



STUDY OF THE EFFECTS OF YOGIC EXERCISES ON PHYSIOLOGICAL AND HEMATOLOGICAL FUNCTIONS IN YOUNG VOLUNTEERS

Physiology

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ABSTRACT

India had a glorious past of rich cultural heritage of its people. The knowledge of medicines in medical India expanded by number of further additions by various Rishis and finally it let it birth to full-fledged science of health known as Ayurveda which involves treatment of various diseases by indigenous drugs. In addition of Ayurveda a different system of medicines which does not involve any medicine but simply practice of a well-organized physical posture known as Yoga was also practiced by ancient Indians even before the advent of Aryans in the Indus Valley. **Method and Methodology:** The Present study was carried out on 17 male & 11 female, normal, healthy, young medical students of medical institute within the age group of 18 to 22 years. Physiological and hematological parameters were measured initially. The yogic training was given under the supervision of a yogic expert. These volunteers were subjected to practice 10 Asanas, 05 Pranayamas, 04 Mudras, and 05 Bundhas regularly for one and half hour daily in the evening for a period of 03 months. The observations were recorded after 01 Month, 02 Months and 03 Moths periods. **Results:** The Effects of Yogic Exercises on physiological and hematological function shows the gradual betterment from mean control after 3 months of Yogic Practices and statistically significant after 1 month, 2 months, and 3 months of Yogic Practices in all the parameters. **Conclusion:** The mechanism of Physiological changes which are induced by Yogic training is not clear and a controversy regarding is still persists. Various authors have given various reasons but none of them are widely accepted. The most accepted view is that yoga effects the autonomic nervous system by decreasing sympathetic tone. The possible side of action may be hypothalamus which regulates the autonomic nervous system.

KEYWORDS

Yogic exercises, Physiological function, Haematological function

INTRODUCTION:

India had a glorious past of rich cultural heritage of its people. The antiquity of achievements of Hindus in analytical and creative thoughts is universally acknowledged. When Aryans entered the Indus Valley they brought with them their good culture, philosophy, arts, sciences and medical knowledge too. In addition, they also look over the assimilated many aspects of existing Indus Valley culture. Vedas are the most ancient written records of Hindu culture, arts, science and medical knowledge. Subsequently the knowledge of medicines in medical India expanded by number of further additions by various Rishis and finally it let it birth to full-fledged science of health known as Ayurveda which involves treatment of various diseases by indigenous drugs. In addition of Ayurveda a different system of medicines which does not involve any medicine but simply practice of a well-organized physical posture known as Yoga was also practiced by ancient Indians even before the advent of Aryans in the Indus Valley. All the evidence from the archaeological studies of the Mohan-Jo-Daro excavation has revealed a seal dating 3000 BC which depicts figure of a deity seated in a yogic posture.

The efficacy of yoga and meditation as an adjunct to routine management of various diseases and disorders has been assessed from time to time. It is an ancient technique, basically a practice of mental and physical exercise aiming to acquire good health in human beings. Yoga is gaining popularity and has the potential to make a significant contribution to the field of health sciences. It has been explored its consistent beneficial effects on various biochemical, physiological, and psychological parameters, among the healthy and diseased human beings.⁽¹⁻⁵⁾

This indicates that the Yogasanas (Yogic Posture) and discipline of yoga itself are much older than the Vedas and Upanishads. Although Yoga was existing since a long time, it was compiled in a systematic manner by Patanjali's Yoga Sutras in 2000 BC.

Out of all Yogasanas Raj Yoga is a practical and fundamental step for the attainment of Samayana. It has been further divided into Yama, Niyama, Asana, Pranayam, dhyana, Dharma and Samadhi, the last three together are responsible for the attainment of Smayana, posture (Asana) Gesture (Mudras) contractions (Bandha) and rhythmic breathing (Pranayam) are the physiological techniques which quicken the mind.

In this work we have studied the efforts of Ten Asanas, Five Pranayams, Four Mudras, and Five Bandhas on Physiological and Haematological functions.

Method & Methodology:

The Present study was carried out on 17 male & 11 female, normal, healthy, young medical students of medical institute within the age group of 18 to 22 years.

Physiological, and Hematological parameters were measured initially. The yogic training was given under the supervision of a yogic expert. These volunteers were subjected to practice 10 Asanas, 05 Pranayamas, 04 Mudras, and 05 Bundhas regularly for one and half hour daily in the evening for a period of 03 months. The Observations were recorded after 01 Month, 02 Months and 03 Moths periods. Following Yogic Exercises were performed in each case:

Asanas:

1. Muktasana (Windclearing Posture):

The student was asked to lie supine and then bring their legs closer to abdomen followed by grasping their knees with their hands. Then they performed rolling & side to side movements.

2. Bhujangasana (Cobra Posture):

The student was asked to lie prone with their muscles completely relaxed and hands bent at the elbow with the palms embracing the ground. The soles made to look upward. This was following by raising the head with the neck bent backward as far as possible. Then they pressed hard on hands and raised their shoulders as high as possible with abdomen in contract with the ground. This asana in the initial phase was maintained for 30 seconds and then then the duration was gradually increased to 2 minutes.

3. Naukasana (Boat Posture):

The student was asked to lie supine keeping their hands on back, palms grasped to one another and then asked to raise head and chest as much as possible, and to raise legs as well without bending them at knee joint. The maximum duration for which this asana was performed was two minutes.

4. Makarasana (Crocodile Posture):

The student was asked to keep their head on hands in supine position and then to keep legs as apart as possible. The duration for which it was performed was 2 minutes.

5. Virasana (Hero Posture):

The volunteers were asked to sit in an upright posture with legs crossed, left foot was under the right thigh and right foot was over the left thigh, clutching the hands beneath the head and then stretching the body. Maximum duration for which this posture was maintained was 2 minutes.

6. Uthit Padmasana (Raised Lotus Posture):

The Volunteers were asked to sit crossed legged with right foot placed on the left thigh with sole facing upwards. Similarly left leg was placed on the right thigh with sole facing upwards. Then both the palms were placed on the ground and pressed hard against it so as to lift the whole body above the ground with the legs held in Padmasana and maintained for 2 minutes

7. Gomukhasana (Cow Posture):

The volunteers were told to kneel cross-legged feet pointing outwards with medial border on floor, sole facing backwards and knees well apart. Then they were told to lower themselves gently till the buttocks touched the ground between the feet. Then they raised right hand and brought it over the right shoulder with left hand behind the back gripping the fingers and then pulling. The hands were reversed and pulled again. This was performed for 2 minutes.

8. Paschimotansana (Posterior Stretching Posture):

The volunteers were asked to sit with their legs stretched Infront and then to hold fingers of the feet with their hand and lower the body so as to touch the forehead with the knees. This was performed for 30 seconds to 1 minute

9. Matsaysana (Fish Posture):

The volunteers were told to assume the Padmasana then asked to hold both the great toes with hands and then to lie supine. This was followed by raising the chest and abdomen above the ground as much as possible and simultaneously extending the neck to the maximum limit. This Asan was performed for 2 minutes.

10. Shavasana (Corpse Posture):

The volunteers were asked to lie supine with arms outstretched and parallel to the body and then were asked to relax the musculature of the whole body and simultaneously to undergo mental and emotional relaxation. This was performed for 2 minutes.

Pranayam (Rhythmic Control Of Breathing)**1. Kapalbhati (Skull Starting Breathing):**

The Volunteers were asked to sit in Padmasana and breathe in and out rapidly without expending the chest, contracting the muscles of the stomach forcefully at each compulsion. This maneuver was performed for 10 to 15 times, followed by pause and repeats it for three times

2. Mand Gambhir Swasan (Simple Deep Breathing)

Volunteers were told to sit in Padmasana or Siddhasana close the right nostril with their right thumb, inhale the air through left nostril till they count 3 Oms slowly. Then asked to close left nostril with the little and ring fingers of their right hand and were now asked to retain the breath till they counted 12 OMs, the to remove the right thumb and exhale through the right nostril till they counted 6 Oms.

3. Ujjayi (Victorious Breathing)

The subjects were told to sit in Padmasana close the mouth and inhale slowly through both the nostrils in a smooth and uniform manner. They were asked to retain the breath as long as they could do it comfortably and then to exhale slowly through the left nostril by closing the right nostril with right thumb, next they were asked to expand the chest when they inhaled, during inhalation a peculiar sound was produced owing to partial closure of the glottis. Sound produced during inhalation should be of mild and uniform pitch and of continuous character. Similar five rounds were performed

4. Bhastrika (Bellows Breathing):

Volunteers were made to assume Padmasana close the mouth inhale and exhale quickly 20 times like bellows constantly dilating and contracting the chest as they inhaled and exhaled. During this course a hissing sound was produced. Then they were told to expire forcibly following one another in rapid succession. After 20 such expulsions they were asked to make a deep inhalation and retain breath as long as they could do it comfortably and then expire slowly. It was performed for three times

5. Surya Bhedi (Sun Cleaving breathing):

The Volunteers were told to sit in Padmasana to close the eyes, keeping the left nostril closed with their right little and ring fingers, slowly inhaling without making any sound as long as they could do it comfortably through the right nostril. Then they were asked to close the right nostril with thumb and retain breath by firmly pressing the

chin against the chest (Jalandhara Bandha) and to hold the breath till perspiration oozed out from the root of the hairs (Hair Follicles). Volunteers were made to gradually increase the period of kumbhaka. Then asked to release Jalandhara Bandha and exhale very slowly, without making any sound through the left nostril with the thumb closing right nostril. It was performed for three times.

Mudras (Gesture):**1. MAHAMUDRA (Might Gesture):**

The students were told to press the anus carefully with the left heel, stretch out the right leg then catch hold the toe with the two hands, inhale and retain the breath. Then asked to press the chin against the chest firmly (Jalandhara Bandha), and fix the gaze between the eye brows, and to retain the posture as long as they could and then asked to exhale slowly. They were told to practice first on left leg and then on right leg

2. Singh Mudra (Lion Gesture):

The volunteers were asked to kneel and sit back on heels, place the hands-on thigh just above the knees and inhale deeply then they were asked to lean forward and open mouth widely and say 'Ha' loudly with tongue remaining stuck out as far as possible. It was repeated half a dozen times. While saying 'Ha' the volunteers were instructed to raise their heads from below upwards.

3. Shakti Chalni Mudra (Energy Moving Gesture):

The volunteers were asked to sit in Padmasana and to draw in air forcibly and to join it with apana. Then they were asked to perform Mulabandha till the VAYU entered the sushumna. Then they were asked to contract their anal sphincter. After 30 seconds they were asked to release the Bandha.

4. Vajroli Mudra (Vajroli Gesture):

The volunteers were asked to sit in Padmasana and to contract and relax the anal splinters in succession; this was performed for 2 minutes.

Bandhas (Contraction)**1. Uddiyan Bandha (Gut Contraction):**

The volunteers were asked to expire forcibly through the mouth the empty the lungs, then they were asked to contract and draw up the intestine above and below the naval towards the back, so that the abdomen rested against the back of body high up in thoracic cavity. This was performed 5 times.

2. Jalandhara Bandha (Tracheal Contraction):

The volunteers were instructed to contract the throat and press the chin firmly against the chest after inspiration. This was done 5 times.

3. Mul Bandha (Anal Splinter Contraction):

The students were told to press the anal sphincter with the left heel, keep the right heel pressed at the space just the organ of generation. Then asked to contract the anus and draw apanavayu upwards. This was performed for 2 minutes.

4. Maha Bandha (Great Contraction):

The subjects were asked to press the anus with the left heel, place the right foot upon the left thigh. Then they were asked to contract the anus and muscle of perineum, thus drawing the apanavayu upwards, drawing the breath slowly and retaining it by Jalandhara Bandha as long as they were told to exhale of the right side.

5. Maha Vedha (Great Penetration):

The volunteers were told to sit in Maha Bandha posture, asked to draw a breath slowly, retain the breath and press the chin against the chest. Place the palms on ground, rest the body on them and then raise the buttocks slowly and strike them gently against the ground. This was performed for 2 minutes.

The following Physiological, and Haematological parameters were recorded initially and in the subsequent follow up at one month, two months and three months duration.

Physiological Parameters:

Height: The height of each candidate was measured with the aid of Staedio Meter up to 0.1 cm.

Weight: Weight of each volunteer was taken with the help of beam balance type of weighing machine and the reading was noted up to

0.1kg.

Surface Area: Body surface area was calculated from height and weight in square meters with the help of Du- Bois Chart (Hock 1976).

Blood Pressure: This para-meter was recorded by Mercury Sphygmomanometer by standard technique.

Heart Rate: Electrocardiograph of each volunteer was recorded from which the heart rate was calculated by dividing 1500 with R.R. Interval.

Respiratory Rate: The number of Chest movements in one minute were recorded which denoted the respiratory rate.

Maximum Breath Holding Time: The volunteers were instructed to hold the breath at the end of deep inspiration and then with the help of stop watch the maximum duration for which they could hold the breath was recorded in seconds.

40 MM Test: For this test only the manometer part of the B.P. Instrument was utilized. The volunteers took deep inspiration and then blow into the manometer tubing so as to raise the mercury column up to 40 mm of mercury. The duration for which he sustained the mercury column level at 40 mm level was recorded with the help of stop watch. During this test, care was taken so that the subject did not respire through the nasal passage.

Oxygen Consumption: To measure this para-meter the volunteers were asked to take light meal at the previous evening and a sedative was given at night so that they had a sound sleep for 12-14 hours. Before measuring this para-meter the volunteers were explained everything so as to relieve them of anxiety and apprehension.

To measure oxygen consumption, the oxygen cylinder was connected to the Toshniwal Expirograph and the instrument was rinsed with oxygen 3 to 4 times and finally the bell of the instrument was filled with sufficient oxygen so as to run the test for required time. Soda Lime was kept in container inside the bell so as to absorb the Carbon-di-Oxide from the expired air. The volunteers were instructed to respire through Toshniwal Expirograph with nose clamped. The student breathed normally for 7 minutes and during this period graphic recording were taken at the speed of 60 m.m./minutes. The Oxygen consumption was calculated from the obtained graphic recordings in liter per minute.

Basal Metabolic Rate: The Basal Metabolic Rate was calculated with the help of body surface area and corrected Oxygen Consumption which gave the value of energy production. Finally with the help of energy production, age and sex, the BMR was calculated. (Hock 1976).

Lung Volume And Capacities: The volunteers were connected with Toshniwal Expirograph and all the Lung Volumes and capacities viz. Tidal Volume, inspiratory reserve volume, inspiratory capacity, Expiratory Reserve Volume, Expiratory capacity maximum breathing capacity and vital Capacity were measured by using the speed of 60 mm per second and FEV1 (Forced Expiratory Volume in First Second) was calculated by using the speed of 1200 mm per second (Compbell and Dickinson, 1975).

Hematological Parameters:

The blood samples were taken from the cubital vein of volunteers. For counting Differential Leucocyte, Total Leucocyte, Total Red Blood Cell, and Platelets and for estimation of Erythrocyte Sedimentation Rate, Packed Cell Volume and Hb% the double exalted vials were used.

The Total Leucocyte Count and Total Red Cell count was done with Neubaur Chamber. The platelets count was done by using formal citrate as anti-coagulant by Neubaur Chamber. Differential Leucocyte count was done by staining the slide with Leishman Stain. The Hemoglobin was estimated by Sahlis Haemoglobinometer. The Erythrocyte Sedimentation Rate and Packed Cell Volume were measured with the help of Wintrobs Tube as method described in Decie's practical hematology (1975).

RESULTS:

Effect Of Yogic Practice On Cardiovascular System:

The effects of yogic exercises on Cardiovascular System are

summarized in Table 1. The Mean Systolic and Diastolic blood pressure of the volunteers before starting yogic practice were 121.1 ± 4.04 and 87.7 ± 3.89 mm of Hg respectively. Yogic practices produced a gradual lowering of both systolic and diastolic blood pressure. The fall in systolic blood pressure after 1 month, 2 months and 3 months of yogic practices were statistically significant. Although decrease in Diastolic Blood Pressure was consistent but is only significant after 3 months.

In addition, yogic practices produced a time dependent negative chronotropic effects on heart. The heart rate was decreased for a mean control figure of 83.03 ± 1.98 per minute to 76.82 ± 1.57 after 1 month, 76.35 ± 1.55 after 2 months and 71.85 ± 1.08 after 3 months of yogic practices as shown in Table No. 1 Figure No.1. Although the decrease in heart rate was small but statistically significant.

Table 1: Effect Of Yogic Practices On Cardiovascular System

Groups	Blood Pressure (mm of Hg)		Heart Rate
	Systolic Mean $\pm$ S.E	Diastolic Mean $\pm$ S.E	Per minute (Mean $\pm$ S.E.
Control	121.1 ± 4.04	87.7 ± 3.89	83.03 ± 1.98
1 Month of Yoga Practice	$117.21 \pm 4.22^{***}$	77.6 ± 1.17	$76.82 \pm 1.57^{**}$
2 Months of Yoga Practice	$115 \pm 1.47^{***}$	77.07 ± 0.05	$76.35 \pm 1.55^{***}$
3 Months of Yoga Practice	$110.42 \pm .92^{***}$	$69.71 \pm 0.75^{***}$	$71.85 \pm 1.08^{***}$

*Indicating $P \leq 0.05$

**Indicating $P \leq 0.01$

***Indicating $P \leq 0.001$

Effect of Yogic Practices on Respiratory Functions:

The Effects of Yogic practices on respiratory rate, chest expansion, breath holding time and 40 mm test are summarized in Table 2A. The respiratory rate was decreased for a mean control figure of 22.28 ± 0.89 per minute to 19.25 ± 0.71 after 1 month, 18.32 ± 0.51 after 2 months and 16.21 ± 0.4 after 3 months of Yogic practices as shown in table No. 2A and Figure No 2. The Decrease in respiratory rate after 1 month, 2 months and 3 months of yogic practices was statistically significant.

The effect of Yogic practices on chest expansion showed an increase for a mean control group figure of 4.6 ± 0.32 cms to 5.77 ± 0.47 after one month, 7.25 ± 0.49 after two months and 8.37 ± 0.5 after three months as shown in Table 2A. Yogic practices produced a gradual increase of chest expansion after 1 month, 2 months and months which were statistically significant.

The breath holding time increase from a mean control figure 43.07 ± 3.16 seconds to 57.39 ± 4.32 after 1 month, 63.25 ± 4.22 after 2 months and 67.42 ± 5.85 after 3 months of yogic exercise as shown in Table 2A. It shows gradual increase after 1 month, 2 months and 3 months. The increase in breath holding Time after 1 month, 2 months and 3 months of Yogic Exercises were statistically significant.

The 40 mm test also showed gradual increase for a mean control figure of 33.21 ± 1.55 seconds to 42.07 ± 2.08 after 1 month, 46.75 ± 2.01 , after 2 months and 52.67 ± 2.09 after 3 months of yogic practices as shown in Table 2A and statistically significant.

The effects of yogic practices on tidal volume are summarized in Table 2B. It shows decrease after 1 month of yogic exercise for mean control figure 603 ± 35 ml to 509 ± 26 and after 2 months, 566 ± 36 along with after 3 months the tidal volume increased from mean control figure to 668 ± 42 ml and statistically significant.

The Inspiratory Reserve Volume showed gradual increase for mean control figure 1395 ± 161 ml to 1666 ± 71 after 1 month, 1744 ± 81 after 2 months and 1906 ± 87 after 3 months of yogic practices as summarized in Table 2B. Statistically significant in 1 month and highly significant after 2 months and 3 months of yogic practices.

The Inspiratory Capacity also showed gradual increase for mean control figure 2032 ± 87 ml to 2202 ± 60 after 1 month 2273 ± 160 after 2 months and 2536 ± 115 after 3 months of Yogic Practices as summarized in Table 2 B but statistically Significant after 2 and 3 months of Yogic Practices.

The Expiratory Reserve Volume also showed a gradual increase for a

mean control figure of 805 ± 75 ml to 827 ± 57 , after 1 month, 900 ± 63 after 2 months and 1040 ± 71 after 3 months of Yogic Practices as summarized in Table 2B statistically significant only after 3 months of Yogic Exercise.

The Effect of Yogic Exercises on Expiratory Capacity showed gradual increase for a mean control figure 1404 ± 80 ml to 1461 ± 11 , after 1 month, 1561 ± 85 after 2 months and 1683 ± 119 after 3 months of Yogic Exercise as summarized in Table 2. 5 bus statistically significant after 2 and 3 months of yogic practices.

The Vital Capacity showed gradual increase for mean control figure 2754 ± 118 ml to 2944 ± 123 after 1 month's yogic exercise, 3002 ± 113 after 2 months of yogic exercise and 3276 ± 131 after 3 months of yogic exercise as summarized in Table 2C and statistically significant after 1 month, 2 months and 3 months of yogic exercise.

The effects of yogic exercise on V. E. V1 also showed a gradual increase for a mean control figure of 63.18 ± 2.33 percent to 80.22 ± 1.94 after 1 month, 87.21 ± 1.41 after 2 months 92.79 ± 1.28 after 3 months of yogic exercise as summarized in Table 2C and statistically significant after 1 month, 2 months and 3 months of yogic practices.

The Maximum Breathing Capacity showed gradual increase from a mean control figure 52.89 ± 2.74 Liter to 64.03 ± 2.62 after month, 74.39 ± 2.45 after 2 months and 87.08 ± 2.97 after 3 months of yogic practices as summarized in Table 2C and statistically significant after 1 month, 2 months and 3 months of yogic practices.

Table 2A: Effect of Yogic Practices on Respiratory Functions

Groups	Respiratory Rate (Per Minute) (Mean $\pm$ S.E.)	Chest Expansion (in CMS) (Mean $\pm$ S.E.)	Breath Holding time (in Seconds) (Mean $\pm$ S.E.)	40 mm test (In Sec.) (Mean $\pm$ S.E.)
Control	22.28 ± 0.89	4.6 ± 0.32	43.07 ± 3.16	33.21 ± 1.55
1 Month Yoga Practice	$19.25 \pm 0.71^{***}$	$5.77 \pm 0.47^{***}$	$57.39 \pm 4.32^{***}$	$42.07 \pm 2.08^{***}$
2 Months Yoga Practice	$18.32 \pm 0.51^{***}$	$7.25 \pm 0.49^{***}$	$63.25 \pm 4.22^{***}$	$46.75 \pm 2.01^{***}$
3 Months Yoga Practice	$16.21 \pm 0.40^{***}$	$8.37 \pm 0.50^{***}$	$67.42 \pm 5.85^{***}$	$52.67 \pm 2.09^{***}$

*** Indicating $P \leq 0.001$

Table 2B: Effect of Yogic Practices on Respiratory Functions

Groups	Tidal Volume In ML. (Mean $\pm$ S.E.)	Inspiratory Reserve Vol. UME in ML (Mean $\pm$ S.E.)	Inspiratory Capacity In ML (Mean $\pm$ S.E.)	Expiratory Reserve Vol. UME in ML (Mean $\pm$ S.E.)	Expiratory Capacity in ML (Mean $\pm$ S.E.)
Control	603 ± 35	1395 ± 161	2032 ± 87	805 ± 76	140 ± 80
1 Month Yoga Practice	$509 \pm 26^{**}$	$1666 \pm 71^{**}$	2202 ± 60	827 ± 67	1461 ± 11
2 Months Yoga Practice	$566 \pm 36^{***}$	$1744 \pm 81^{***}$	$2273 \pm 106^{**}$	900 ± 63	$1561 \pm 85^{*}$
3 Months Yoga Practice	$668 \pm 42^{***}$	$1906 \pm 87^{***}$	$2536 \pm 115^{***}$	$1040 \pm 71^{**}$	$1683 \pm 119^{***}$

* Indicating $P \leq 0.05$

** Indicating $P \leq 0.01$

*** Indicating $P \leq 0.001$

Table 2C: Effect of Yogic Practices on Respiratory Functions

Groups	Vital Capacity In ML (Mean $\pm$ S.E.)	FEV_1 (Mean $\pm$ S.E.)	Maximum Breathing Capacity in Ltr per minute (Mean $\pm$ S.E.)
Control	2754 ± 118	63.18 ± 2.33	52.89 ± 2.74
1 Month Yoga Practice	$2944 \pm 123^{***}$	$80.22 \pm 1.94^{***}$	$64.03 \pm 2.62^{***}$
2 Months Yoga Practice	$3002 \pm 113^{***}$	$87.21 \pm 1.41^{***}$	$74.39 \pm 2.45^{***}$

3 Months Yoga Practice	$3276 \pm 131^{***}$	$92.79 \pm 1.28^{***}$	$87.08 \pm 2.97^{***}$
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* Indicating $P \leq 0.05$

** Indicating $P \leq 0.01$

*** Indicating $P \leq 0.001$

Effect of Yoga Practice on Haemopoietic Functions:

The effect of yogic exercise is summarized in Table 3A and 3B. The Erythrocyte Sedimentation Rate showed gradual decrease from a mean control figure 13.64 ± 1.54 mm in first hour to 11.14 ± 1.69 after month, 9.39 ± 1.2 after 2 months and 8.82 ± 0.97 after 3 months of yogic practices as summarized in Table 3A and Figure 8 and statistically significant after 2 months and 3 months of yogic exercises. The Packed Cell Volume showed no significant changes from mean control figure 45.25 ± 1.6 percent to 45.92 ± 0.29 after 3 months of yogic exercises as summarized in Table 3A. The effect of Yogic exercises showed gradual increase in Haemoglobin Gm % from mean control figure 12.71 ± 0.46 to 12.9 ± 0.4 after 1 month, 13.96 ± 0.09 after 2 months and 14.36 ± 0.22 after 3 months of yogic.

Exercises as shown in Table 3A but the difference was statistically significant only after 3 months yogic exercise.

The Red Blood Cell count showed gradual increase from a mean control figure 4.56 ± 0.07 million per cu.mm of blood to 4.84 ± 0.16 after 1 month, 4.84 ± 0.15 after 2 months and 5.03 ± 0.03 after 3 months of yogic exercises as summarized in Table 3A and statistically significant after 1 month, 2 months and 3 months of yogic exercise.

The platelets count also showed gradual increase from a mean control figure 2.55 ± 0.05 lacs/cu.mm of blood to 2.61 ± 0.12 after 1 month, 2.82 ± 0.07 after 2 months and 2.97 ± 0.01 after 3 months of yogic practices as summarized in Table 3A and statistically significant after First, 2nd and 3rd months of yogic exercises.

Total Leucocyte Count showed gradual increase from a mean control figure 6089 ± 440 thousand per cu.mm of blood to 7411 ± 280 after 1 month, 7550 ± 140 after 2 months and 7840 ± 360 after 3 months of yogic practices as summarized in Table 3B and statistically significant after 1 month, 2 months and 3 months of yogic exercises.

The Differential Leucocyte Count did not show any remarkable changes. Only Lymphocyte Count increased from a mean control figure 34.89 ± 1.44 percent to 38.5 ± 0.09 after 3 months of yogic exercises as summarized in Table 4 and statistically significant after 1 month, 2 months and 3 months of yogic exercises.

Table 3A: Effect of Yogic Practice on Haemopoietic Functions

Groups	Erythrocyte Sedimentation Rate in First Hour (Mean $\pm$ S.E.)	Packed Cell Volume in % (Mean $\pm$ S.E.)	Haemoglobin in GM % (Mean $\pm$ S.E.)	Red Blood Cell Count in Millions per Cu.mm of Blood (Mean $\pm$ S.E.)	Expiratory Capacity in ML (Mean $\pm$ S.E.)
Control	13.64 ± 1.54	45.25 ± 1.6	12.71 ± 0.46	4.56 ± 0.07	2.55 ± 0.05
1 Month Yoga Practice	11.14 ± 1.69	46.64 ± 1.08	12.9 ± 0.4	$4.84 \pm 0.016^{***}$	$2.61 \pm 0.12^{**}$
2 Months Yoga Practice	$9.39 \pm 1.2^{*}$	46.39 ± 1.70	13.96 ± 0.09	$4.84 \pm 0.15^{***}$	$2.82 \pm 0.07^{***}$
3 Months Yoga Practice	$8.82 \pm 0.97^{**}$	45.92 ± 0.29	$14.36 \pm 0.22^{**}$	$5.03 \pm 0.03^{***}$	$2.97 \pm 0.01^{***}$

* Indicating $P \leq 0.05$

** Indicating $P \leq 0.01$

*** Indicating $P \leq 0.001$

Table 3B: Effect of Yogic Practice on Haemopoietic Functions

Groups	Total Leucocyte Count per CU. MM of Blood (Mean $\pm$ S.E.)	Differential Leucocyte Count in Percent				
		POLY MORPH (Mean $\pm$ S.E.)	LYMPHOCYTE (Mean $\pm$ S.E.)	EOSINOPHIL (Mean $\pm$ S.E.)	MONOCYTE (Mean $\pm$ S.E.)	BASOPHIL (Mean $\pm$ S.E.)

Control	6089 ± 440	59.57 ± 1.28	34.89 ± 1.44	4.32 ± 0.71	1.10 ± 0.2	0
1 Month Yoga Practice	7411 ± 280***	59.28 ± 85	32.53 ± 2.6	4 ± 0.34	1.25 ± 0.19	0
2 Months Yoga Practice	7550 ± 140***	59.46 ± 0.64	35.1 ± 1.03	3.85 ± 0.32	1.57 ± 0.21	0
3 Months Yoga Practice	7840 ± 360***	55.35 ± 1.65*	38.5 ± 0.09*	4.39 ± 0.3	1.78 ± 0.23	0

*Indicating $P \leq 0.05$

**Indicating $P \leq 0.01$

***Indicating $P \leq 0.001$

Effect of Yogic Practice on Body Weight, Basal Metabolic Rate and Oxygen Consumption:

The effects of yogic practices on body weight showed slight increase from a mean control figure 52.28 ± 1.52 kg to 52.28 ± 2.1 after 1 month, 53.44 ± 1.82 after 2 months and 53.63 ± 1.19 after 3 months of yogic exercises and statistically significant after 2 months and 3 months of yogic exercises as summarized in Table 4.

The Basal Metabolic Rate showed gradual reduction from a mean control figure 28.44 ± 2.00 percent to 24.07 ± 2.48 after 1 month, 5.75 ± 2.79 after 2 months and -12.14 ± 1.93 after 3 months of yogic exercises and statistically significant after 1 month, 2 months and 3 months of practices as summarized in Table 4.

The Oxygen consumption also showed gradual decrease from mean control figure 311.78 ± 13.30 ml to 292.5 ± 14.69 after 1 month, 241.07 ± 7.94 after 2 months and 196.07 ± 4.99 after 3 months of yogic practices as summarized in Table 4 and statistically significant after 1 month, 2 months and 3 months of yogic practices.

Table 4: Effects of Yogic Practice on Body Weight, Basal Metabolic Rate, and Oxygen Consumption

Groups	Body Weight in Kgs (Mean ± S.E.)	Basal Metabolic Rate in (Mean ± S.E.)	Oxygen Consumption in ML. / Minute (Mean ± S.E.)
Control	52.28 ± 1.52	28.44 ± 2.00	311.78 ± 13.30
1 Month Yoga Practice	52.28 ± 2.1	24.07 ± 2.48 ***	292.5 ± 14.69 ***
2 Months Yoga Practice	53.44 ± 1.82 *	5.75 ± 2.79 ***	241.07 ± 7.94 ***
3 Months Yoga Practice	53.63 ± 1.19 **	-12.14 ± 1.93 ***	196.07 ± 4.99 ***

*Indicating $P \leq 0.05$

**Indicating $P \leq 0.01$

***Indicating $P \leq 0.001$

DISCUSSION:

The practice of yoga in contrast to physical exercise extracts minimum physical efforts but influence vital organs and neuroendocrine system to induce the variety of physiological changes.^(6,7,8) Yogic Asanas are a preliminary stage in the comprehensive classical practice of yoga although each and every yogic Asana produces specific physiological effect⁽⁹⁾ but combined practice of several important Asanas have shown considerable improvement in Cardio-respiratory, Metabolic and Adrenocortical functions^(6,7,8)

Although a good number of studies have been conducted to show the Physiological, and Psychological, effects of yogic practices but most of the studies have not drawn any specific conclusion. Therefore, the present work has been undertaken to study the physiological, and haematological effects produced by yogic practices which can be therapeutically exploited in future on the basis of Physiological changes.

In present study, a group of yogic exercises have been performed by 28 health volunteers and produced a highly significant fall in Systolic Blood Pressure at the end of first month, second month and third month of yogic practices but there was a significant fall in Diastolic Blood Pressure only at the end of third month. The decrease in Systolic and Diastolic Blood Pressure, due to yogic practices this study is in agreement with earlier reports.⁽¹⁰⁾ Similarly there was a definitely significant decrease in heart rate at the end of first month, second month, and third month. This decrease in heart rate is in agreement with earlier reports.⁽¹¹⁾ Although a gradual decrease in blood pressure

and heart rate is a consistent finding after varying period of yogic exercises, but it is difficult to explain the mechanism how these effects are produced, investigated 4 Yogis and concluded that Yogic exercises could increase the vagal tone of unknown origin. Moreover, it has been recognized that Cardiovascular responses both in normal and abnormal individuals can be influenced by definite environmental conditions and by a wide variety of behavioural factors such as stress, anxiety and numerous effective and altitudinal dispositions of the individual.⁽¹²⁾ Thus chronic arousal of Hypothalamic emergency reactions which are associated with increased sympathetic nervous system activity was believed to lead to elevated systemic arterial blood pressure.⁽¹³⁾ If this is the true alteration in behaviour which were associated with decreased sympathetic activity, will lead to depression in blood pressure.

Yoga practices and transcendental meditation are known to cause behavioural alteration and reduce anxiety and tension, leading to diminished blood Pressure. Thus it appears that the yogic practices reduce sympathetic tone and increase vagal tone probably to produce beneficial effect on Cardio-vascular system.

In the present study, combined practices of yogic exercises have shown to produce a significant change exercises change in respiratory functions. With increase in yogic exercises a significant decrease in respiratory rate, and increase in chest expansion. Breath holding time, 40 mm test, PEV_{10} and maximum breathing capacity at the end of first, second and third month. Unexpectedly there was a decrease in tidal volume at the end of first month and then it increased gradually afterwards finally leading to statistically significant increase at the end of third month.

There was a gradual increase in inspiratory reserve volume at the end of first Month, second month, and third month. There was no change in inspiratory capacity at the end of first month but it increased significantly at the end of second month, and third month.

The Expiratory Reserve Volume (ERV) increased significantly only at the time of Third month while expiratory capacity increased significantly at the end of Second Month, and the third month. These observations are in accordance with earlier reports.^(7,8,9) However, the respiratory rate decreased to a significant extent which is in consistent with other reports.^(14, 6) The yogic exercises specially the breathing exercises by making full use of the diaphragm and abdominal muscles clears the respiratory passage and all alveoli making room for more air.⁽¹⁵⁾ Moreover pranayamic exercises by increasing the elasticity of joints and muscles and by reducing the various resistance of lung⁽¹⁶⁾, there by the Lung Volumes and capacities are probably increased.

The yogic practices in present study have produced a gradual decrease in Erythrocyte Sedimentation Rate but it significantly decreased only at the end of second month, and third month, although the changes is Packed Cell Volume were not statistically significant but a tendency of slight increase after yogic practices were observed. The Red Blood Cell Count increased significantly at the end of First, Second and Third month. Platelet Count increased significantly at the end of First Month, Second Month, and the Third Month.

The Haemoglobin level increases significantly only at the end of Third Month. The increase in Haemoglobin in the study of supports the finding.⁽¹⁷⁾ Since the rate of Sedimentation of Red Cells is influenced by a number of inter-reacting factors, it is difficult to explain how yogic practices bring about lowering of Erythrocyte Sedimentation Rate. But ratio of Red Cells to Plasma is one of the factors which affects Erythrocyte Sedimentation Rate. Decrease in Red Blood Cell Count and Packed Cell Volume may possibly explain the lowering of Erythrocyte Sedimentation Rate after yogic practice. Yogic practices have not only increased Red Blood Cells count but also increased other cellular components of blood like Leucocytes and Platelets.

There was an increase in Total Leucocyte count at the First, Second & Third month. There was not so much change in Differential Leucocyte Count except a significant increase in Lymphocyte count was seen at the end of third month. The increase in Lymphocyte observed in this study is agreement with.⁽¹⁸⁾ Physical exercises and stressful situations increase corticosteroids synthesis and raise plasma steroid level. Glucocorticoids influence the formed elements of the blood after glucocorticoids therapy. The Haemoglobin, Red Blood Cell count and Polymorphonuclear Leucocytes are increased and Lymphocytes and

other Leucocytes are decreased.⁽¹⁹⁾ Since yogic practices are one of the types of physical postures which might be associated with increased Glucocorticoid level, but the increase in Haemoglobin and Red Blood Cell count supports increased steroidogenesis but low Polymorph and high Leucocytes Count are in contrast to the speculation. So it is difficult to draw a definite conclusion to explain the mechanism of changes in haemopoietic parameters.

In the present investigation, yogic practices appears to stimulate anabolism and decrease catabolism, evidenced by increased body weight which is statistically significant at the end of second month, and third month. The decrease in basal metabolic rate was statistically significant at the end of first, second and third month, and decreased and decreased oxygen consumption at the end of first, second and the third month. Sachdewa et al in 1980⁽¹⁰⁾ reported decrease in Basal Oxygen consumption by 20-25%. The postulated that the decrease in peripheral resistance produced by yogic practices resulted in lowering of Blood Pressure and possibly increase muscular relaxation along with a decrease in sympathetic tone produced a decrease oxygen consumption in this study is in agreement.^(14, 20) However, have reported increased oxygen consumption in yogic practices. Increase in body weight might be primarily due to decreased metabolism probably due to relaxation by exercises of yogic practices. Effect of yoga on body weight is controversial.^(21, 22) Some workers, have showed decrease in body weight^(6,7,22,23) whereas other workers have observed an increase in body weight after yogic practices.⁽²⁴⁾ However, an increase in body weight after yogic practices. It have also noticed increased urinary excretion of testosterone.⁽⁶⁾ The increased excretion might be due to increased plasma testosterone level. Although it has not been estimated. The higher testosterone synthesis might be exerting anabolic effect and gain in body weight.

CONCLUSION:

The various findings which were observed after three months of Yogic practice in this study are in agreement with the observations of other workers. However the mechanism of Physiological changes which are induced by Yogic training is not clear and a controversy regarding is still persists. Various authors have given various reasons but none of them are widely accepted. The most accepted view is that yoga effects the autonomic nervous system by decreasing sympathetic tone. The possible side of action may be hypothalamus which regulates the autonomic nervous system. This study as well as studies by other workers clearly indicates that it needs a scientific approach and a long term plan to get all roots of yoga to reveal the mystery.

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