	t	P
Respiratory rate	32	19.2	18.7	-0.5	0.42	4.8	Significant
Breath holding time	32	30.9	39.8	8.9	7.74	5.5	Significant
Pulse Rate	32	74.6	71.8	-2.8	2.43	4.8	Significant
SBP	32	128.2	126.4	-1.8	1.56	2.5	Not Significant
DBP	32	80.2	78.6	-1.6	1.32	2.7	Not Significant

Group C-

Test	Sample Size	Mean Before	Mean After	Mean Difference	SD	t	P
Respiratory rate	25	20.2	19.5	-0.7	0.62	7.1	Significant
Breath holding time	25	24.6	28.5	3.9	3.39	4.6	Significant
Pulse Rate	25	73.5	71.6	-1.9	1.67	6.2	Significant
SBP	25	134.2	132.8	-1.4	1.32	3.1	Not Significant
DBP	25	84.2	82.6	-1.6	1.53	2.3	Not Significant

Table 2: Change in vital capacity before and after the pranayam session among groups- Group-A

Data	
Hypothesized Mean Difference	0
Level of significance	0.05
Intermediate Calculations	
Sample Size	43
DBar	0.3030
Degrees of Freedom	42
S_D	0.1646
Standard Error	0.0251
t Test Statistic	12.0742
Upper-Tail Test	
Upper Critical Value	1.6820
p-Value	0.000000000000002

Group -B

Data	
Hypothesized Mean Difference	0
Level of significance	0.05
Intermediate Calculations	
Sample Size	32
DBar	0.2675
Degrees of Freedom	31
S_D	0.1373
Standard Error	0.0243
t Test Statistic	11.0249
Upper-Tail Test	
Upper Critical Value	1.6955
p-Value	0.0000000000015

Group –C

Data	
Hypothesized Mean Difference	0
Level of significance	0.05
Intermediate Calculations	
Sample Size	25
DBar	0.1980
Degrees of Freedom	24
S_D	0.0835
Standard Error	0.0167
t Test Statistic	11.8539
Upper-Tail Test	
Upper Critical Value	1.7109
p-Value	0.000000000008

Table 3: Change in oxygen saturation before and after pranayam session among groups -Group A-

Paired *t* Test	
Data	
Hypothesized Mean Difference	0
Level of significance	0.05
Intermediate Calculations	
Sample Size	43
DBar	0.7907
Degrees of Freedom	42
S_D	0.5999
Standard Error	0.0915
t Test Statistic	8.6426

Upper-Tail Test	
Upper Critical Value	1.6820
p-Value	0.0000

Group B-

Paired *t* Test	
Data	
Hypothesized Mean Difference	0
Level of significance	0.05
Intermediate Calculations	
Sample Size	32
DBar	0.8750
Degrees of Freedom	31
S_D	0.7071
Standard Error	0.1250
t Test Statistic	7.0000
Upper-Tail Test	
Upper Critical Value	1.6955
p-Value	0.0000

Group C-

Paired *t* Test	
Data	
Hypothesized Mean Difference	0
Level of significance	0.05
Intermediate Calculations	
Sample Size	25
DBar	0.7200
Degrees of Freedom	24
S_D	0.6137
Standard Error	0.1227
t Test Statistic	5.8658
Upper-Tail Test	
Upper Critical Value	1.7109
p-Value	0.0000

RESULT:

On evaluating the effect of regular practice of *pranayam* for 15 days, it was found that the parameters like *vital capacity, oxygen saturation, and breath holding time, respiratory rate and pulse rate* showed significant changes. This can be explained on following basis:

- The *mean respiratory rate* before doing the *pranayam* and after doing the *pranayam* was 18.2 and 17.5 respectively in group A; 19.2 and

18.7 in group B; 20.2 and 19.5 in group C (Table 1). This indicates significant decrease in the *respiratory rate* and it was found to be statistically significant.

- The *mean breath holding time* before doing the *pranayam* and after doing the *pranayam* was 34.5 and 45.6 respectively in group A; 30.9 and 39.8 respectively in group B ; 24.6 and 28.5 respectively in group C (Table 1).This indicates significant increase in the *breath holding time* and it was found to be statistically significant.
- The mean pulse rate before doing the *pranayam* and after doing the *pranayam* was 78.4 and 74.2 respectively in group A; 74.6 and 71.8 respectively in group B; 73.5 and 71.6 respectively in group C (Table 1). This indicates significant decrease in the *breath holding time* and it was found to be statistically significant.
- The *mean SBP* before doing the *pranayam* and after doing the *pranayam* was 118.4 and 114.8 respectively in group A; 128.2 and 126.4 respectively in group B; 134.2 and 132.8 respectively in group C (Table 1). This was found to be statistically insignificant.
- The *mean DBP* before doing the *pranayam* and after doing the *pranayam* was 76.4 and 78.6 respectively in group A; 80.2 and 78.6 respectively in group B; 84.2 and 82.6 respectively in group C (Table 1). This was found to be statistically insignificant.
- The main investigatory parameter *vital capacity* and *oxygen saturation* was found statistically significant in all the three groups (Table 2 & 3).

DISCUSSION

The result obtained can be explained on the following basis:

I. Respiratory centres are group of neurons, which control the rate, rhythm and force of respiration. These centres are bilaterally situated in reticular formation of the brainstem. Depending upon the situation in the brainstem, the respiratory centres are classified into two groups: *Medullary centre*-Dorsal respiratory group of neurons and ventral respiratory group of neurons. *Pontine centre*-Pneumotaxic centre and apneustic centre. The dorsal group of neurons are responsible for basic rhythm of respiration. The ventral group neurons are inactive during quiet breathing and become active during forced breathing. During forced breathing, these neurons stimulate both inspiratory muscle and expiratory muscles.The *pneumotaxic centre* influences the switching between inspiration and expiration.The *pneumotaxic centre* increases the respiratory rate by reducing the duration of inspiration. The *apneustic centre* increases the depth of inspiration by acting directly on the dorsal group neurons[6]. We can say that the regular practice of *pranayam* for few weeks adjusted respiratory centres to new pattern of breathing which is slower than its basal rhythm which in turn decreases the respiratory rate[7].

II. There is significant increase in breath holding time in all the three groups. The possible explanations are discussed below-

- Regular practice of *pranayam* produces the hypometabolic state of the body characterised by decreased CO_2 production and decreased consumption. This allows the *breath holding* for a longer time[7,9].
- Also we can further explain it as the regular practice of *pranayamic* breathing increases muscle endurance and delays the onset of their fatigue thus promoting *breath holding* for longer time[8].
- By practicing the *pranayam* regularly, the alveoli are trained in such a way to withstand the maximum extend of stretching. Thus allowing the breath holding for longer time[8].

III. The significant increase was observed in *vital capacity* in all the three groups. This can be explained as-

- Regular practice of *pranayam* strengthens the respiratory musculature of the body so that the lungs inflate and deflate to the fullest. The interwoven elastic and collagen fibres present in

lung parenchyma stretches while slow and prolonged inspiration[10].

- Lung inflation near to total lung capacity is a major physiological stimulus for the release of lung surfactant and prostaglandins into alveolar spaces which increase compliance and decrease bronchial smooth muscle tone.
- *Kapalbhati pranayam* involves the contraction of lower abdomen during inhalation and during exhalation the breath is forced out with powerful stroke. This allows the subject to make use of the diaphragm and abdominal muscle to fullest. It also helps in clearing the respiratory passage[10].
- *Yoga* with its calming effects on the mind can reduce the emotional stress there by withdrawing the bronchial constrictor effect[10].

IV. Regular practice of *pranayam* influence the pulse rate. In the previous studies it has been reported that *pranayam* stimulate the parasympathetic system. Also evidence of production of gamma wave indicating that parasympathetic dominance[11].

CONCLUSION

Pranayam proved to be beneficial in improving the lung parameters. There is significant effect of *pranayam* on *vital capacity, oxygen saturation, BHT, pulse rate and respiratory rate*.

LIMITATIONS OF THE STUDY:

The sample size was small so the study must be conducted on large scale to be globally accepted. Stipulate time of the *pranayam* session was 15 days. It was less as these things require longer time to show effects.

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Source of Support: Nil
Conflict Of Interest: None Declared

How to cite this URL: Pallvi Pandey et al: Physio-Clinical Study Of Pranayam w.s.r. to Vital Capacity. International Ayurvedic Medical Journal {online} 2018 {cited September, 2018} Available from: http://www.iamj.in/posts/images/upload/1322_1328.pdf