Chapter - I

INTRODUCTION

"Yoga is a life of self-discipline. Yoga balances, harmonizes, purifies and strengthens the body, mind and soul. It shows the way to perfect health, perfect mind control and perfect peace with one's own Self, the world, nature and God".

- Swami Vishnu-devananda

According to Swami Rama¹ "Yoga is a Sanskrit word. It is derived from the root 'yuj' which means union. In yoga the embodied spirit is made to become one with atman by certain methods. The methods vary but the goal is one. Yoga means union with the universal spirit.

Yogasanas not only work to bring fitness and vigour to physical body, but also harness our will and emotions to improve our power of analysis, insight and vision. They calm the mind and steady the emotions, still not losing the sharpness of intellect, which is the key to human progress. The science of yoga is dedicated to helping people to change their personalities and life styles.

Yoga has been a part and parcel of Indian Culture for thousands of years it is rather difficult to mention a specific year as the year of commencement. It was known with different names like Raj Yoga, Gyan Yoga, Bhakhti Yoga, but these were different ways of reaching the final target, which was salvation (Moksha). The followers could practise as per their choice.

In modern times during the earlier part of the 20th century, a modern Indian Yogi emerged on the scene by the name Kuvalayananda. He was the pioneer to start and think of Yoga on Scientific lines. It was the thinking of Kuvalayananda which brought Yoga and physical education close to each other. Swami also held a responsible position – Chairman, Physical Education Committee of the then Bombay State. This was as early as 1937. He later worked as the member of the Central Advisory Board of Physical Education and Recreation. He continued to work till his time of Samadhi. He used to be a most enthusiastic, energetic and active member of the Board.

Swamiji was the first person to introduce Yoga, particularly the Asanas – as a part of physical education like Calisthenics. He only introduced counting for the performance of the asanas and got it incorporated as a part of curriculum of Teachers Training of Physical Education. Initially it was in Kandivali Bombay and in due course of time it spread all over India, particularly in physical education colleges and naturally in schools and colleges all over.
Swamiji on the other hand had established Kaivalyadhama as early as 1924 at picturesque Lonavala near Pune. It was the pioneer institute, having started research on various aspects of yoga like Asanas, Pranayama, Cleansing processes (Shat Kriyas), Bandha, Mudras etc. on scientific lines. A full-fledged laboratory was developed and the findings of the research were published in Yoga Mimansa – a quarterly Journal, which is now recognised and acclaimed all over the world.

When we study the description of Pranayama in the literature of Yoga, it becomes quite clear that along the passage of time, the concepts as well as the techniques of Pranayama have undergone a change indicating definite stages of evolution and expansion.

The earliest reference to Pranayama is found in the Vedic literature, which extends from approximately 1500 B.C. backward into a hoary past. In this period the practice of Pranayama had no independent position. As described in Baudhayanadharma Sutra and Goutamadharma Sutra, the practice of Pranayama was mainly a part of some religious ceremony and the word Pranayama was applied to a practice of holding the breath inside while reciting some Mantras in the mind. Probably this was done with an idea that when the breath is held inside, the wavering of the mind gets controlled and the mental recitation of the Mantra becomes more fruitful.

With the passage of time, the technical aspect of Pranayama got more elaborated, as is found in the ancient literature known as Puranas. These were written during the period spanning approximately 500 B.C. to 800 A.D. In Kurma Purana and Vayu Purana we find a specific mention of the time-ratio between the phase of Puraka (controlled inhalation) Kumbhaka (controlled retention) and Rechaka (controlled exhalation) as well as the detailed discussion on how to measure the Matra (time unit) to arrive at a desirable time-ratio.

In the Yoga Sutras of Patanjali, Pranayama being treated for the first time as a pure and simple psycho-physiological practice devoid of any religious element. This happened around 300 B.C.

In the practice of Pranayama, the process of inhalation, inner retention of breath and the process of exhalation got elaborated in its minutest detail with a clear-cut instructions for some additional techniques to be used alongwith it like Jalandhara Bandha, Uddiyana Bandha and Mulabandha. We find a description of this kind of Pranayama in Hatha Yoga texts like Gorakshashataka by Gorakhanatha (1000 A.D.), Hathapradipika by SWATMARAMA (1400 A.D.), Gherandasamhita and Gherenda (1700 A.D.).

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1 Ibid, p. 50

2 Ibid, p. 50

3 Ibid, p. 51
According to Patanjali Pranayama means “Tasmiṃ sati
svasaprasvasayor-gativicchedah pranayamah i.e. Regulation of breath or
the control of prana is the stoppage of inhalation and exhalation, which
follows after securing that steadiness of posture or seat.

Svasa means inspiratory breath. Prasvasa means expiratory breath.
One can only take up the practice of Pranayama gaining steadiness in some
specific Asana (posture). According to scientific Yoga literature, if one can
sit for 3 hour in one Asana continuously at one stretch, he/she considered to
have gained mastery over the Asana. If one is able to sit from even half to
one hour then, one can take up practice of Pranayama. No one can make
any spiritual progress without the practice of Pranayama, as per the
traditional faith.

Pranayama is more important because it produces deeper effects as
far as the physique is concerned. The effect of asanas are superficial in
nature whereas the Pranayama is deeper as far as the outcomes are
concerned. In simple words it could be said that asanas are more linked
with muscular system, whereas the Pranayama is concerned with nervous
system of the body.

Svatmarma Suri⁶ mentioned in his famous Hatha-Pradipika, eight
varieties of Pranayama.

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The established varieties of Pranayama are Ujjayi, Bhastrika, Sooryabhedan, Seetkari, Sheetali, Bharamari, Moorchha, Plavini. The practice of certain Pranayama is advised as per the seasons e.g. Sheetali, Seetkari during summer, Sooryabhedan during winter etc. But the practice of Bhastrika as well as Ujjayi can be carried on through out the year with certain limitations. Hence the scholar preferred to work on these two. Bhastrika has been a little different in nature. It has got the scope for speed as well. Having been familiar with Kapalbhati, Bhastrika is a sort of advancement. Ujjayi too is another important variety of Pranayama.

In Plavini Pranayama, the stomach completely filled up with a liberal quantity of air introduced (through the oesophagus) and with the lungs similarly filled up (through the wind pipe) a Yogin easily floats like a lotus leaf even on deepest water\(^7\). At the end of Puraka one should very firmly form Jalandhara (Chin-lock) and then slowly exhale. This Pranayama is called Murchana. It leads to loss of awareness and is pleasant\(^8\).

In Bhramari Pranayama, by quick forced inspiration, one should produce a high humming sound like that of a male bee and by very slow expiration a low sound should be produced resembling that of a female bee\(^9\).

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\(^7\) Ibid. p. 103

\(^8\) Ibid. p. 101

\(^9\) Ibid. p. 97
In Sitkari Pranayama through the mouth the sound ‘si’ should be produced (at the time of Puraka). So also Recaka should be practised only through nose\textsuperscript{10}.

In Suryabhedana Pranayama, in every breath, the Puraka is performed through right nostril and the Rechaka through left nostril. This breathing is thought to stimulate the surya nadi or fingala nadi\textsuperscript{11}.

In Sitali Pranayama inhaled air through the tongue and having performed Kumbhaka as before (as in Suryabhedana) slowly exhale the air through both the nostrils\textsuperscript{12}.

In Ujjayi Pranayama, both the nostril are kept open during Puraka and Rechaka but the glottis is kept partially closed, narrowing the air passage at the level of vocal cords. This results in the production of characteristic low pitch, hissing sound and depending upon the control over the flow of breath, is expected to be very smooth, un-interrupted and of uniform quality. In Ujjayi Pranayama one should keep his attention focussed on this sound, which makes the mind very quiet. Like the Suryabhedana variety, this also is said to increase the heat with in the body. Following the Anuloma-Viloma, Ujjayi Pranayama is the next important practice and is always to be included in the daily Pranayama Sadhana\textsuperscript{13}.

\textsuperscript{10} Ibid, p. 92


\textsuperscript{13} Ibid, p. 84.
In Bhastrika Pranayama, one single cycle of this variety consists of two parts. First part begins with quick expulsions of breath following one another in rapid succession like bellows of blacksmith. When necessary number of expulsions (say 20 or 40), is done, then the second part begins. This consists of usual Puraka, Kumbhaka and Rechaka form of Pranayama. Thus in this variety of Pranayama, one additional type of breathing pattern is incorporated, which distinctly differs from slow and deep breathing pattern of all the earlier varieties of Pranayama. Besides being a part of Bhastrika Pranayama, this fast breathing pattern has also an independent position as one of the cleansing process of Yoga i.e. Shodhana Kriyas and there it is known as Kapalabhati Kriya. In Kapalabhati Kriya, the active exhalation and passive inhalation is brought about mainly by the movement of abdominal muscles. The chest is expanded only midway and not fully; and is kept fixed in the same position, throughout the practice. The expulsion of the breath is brought about by the rapid inward stroke of the abdominal muscles, which are immediately and fully relaxed, which then go back to its original un-contracted position. This makes the breath come-in, passively and automatically. This rapid contraction and relaxation of the abdominal muscles is performed at a very fast rate of approximately two strokes per second. When performed as a part of Bhastrika Pranayama the usual pranayamic deep and slow Puraka is performed after the 20 to 40 strokes of Kapalabhati. The Kumbhaka phase which follows, is usually more prolonged because due to preceding fast breathing of Kapalabhati.
one is able to maintain the phase of inner breath retention more easily and for fairly long time. The Rechaka phase at the end is as usual. This Bhastrika Pranayama, due to its fast breathing part and also due to more longer Kumbhaka phase has a very honoured place in the daily practice of Pranayama Sadhana\(^\text{14}\).

Physiological system of the body to be fit, it must function well enough to support the specific activity that the individual is performing. Moreover different activities make different demands upon the organism with respect to circulatory metabolic neurological and temperature regulative function\(^\text{15}\).

Body composition plays an important role in athletic performance. A substantial amount of evidence is available to indicate that the relative degree of fat free body weight is an important factor contributing to higher levels of physical performance in activities where the total body weight must be moved. In addition, studies have shown that high percentage of body fat not only serve as dead weight but also lessens the relative ability to support oxygen to the working muscles then cutting down on one’s cardiovascular endurance\(^\text{16}\).

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\(^{14}\) Ibid, p. 87-88.


The assessment and prediction of body composition has gained widespread application in various exercise science discipline. There are applications to physiology of exercise, bio-mechanics, exercise biochemistry, anatomy, motor integration, and other allied medical fields that consider such topics as nutritional and dietary assessment, the man-machine interface, as well as various environmental concerns, what ever the application, one major area of interest is the predictive accuracy of body composition assessment, particularly percentage body fat and lean body weight\textsuperscript{17}.

With training and conditioning the heart becomes more efficient and is able to circulate more blood while beating less frequently. For a standard amount of work the heart becomes slower as training progresses. These heart rate changes indicate a decreasing load on the cardio-vascular adaptation to exercise. Blood pressure is also influenced by training. Prolonged efforts in the untrained subjects leads to progressive fall of the systolic pressure which indicates approaching exhaustion\textsuperscript{18}.

\textsuperscript{17} Frank I. Katch and Victor L. Katch, "Measurement and Prediction Error in Body Composition Assessment and the Search for the Perfect Prediction Equation". \textit{Research Quarterly} 51 (March 1980), pp 249-260.

It is perhaps evident that there is a growing realization of importance of physiological variables enhancing the human health and performance. Therefore, physiological variables such as anaerobic power, vital capacity, resting heart rate, resting respiratory rate, lean body weight, body fat percentage and breath holding capacity receive special consideration and it is an important pre-requisite for outstanding performance in sports.

Proponents of the Transcendental meditation technique state that this simple mental process bring about increased efficiency in action after meditation. Efficiency is an index of skill developed through learning characterized by smoother and more integrated behaviour. Efficiency requires good coordination between body and mind. Lack of coordination results in unskilled or poor movements which is dominated by cortical control that supersedes reflex and integrated mechanism\textsuperscript{19}.

In technical sports beautiful and graceful movements are a product of well developed technical skills and coordinative activities. The coordinative abilities to a great extent determine the maximum limits to which sport performance can be improved in several sports especially the sports which depend largely on technical and tactical factors\textsuperscript{20}.


Seemingly, coordinative abilities have no essential significance in sports with standard structures of the movements and relatively constant permanent competitive conditioning. However, purposeful development of coordinative abilities in the given cases one of the determining aspects of sports functioning, on which, above all, depends the level of the sports technical and tactical mastery. If account is not taken of this, constant specialization in standard form of movement will lead to stagnant motor skills and will narrow down the very possibility of their restructuring and renewal\textsuperscript{21}.

There are seven identified coordinative abilities namely (i) Orientation ability, (ii) Differentiation ability, (iii) Coupling ability, (iv) Adaptation ability, (v) Rhythmic ability, (vi) Balance ability, (vii) Reaction ability. All the coordinative abilities are important for learning of sports techniques and for their continuous refinement and modifications during long term training process. The motor learning ability depends to a large extent on the level of coordinative abilities\textsuperscript{22}.

When executing “Coordination assignments” are determined first of all by the fact that they demand utmost concentration of attention, subtle differentiations and regulations considerable with, alertness, creation of new


\textsuperscript{22} Singh. “Sports Training”. pp 225.
forms of movements, coordination and what is more restructuring of the firmly-formed coordination links present a rather difficult task for the nervous system. Naturally it is best of all to tackle it at the beginning of the main part of the training session\textsuperscript{23}.

Coordinative abilities are primarily dependent on the motor control and regulation process of central nervous system. For each coordination ability the motor control and regulation process function in a definite pattern when a particular aspect of these functions is improved then the sports-person is in a better position to do a certain group of movements which for their execution depends on the Central Nervous System functioning pattern\textsuperscript{24}.

The coordinative function of the central nervous system and the one of its properties which Ivan Pavlov called plasticity are given a leading role in physical treatment of the essence of coordinative abilities. The ability qualitatively to coordinate movements undoubtedly depends on the perfection of function of the analyzers\textsuperscript{25}.


\textsuperscript{25} Ibid, pp 146.
To train such training means can also be used as ancillary means of fostering, the improvement of analysers function while at the same time the athlete can stay relatively passive. The analysers: as part of the whole neuromuscular system should be seen as a part of the “Physiological Substratum” of coordination. Their functions co-determine the level of the coordinative abilities. This should be taken in to consideration and these means only applied as an additional means to develop these functions.26

Insufficient training of coordinative abilities limits the performance ability specially at higher level. On the contrary, better developed coordinative abilities provide essential base for effective learning, stabilization of base for faster and effective learning, stabilization and valuation in technique and their successful execution in game situation. The quality of performance of all fundamental mechanical skills, the rhythm, flow, accuracy, amplitude etc. are improved by coordinative ability, it helps in developing very fine extra credible skills.27

The scholar, being ardent lover of yogic exercises and has experienced the great benefits of such exercises. The visible effect of Pranayama is well known and hence the researcher became inclined to venture in to the study to find out the effect of two types of Pranayama on vital physiological variables and lesser known and explored coordinative abilities.

Statement of the Problem

The purpose of this study was to find out the effects of Bhastrika and Ujjayi Pranayamas on selected physiological and coordinative abilities among engineering students.

Delimitations

1. To keep the study unitary and within manageable proportions, it was delimited to the following physiological variables:

   (i) Anaerobic Power  
   (ii) Vital Capacity  
   (iii) Resting Heart Rate  
   (iv) Resting Respiratory Rate  
   (v) Body Composition:
     - Total Body Fat Percentage  
     - Lean Body Weight  
   (vi) Breath Holding Capacity:
     - Positive Breath Holding Capacity  
     - Negative Breath Holding Capacity

2. Was further delimited to the following coordinative abilities:

   (i) Reaction Ability  
   (ii) Orientation Ability  
   (iii) Differentiation Ability  
   (iv) Balance Ability  
   (v) Rhythmic Ability

3. Was also delimited to the male subjects of Madhav Institute of Technology and Science, Gwalior, M.P., India.
**Limitations**

1. Daily routine, food habits and the social background of the Engineering students that might have had affected the study was considered as the limitation for the study.

2. Though the Scholar put exhaustive efforts in procuring best instruments, however still non availability of the sophisticated instruments for the collection of data was also considered as the limitation for the study.

3. Insincere response if any, of the subjects, during the collection of data was further considered as the limitation for the study.

**Hypothesis**

From the scholars own understanding of the problem and as gleaned through the literature it was hypothesized that:

1. There shall not be any significant effect of Bhashrika Pranayama on selected physiological variables.

2. There shall not be any significant effect of Bhashrika Pranayama on selected coordinative abilities.

3. There shall not be any significant effect of Ujjayi Pranayama on selected physiological variables.

4. There shall not be any significant effect of Ujjayi Pranayama on selected coordinative abilities.
Definition and Explanation of the Terms

Anaerobic Capacity

The anaerobic capacity or power is the ability to jump, sprint, put the shot, throw the javelin or perform fast sports converting energy to power. Power is performance of work expressed per unit of time. The terms explosive has been associated with the anaerobic metabolism and test to measure it.\(^\text{28}\)

Vital Capacity

Vital capacity is defined as the largest volume of air that can be exhaled after deepest possible inhalation.\(^\text{29}\)

Resting Heart Rate

Best and Taylor\(^\text{30}\) have stated that the resting heart rate is pressure change transmitted as a wave through the arterial wall and blood column to the periphery while the person is at rest.

Body Composition

Body composition is the proportion of the lean, fat free body mass and depot fat, it is one of the most important morphological features characterizing human organism.\(^\text{31}\)

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Lean Body Weight

The total body weight minus the weight of the body's fat is called lean body weight\textsuperscript{32}.

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\text{Lean Body Weight} = \text{Total Body Weight} - \text{Weight of Fat}.
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Total body Fat Percentage

The percentage of fat contained in the body. It is measured in terms of percent of the body weight\textsuperscript{33}.

Resting Respiratory Rate

Number of breaths taken in a minute or number inspiration / expiration in a minute\textsuperscript{34}.

Coordinative Abilities

"Coordinative abilities are understood as relatively stabilized and generalized patterns of motor control and regulation process". (Those enable the sportsman to do a group of movements with better quality and effect)\textsuperscript{35}.

Reaction Ability

"It is the ability to react quickly and effectively to a signal"\textsuperscript{36}.


\textsuperscript{34} Ibid., p 184

\textsuperscript{35} Singh, Science of Sports Training, p 164.

\textsuperscript{36} Ibid., p 166.
Orientation Ability
It is the ability to determine the position and movements of the body in time and space in relation to a definite field of action.\textsuperscript{37}

Differentiation Ability
"It is the ability to achieve a high level of fine tuning or harmony of individual movement phases and body part movements."\textsuperscript{38}

Balance Ability
"It is the ability to maintain balance during whole body movements and to regain balance quickly after the balance disturbing movements."\textsuperscript{39}

Rhythmic Ability
"It is the ability to perceive the externally given rhythm and to reproduce it in motor actions."\textsuperscript{40}

Significance of the Study
1. The results of study may provide an authentic understanding of practising Bhastrika and Ujjayi Pranayamas.

2. The results of the study may highlight the effect of practising selected Pranayamas on selected physiological variables and coordinative abilities.

\textsuperscript{37} Ibid., p 166
\textsuperscript{38} Ibid., p 165
\textsuperscript{39} Ibid., p 167
\textsuperscript{40} Ibid., p 167
3. The study may throw light and open new vistas with regard to its practical implication on physiological variables and coordinative abilities.

4. The study may help in planning health related fitness programme for engineering students.

5. The study may enlighten public in general, about the role of various types of Pranayama.