CHAPTER I

INTRODUCTION

1.1 Preamble

The discus throw is a field event in athletics where an athlete attempts to throw a heavy disc called as discus as far as possible. This event of discus throw originated in ancient Greece, wherein the athletes were awarded for their precision, physical strength and coordination. The event was supposed to be emerged about 708 B.C. & subsequently added in eighteenth Olympiad. During ancient time the discus was made of lead, bronze stone or iron with varying weights, depending upon the male or female athletes. A typical discus weighs around 41/2 to 13 pounds. or 2-6 kilogram & measures around 8 ½ - 13 ¼ inches or about 21-24 cms. During 1900s, the event gained popularity worldwide and various styles of discus throwing events were evolved. Both hand and single hand competitions were developed in this time period with Nordic swinging throw style.

Presently, the discus or a disc is weighing two kilogram with diameter of 0.219 meter for male athletes while for female athletes the discus is weighing 1 kilogram with diameter of 0.180 meter. To attain proper weight all sides of discus are made up of plastic, metal rim, wood, and carbon fiber. The rim of discus is smooth without any roughness so that the athlete can hold the discus in proper way. Further, more weight is placed towards the rim so that it will produce greater angular momentum and more stability. As per the established rules the athlete takes start in a in a circle with a diameter of 2.5 meter. The circle is made up of concrete. The thrower takes an initial stance generally shoulder width apart and opposite from direction of throw. After that thrower spins anticlockwise inside the circle one and half times to get momentum and releases throw. Throw and shot put are mostly similar only difference is that in discus throw the circle is larger than
the shot put even. Further, stop board is not used in discus throw and athlete has liberty to use any technique to throw discus. In this event the performance of an athlete is measured as distance from the front edge of circle to the discus where it landed. Mostly, three trials are given to the athlete and the winner is declared on the basis of distance where an athlete able to throw discus.

The discus throw, a field event, is becoming popular and many athletes are participating in this event. Infact, the athletes of discus throw should develop several components of technique and physical fitness in order to achieve success. The physical demands vary greatly among the track and field sports, thus appropriate tests may vary greatly for specific athletes as well as for each discipline. In Discus throw event athlete has to maintain coordination between upper and lower body. Further, balance, speed and power are the important factors which contribute towards improvement in discus throw. The discus throwers are prone to injuries that include wrist, knee, lower back strains, tendinitis of the elbow etc. which can be prevented through practice of certain yoga exercises. As it has been evidenced that a discus thrower need to have mastery over controlled breathing along with particular level of speed, leg strength, and loosens up most of the joints, bones, muscles etc to exhibit top performance; the researcher of the present investigation planned this investigation.

1.2 Pranayama- Physiological basis

The purpose of physiological control of respiration is not to equilibrate the blood gas composition with the atmosphere. The whole respiratory mechanism is a great effort towards absorbing oxygen from the atmosphere while still retaining the carbon dioxide in optimum concentration, much above that present in the atmosphere.

The respiratory rate and depth has been adjusted by nature much more than is required for maintaining adequate gas concentration, and large safety margins are in place to avoid wide variations in the blood gas composition. The purpose of yogic pranayama is to train the respiratory apparatus so that to slow down the respiratory rate and depth in
general and occasionally let the oxygen concentrations dip down to hypoxic levels to reap the benefits of adaptive changes to hypoxia. In Hath yoga, the ultimate state Samadhi is very similar to biological hibernation seen in hibernating animals and it is a state of existence in hypoxia-hypothermia.

Let us first see what the ancient scriptures have to say about this.

_Evam vidhividhanena pranayamam samacharet._
_Arambhe prathame kuryat ksirajyam nityabojanam._
_Madhyahne caiva sayahne bhojanadvayamacaret. GS/32_

In the way as described, one should practice regulation of breath. At first one should decide to take meals twice a day.

_Nadi-suddhim katham kuryannadisuddhim tu kidrski_
_Tatsrvam srotumicchami tadvadasva dayanidhe GS/34_

How is nadi suddhi (purification of the nadis) done? Traditionally the word nadi has been interpreted to represent the 72000 nadis, the location of which is mystical. However, the medical understanding of nadis for this verse and the following ones should be understood to be related with the nasal passages.

How are the nostrils cleaned? What is mean by purification of the nasal airways? All that I want to listen. Oh merciful, please tell me all.

_Malakulasu nadisu maruto naiva gacchati._
_Pranayamah katham siddhyettatvajnyanam katham bhavet._
_Tasmannadishuddhimadau pranayamam tatobhyaset. GS 5/35_

If the nasal airways are choked with filth, air can not enter them. Then how can one maste regulation of breath and how can one achieve knowledge of the self? For this reason, at first cleaning of nasal passages, only then should one practice regulation of breath.
For cleaning of nasal passages two methods have been suggested, samanu and nirmanu. Of these by samanu is meant along with recitation of a bija mantra and nirmanu is by the procedure described to wash the nasal passages.

Of these the procedure to wash the nasal passages has already been recounted along with sat karma. The text of Gheranda Samhita contains several verses, the meaning of all those can be summarized as under:

Sitting comfortably in Padmasana, remembering one’s guru and according to the procedure taught by one’s guru, one should perform cleaning of nasal passages, and then one should practice regulation of breath.

Draw in air from left nostril and count upto 16, then hold the breath counting upto sixty four after that exhale from right nostril counting upto thirty two. Next repeat the same while inhaling from right nostril.

It must be made clear that in the ancient scriptures the process of alternate nostril breathing or Anuloma viloma is not considered as a pranayama. This is a requisite in cases where there is filth (mucus) accumulated in the nose. This also implies that anuloma viloma is for the beginners, and once the nasal passages become clean and remain open, there is no need to continue with it further and one may devote more time to the other pranayama. In Anuloma viloma each nostril perceives only half the number of breaths per unit time. In this way, for the beginner, the practice of anuloma viloma also provides some training for the respiratory mechanism to be content with only 7 breaths in a minute in place of the usual 14. This helps in prolonging the breath holding.

**Physiology of the nose**
The nose is a very important organ of the respiratory system. It filters the incoming air by the hair present in it and renders it free of suspended particles by trapping them in the mucus. The richly vascular nasal conchae brings the air to the body temperature, warms it up and makes it moist, or cools it if it is too hot. The capillaries in the nasal circulation drain in sinusoidal structures which are endowed with smooth muscles in their walls and are capable of contracting. When they fill up with blood, the nasal mucosa gets congested and the nose gets blocked. Sympathetic nervous stimulation constricts them. For this reason sympathomimetic drugs are used as nasal decongestants.

The nasal mucosa is very sensitive to air temperature. Cold air entering the nose produces immediate reaction in the form of congestion and mucus secretion. Sometimes this reaction becomes disproportionate and takes the form of what is known as vasomotor rhinitis. Therefore, exposure to cold air may ruin a perfectly fine morning. In medical physiology, while the temperature sensitivity of the nose is well recognized, no thought has been given as to whether this sensitivity is in any way different for the right and the left nostril.

The anatomy of both the nostrils is the same, and physiologists will hardly agree there could be any functional difference between them. However, there is no controversy about the functional differences that exist between the two cerebral hemispheres, leading to right or left handedness. If due to handedness one's right fingers, right eye and right ear is more sensitive than the left, it is logical to expect that there is some difference in the two nostrils.

The nasal cycle

Eighty percent of normal individuals experience a cyclic change in the state of congestion in one or the other nostril. The cycle length is said to vary from 2-7 hours. Also, if one lies in a decubitus position, the upper nostril gets opened while the lower gets congested. Here also, no importance is given to the nasal cycle in Medical physiology, nor are we told about the purpose of the nasal cycle.
Ancient scriptures in yoga particularly Svara Sastra of which Siva Svorodaya is a representational work advises everyone to start the day with the right nostril open. Although the scripture ascribes some mystical advantages with this, practically speaking the minimum one can expect is to have the nose open throughout the day. The easiest way to achieve this is to lie in the left lateral decubitus for just 2 or 3 minutes before getting up from the bed while awaking and one should leave the bed only when the right nostrils opens up.

The physiological mechanism is easy to understand in the following way. It seems that at least in all right handed persons the left nostril is more sensitive to cold air than the right one. Thus if cold air enters the left nostril, more congestion and nasal discharge results. For this reason, one should not allow cold air to enter the left nostril. When we get up from the left decubitus, we allow more cold air in the right nostril, and thus escape the nasal reaction by allowing less cold air to enter the left nostril.

There are many alternative ways to correct a running or congested nose other than by instillation of nasal drops. In our childhood we used kerosene lanterns as a source of light for studying. Whenever we caught a cold, we used to breathe in hot air from this lantern which would quickly open up a blocked nose. But we observed that the congestion returned as soon as the nose was exposed to cold air again. Presently, it is recommended anyone to use Sitali pranayama which involves taking in air through the mouth rolling the tongue into a tube like structure, exhaling it slowly through the nose. Physiological explanation is that we take in cold air through the tongue rolled in a tube, thus avoiding exposure of the nasal mucosa to cold air, and taking advantage of the fact that it immediately gets heated to body temperature, we exhale it slowly through both the nostrils.

Another way to get relief in blocked nose is to use the open nostril to fill in the air and after allowing the air to get heated in the lungs exhaling it slowly through the closed nostril. This is the physiological basis of one of the benefits of the widely practiced technique Anuloma-Viloma.
The third way to get relief from blocked or running nose is through the technique of Mul Bandha (contraction to the external anal sphincter). This is a great yogic technique which pumps adrenaline into the system.

In yoga, the breathing cycle is not counted as inspiration expiration, but just the reverse i.e. expiration-inspiration. That is, one first breathes out through a nostril and then fill in the air through this nostril. After holding for some time, one exhales through the other nostril and then inhales through the same nostril. In effect, while performing nadi sodhana (Anulom-Viloma) even if one continues to breathe exactly 14 times a minute, instead of breathing all the 14 times through both the nostrils one is now breathing 7 times per minute through each nostril. This reduces the proprioceptive impulses reaching the respiratory centre. Gradually this teaches one to slow down the breathing without getting restless, and trains one to overcome the first urge to breathe the urge that something should continue to flow through the airways. Further, it has been observed that the alternation of nostril breath after breath improves interconnection between the two hemispheres, although this is only a distant hypothesis.

**Prana and Consciousness**

It is said that prana is the vital aspect for existence and consciousness. Prana is considered as the medium of consciousness. That means without prana, consciousness will not be able to express. Prana and consciousness are considered two poles of the one source: the self.

This is because both prana and consciousness come together when the individual is born and leave together at the point of death.

**Prana and Scientific Research**

The knowledge of Prana is not new. It has been known to the yogis from time long past by virtue of their intuitive realizations. Scientific research in the 20 the century has endorsed the findings of these wise men, confirming the existence of the pranic body.
There have been several non-mystical scientific minded people who have demonstrated and or given evidence to support the existence of the pranic body. In 1935 Dr. Harold S Burr, established that all plants, animals, organic matter and humans are enveloped by an energy body. He called it the electro dynamic field and stated that it controlled shape & decay of all cells, tissues and organs, growth which is responsible to regulate the functions of the physical body.

In 1939, Semiyon Kirlian, an ingenious technician from Russia, and his wife developed a photographic device of high frequency that produced images of the pranic body of humans, plants and other organic matter, with revealing conclusions. No one had seen such beautiful, iridescent colors emanating from the pranic body lights of all colors bursting and ten some fading away. The scientists were seeing a new kind of energy that defied all previous characterization into normal forms of energy. They called it the bioplasmic body and termed its light emanations as bioluminescence. Bio means life and plasma is defined as a gas containing ionized and neutral particles, or ionized gas with positive and negative charged particles.

Scientists were surprised to come across that even if a part of the physical body was detached, the cut off or amputated portion still retained its vital bio plasmic mold or pattern and corresponding pranic energy they further found that this body gives off its own electromagnetic field which can be measured by sensitive instruments, further, that this field changes according to the moods or mental and emotional conditions of the individual possessing it.

This led to the conclusion that an individual’s electromagnetic field is influenced by various other energy fields, such as those emitted from various machines & the vibratory effects of the sun, the moon and other planetary bodies.

However, the most notable discovery was subsequently made by eminent Russian scientists who stated that this energy or pranic body needed continual replenishment from the air we breathe. It was found that the oxygen absorbed during the body’s intake
of life sustaining breaths gives few of its excess of free electrons and quantum energy to this bi plasmic body.

Dr. Hiroshi Motoyama, President, of the International Association of Religion and Parapsychology in Japan has done some extraordinary research proving the existence of nadis, chakras and the meridians of the Chinese system of acupuncture.

The subject of manipulating the pranic body by pranic healing is an esoteric science and adequately propounded and demonstrated by Master Choa Kok Sui of the Philippines, the modern founder of pranic healing and Arhatic yoga. His books, especially the Miracles of Pranic Healing are extremely practical and revealing.

Science has thus confirmed knowledge propounded by the ancient yogis. As a result of the close relationship among the pranic body, mind & physical body, Pranayama exercises are found not only to manipulate and revitalize the pranic body, but in addition, breath with prana as its matrix establishes itself veritably as the very source of sustenance of this bio plasmic body.

It must be noted that the pranic body can be manipulated not only by pranayama and pranic healing, but also by acupuncture and acupressure. Due credence is given to the Chinese yogis who were aware of the pranic body and discovered about seven hundred points on the skin which correspond to the flow of prana or qi, and developed the system of acupuncture.

A prick of a very fine needle at those meridian points corrects the balance of prana in the pranic body, by the redistribution of prana to the diseased part to other parts of the body, thereby curing a particular ailment and preventing the occurrence of illness.

In case of acupressure or reflexology, the principle is the same but, instead of needles, the healer uses his or her fingers to apply pressure to certain points on the palms or the soles of the feet and, in addition, transmits their own excess prana to the pressure points for distribution to the needy parts of the patient.
**Pranayama**

Pranayama is composed of two words. ‘Prana’ equates ‘vital life force in motion and ayama means to stretch, restrain and expand. Hence, pranayama can be stated as to overcome the limitations. It also implies pranic capacity or length.

It employs breath control to bring about alterations in the flow of prana in our body.

Breath control means to alter:

- The extent of retention, exhalation and inhalation.
- The deepness of inhalation and
- The strength of inhalation and exhalation.

Pranayama exercises can be sorted into four basic categories:

- Sensitizing
- Tranquilizing
- Balancing
- Vitalizing

All pranayama exercises have an energizing effect; the vitalizing techniques have a heating effect, tranquilizing techniques have a cooling effect and balancing techniques have a balancing effect on prana flow and the physical body. All such techniques essentially refine, harmonized decongest, charge the frequency of pranic flow and promote proper distribution to parts of the body via the vast network of nadis.
Prior to starting any pranayama exercises, it is imperative to know and practice yogic breathing and a few exercises for developing lung and breath capacity. This will facilitate the practice of other balancing and vitalizing exercises. One of the safest and basic breathing exercises to develop breath and lung capacity is sama vrittin pranayama. Sama means equal and vritti means movement. In this exercise one full respiration comprised of inhalation, retention, exhalation and retention, in the ratio 1:1:1:1. So if you inhale for a count of four, then each of the other three actions must also be maintained for a count of four. This can be done with ease several times to achieve positive results. The count could be increased according to your comfort and capacity.

Advanced pranayama exercises are best learnt in a yoga class from an experienced yoga teacher or master. There are many who, without having any knowledge of prana and its relationship with breath, start doing these exercises by reading books or watching video clips, without understanding the contra-indications of each exercise. This ignorance can bring the practitioner to a state of ill health and great danger. So never be in any kind of hurry in learning this.

There are several guidelines for the practice of pranayama.

Posture: The primary requirement is a relaxed, upright position, enabling the flow of breath to be unhhampered, so that pranic forces may be liberated. There are many who assume a hunched position while sitting cross legged. This must be avoided, as this position contracts the abdominal area and restricts the flow of breath, resulting in various respiratory ailments. In addition, it hampers concentration and the effects of the techniques employed.

Place or environment: Pranayama should be ideally practiced in a clean, open room with proper ventilation, or in the open air, but a site free of environmental pollution.

You must avoid practicing in any kind of foul-smelling or dusty room.
Never do this in the heat of the day or

When it is windy, or in a draught, as these factors upset the body temperature and disturb the internal balance.

Time: according to yogis, the best time for yogic practices is early morning, between one and two hours before sunrise. Because at this time environment is pure and best. There is no hard and fast rule about this, and if you are a late riser, then after the morning ablutions is equally good.

Alternatively, after sunset is a suitable time, but there is a caution to be sounded: you must never indulge in any vitalizing pranayama before going to bed. However, before sleeping, a tranquilizing pranayama can be performed, as such exercises can be extremely soothing to the nerves and conducive to sleep.

Bodily conditions: Personal hygiene and cleanliness, external and internal, are of utmost importance. A shower or a bath is a good pep up before pranayama. The bowels and bladder should be relatively empty before any such practice. It should never be done after meals, or when you are hungry. You should wait three to four hours after you eat. It is suggested that you only drink juice one hour or so before pranayama. As prana flows without obstruction and not concentrated in digestive system, thus leaving the prana flow for other subtle activities within the body. Practitioners are advised to refrain from smoking and the intake of any narcotics or hallucinogenic drugs.

Do not wear any clothes or use any coverings such as shawls or blankets of made out synthetic materials. Natural fibers like wool or cotton is supposed to be best. The reason for this is that synthetic fabrics keep away negative ions and draw only positive ions. These positive ions act as an obstruction to the flow of negative ions into body, thereby hampering the effects of pranayama and result in adverse health conditions.

There should be no physical strain of any kind and breath retention should be done only as long you feel comfortable.
Practice and Attitude: Every category of pranayama has advanced levels and it is best to climb the ladder starting at the bottom with preliminaries and ascending with patience and fortitude. The most important aspect is regularity and the maintenance of living habits conducive to these subtle exercises. Pranayama works wonders over a period of time provided one is consistent. It is a slow and steady practice of harnessing the pranic force and stabilizing mental eruptions.

The Pranayama occupies the fourth position in the ladder of Ashtanga yoga of Patanjali and deals with the very fabric of the existence of life which is referred to as vital energy or Prana. The Hatha yoga mentions that practice of yogic methods like Pranayama, Bandha, Mahamudra and Kriya will cure all the diseases both of acute and chronic types as quoted in the verse H.P.: 3.1.6,3.7,2.16 Ed. (Digamberji & Kokaje, 1970). However, the term Prana is a breathing phenomenon in a true physical sense. But the scientific community and medical fraternity recognizes only two facets of respiration i.e. normal and pathological. But the Pranayama according to the tested belief based on traditional claims defined conveniently as per psycho physiologist is often equated to an applied technique of respiration performed voluntarily whose effects are taking place at various physiological levels and cellular level that are mostly attributed to the metabolic domain on all system levels. On the contrary, the neurophysiologists propose the Prana as train of nerve impulse being modulated by the brain to drive all the other systems as logistic units for survival of various body organs by regulating through metabolic activity of the body.

Therefore, according to neuro-psychology, the typical breathing with or without effort involves power of the brain to modulate neuro-muscular system for logistic purposes both on system and cellular level for targeting all the necessary physiological systems such as respiratory, circulatory, cardiovascular systems, etc for an efficient, economical mode of transport of gases, such as O₂, CO₂, NO gases, metabolites like glucose, Na⁺ and K⁺ ions, glandular secretions such as insulin, bile juice and enzyme actions like ATPase, Phosphokinases, etc towards the completion of metabolism at cellular level in each and every cell types. However, on the contrary Swamijis’ preliminary findings which reveal that Pranayama leads to reduced oxygen consumption suggests an unique
objective towards art of managing metabolic resource allocation but not mere logistic aspect to meet the physiological and metabolic demands.

**The value of carbon dioxide**

This gas is not a total waste as we have been given to understand. There is some reason why the body maintains its partial pressure at 40mm Hg. When it is very easy to reduce it to near atmospheric concentration where the partial pressure is just 0.3 mm Hg. Indeed, if we get rid of Carbon dioxide in any amount in excess of the surplus, we land into a state of alkalosis. The ratio of carbonic acid to bicarbonate ion has to be maintained in a defined range; otherwise the pH of the body fluids will change drastically. Although what Hale has suggested appears an oversimplification; that the clinical condition of bronchial asthma is a result of hyperventilation and that the broncho-constriction is a simple attempt at conserving carbon dioxide in the body. This is difficult to agree with at present. Had it been so simple, a gas mixture containing carbon dioxide with a partial pressure of about 35 mm Hg could have solved the problem. Nevertheless, value of carbon dioxide must be recognized.

**Physiology of control of respiration**

In medical physiology, the process by which respiration is normally involuntarily carried out and ventilation is adjusted according to the need of the body is called control of respiration.

The function of the respiratory system is to take in atmospheric oxygen in the lungs, and transport it to the blood, and transport surplus quantity of carbon dioxide from the blood to the atmosphere, while retaining the required quantity in the blood to maintain the blood pH within normal limits. We have been given to understand that we breathe to take in oxygen and throw out carbon dioxide. This statement, although completely true, is an oversimplification. To understand this mechanism a simple experiment is explained in following paragraph.
Let a subject breathe quietly while observe the respiration. Now pinch the nose so as to stop the respiration for just 4 seconds. What do we observe? The subject immediately compensates for the interruption by taking one or two deep breaths. Not only this, but for the next several minutes to come his respiratory pattern remains altered. Stopping the breath produces lack of oxygen and accumulation of carbon dioxide, and that is what causes the subject to take one or two deep respirations. Not true. An interruption or prolongation of duration greater than 4 seconds is caused by several physiological processes, such as swallowing a bolus, speaking a long sentence, singing etc. which do not cause fast breathing.

So, the second to second to second respiration does not depend upon the oxygen and carbon dioxide concentration. It depends more upon the proprioceptive feedback information received by the respiratory centre regarding the amount of air flow, degree of stretch of the lung alveoli, effort done by the respiratory muscles etc. In other words, the primary need (the first urge) is to have some odorless gaseous substance flowing to and fro the air passages. In comparison with the other major systems of the body, such as the cardiovascular or the renal system, the respiratory system is different in several ways.

Unlike other systems, the respiratory system very intensely depends upon the medullary respiratory centre for regulation so that it can be said that like retina, the respiratory system is also an offshoot of the central nervous system.

The respiratory centre is a group of neurons in the pons and the medulla oblongata; parts of the brainstem in the central nervous system. The centre receives afferent impulses via several cranial nerves the trigeminals, glossopharyngeals and the vagi, and also proprioceptive impulses from the skeletal structures of the thoracic cage- the ribs and their joints with the vertebrae. The respiratory centre receives afferents from and sends efferent connections to the intercostals muscles via the thoracic spinal nerves and the diaphragm via the phr0enic nerves.
Normally the rate and depth of respiration is adjusted by the respiratory centre according to the need of the body at that given time, the need to maintain the paO2 and paCo2 within the normal range. Out of these two parameters, the paCo2 is the primary drive we breathe as much as is needed to keep the paCo2 under the upper limit of the normal. In simpler words, normally the respiratory centre does not allow paCo2 to increase, after which, the paO2 is maintained above lower normal limit. If somebody's respiratory centre allows paCo2 to increase, we call it a type of respiratory failure and then the person breaths as much as is required to keep the paO2 within normal limits, we say the respiratory centre is working on the anoxic drive. However, we shall soon see that these are several pitfalls in these concepts. In fact, our minute to minute respiration goes on with a proprioceptive drive and is not mediated by hypoxia or hypercapnia.

In the cardiovascular system, the heart can function normally even when the nerves going to the heart are cut. Both the sympathetic nerves and the vagus can be cut and the heart still performs its functions normally. Not only that, although the baroceptor mediated reflexes are important for maintaining the cardiovascular homoeostasis, the heart itself is normally capable of regulating the blood volume by other means as well. Two examples are the atrial natriuretic peptide and the brain natriuretic peptide, both secreted by the heart and help regulating the blood volume.

The kidneys also can function normally in the absence of an intact nerve supply. Although normally, the adrenergic a receptor mediate the secretion of rennin. The secretion may go on without sympathetic innervations as well.

In contrast to the functioning of the heart which can go on even if the nerves are sectioned, if the nerves to the intercostals muscles and the diaphragm are cut the respiration stops and the individual dies. For this reason, it is decidedly true that respiration depends much more closely upon the integrity of the ponto medullary respiratory centre and its connections with respiratory organs. The respiratory centre has to regulate the respiration not only from minute to minute or from second to second, but the control is exerted over every fraction of a second. Not only the efferent but the
afferent connections are equally important. the respiratory centre needs and gets all pertinent information in real time. Indeed, it is now well known that a wide range of information reaches the respiratory centre which includes the degree of stretch on the lung alveoli, the degree of contraction of the intercostals muscles and the diaphragm, the air content of the thorax, and most likely the volume of air flowing in the trachea, bronchi and one or the other nostrils. How does the nasal mucosa perceive the direction of air flow? Is it through perception of the direction of stretch over its cilia is definitely a subject to be studied. With a little effort, we can consciously perceive the direction of flow in the nose, throat and the trachea and there is all reason to believe that subconsciously, i.e. when the respiration goes on automatically and if we do not pay attention to it, even then all this information regarding the volume, velocity and direction of air flown with each inspiration and expiration goes to the ponto-medullary respiratory centre.

In addition, the information regarding the blood gas content like the arterial partial pressure of oxygen (paO2) and that of carbon dioxide (paCo2) which is being constantly watched by the chemoreceptors also continuously reaches the respiratory centre. Using all this information the respiratory centre regulates the minute volume, i.e. the volume inhales and exhaled per minute. Normally all the data from the various sources is added up to synthesize all the useful information.

Also, normally all the data are congruent. For example, when we inhale a certain amount of air, the information about the volume of air flow through the nostrils/airways matches the degree of stretch of the lung alveoli, the degree of contraction of the intercostals muscles and the diaphragm. So the respiratory system depends more intimately upon the ponto-medullary regulatory centre. That is the reason why we call the failure of this centre to respond to increases in pCo2 as type II respiratory failure while the terms cardiac failure and renal failure are applied to failures of the organs such as the heart and the kidney respectively. Now let us consider why a distressful sensation results from holding breath. The sensation resulting from prolonged breath holding is variously described as tightness in the chest, suffocation and ghabarahat. This has been supposed to be resulting from hypercapnea albeit erroneously. we can
ward off that sensation by performing false inspiratory-expiratory movements. We can tolerate much higher degree of hypoxia or even hypercapnia than is produced by breath holding beyond 60 seconds. This fact is well demonstrated in experiments. It has been seen that in individuals after breath holding to maximum, if a gas mixture is given containing low O2 and high Co2 they can tolerate this for another 20 seconds or so. It can easily be demonstrated that any inert gas flowing in the airways wards off the sensation of suffocation, although it may make one unconscious.

Hence, the most likely reason for the tightness sensation and suffocation appears to be just the lack of cyclic in-out afferent information reaching the ponto-medullary respiratory centre. When this centre perceives the absence of respiratory air flow, it relays the information to the higher centres, like an alarm bell, and we perceive sensation of suffocation.

**Why do we breathe**

It is not due to lack of oxygen or excess of carbon dioxide. Swami Kuvalayanandaji wrote: practically our breathing is under our own control up to a point where life is involved. We can breathe in any manner and at any rate we please. Were it not so, speaking would have become impossible. We can also hold our breath to a certain point; but when life is beginning to be threatened, the voluntary control comes to an end and inspite of the strongest effort, we are forced to breathe. The involuntary control also acts continuously when we are not thinking of our breath at al. none of the vital processes require our constant attention, yet with some we are allowed to play up to a point of danger but not further.

**Urges to breathe**

Here a new concept of different urges to breathe is presented. This is new concept but it will help us understand in a much better way the phenomena associated with control of respiration.

The metaphor: Let us take the example of a shop run by a young man in his thirties, and his old father. While the young shopkeeper runs the shop, counts the money, calculates
the profit and invests some of it in the expansion and maintenance of the goods in the shop, the father only sits at the gate counting the number of people entering the shop and number of people leaving it. Suppose some day the number of people entering the shop reduces drastically, the father gets tense. If things go this way, so few customers coming, how is the shop going to run?, he thinks. Another situation also worries the father, say, some customer stays inside the shop for unusually long time, the son, who is inside the shop, may not have noticed this fact, but the father, sitting at the gate watching the customers enter and leave, gets worried.

The story can be likened to the respiratory system in more than one ways. Starting with the first breath at birth and continuing till death, in a common man not trained to hold the breath, the respiration goes on rhythmically and continuously, inspiration follows expiration and expiration follows inspiration without delay or an intervening period.

There are two urges to breathe:

Something must keep flowing along the airways (sensation of suffocation does not arise if something keeps flowing. It does not matter if it is air, pure oxygen, or any other non-irritating, odorless gas such as pure nitrogen.)

The structures concerned with respiration must keep moving (The chest wall and the diaphragm are the structures involved, and if keep on moving, the movement wards off the sensation of suffocation.)

**The first urge to breathe:**

The information regarding the movement of air in the airways as well as the nasal passages is perceived through the movements of the cilia and transmitted to the CNS (Ponto-medullary respiratory centre) through the maxillary divisions of the two trigeminal nerves, the two glossopharyngeal nerves and afferents in the two vagi. If a graph is plotted of the movement of air in the airways, it is easily seen that not a single second elapses when the air is not flowing in one direction or the other. If one tries to consciously interrupt the process of respiration, one feels acute desire to resume
breathing. If one holds the breath just for four seconds, one will immediately compensate the breach in continuity of this to and fro rhythm by taking one or two deep breaths before the regular pattern of respiration resumes. The longer one holds one’s breath, the deeper one has to inspire to overcome the feeling that results from holding the breath. Thus we have a need to have air flossing in one or the other direction. This may be termed as the first urge the urge to keep the air in the airways moving.

To those who still think that we breathe in order to maintain a definite oxygen concentration, I must point out that the first urge to breath can be satisfied by breathing pure nitrogen; and for several seconds no feeling of suffocation results. Inhalation of pure nitrogen may make an individual unconscious and cause brain damage without him noticing it. It is possible to produce hypoxia by breathing 10% oxygen at normal barometric pressure.

Indeed, a mixture of oxygen 10% with nitrogen 90% has been called the HGM-10 (hypoxic gas mixture 10%) and made use of in the USSR for more than 50 years for research and training, and for treatment of conditions ranging from coronary artery disease to cancers.

Of interest to the physiologist should be the fact that while the information regarding air flow in one or both the nostrils in inward or outward direction must be conveyed to the ponto-medullary centre through the trigeminal nerves, to date no experiments have been conducted to study the effect of sectioning the trigeminal nerves on the regularity, rate and depth of respiration. Such studies have been done by sectioning the vagi, whereby it has been shown that the respiration becomes irregular and deep. Without studying the involvement of and effect of sectioning the trigeminal nerves, these studies appear inadequate and incomplete.

**Yogic way to overcome the first urge**

Here comes the importance of alternate nostril breathing. If one breathes alternately through one or the other nostril, the closed nostril does not send up any signal to the respiratory centre. Only when it is opened it transmits some impulse. Thus each of the two nostrils transmits information only half the times as compared to normal respiration.
when both the nostrils are kept open. The yogic practice of anuloma viloma which is a process for nadi sodhana or cleansing the airways rather than being classified as a pranayama can be perceived as alternate breathing through the right and the left nostril, (in yoga respiratory cycle is counted as expiration-inspiration instead of the medical inspiration expiration). With alternate nostril breathing, given a respiratory rate of 14 per minute, each nostril will transmit signal only 7 times in a minute. In the process the respiratory centre learns to do away with a lesser inflow of information, or, more precisely, do with 7 signals per minute instead of 14.

It can be easily demonstrated that after breath holding when the urge to ventilate becomes irresistible, it can be satiated for some more time even by the opposite movement. Let it explain this further, suppose one has held the breath after a deep inspiration. One holds it for 50-60 seconds till it becomes irresistible. Apparently the urge is to breathe out. However, if at this point one opens the throat and inspires a little further, one is able to hold the breath for a few seconds more. Same is the case with holding breath in expiration. (Bahya Kumbhaka). Bahya Kumbhaka is done in the following way: Throw the breath out and hold it there for as long as you can. When it becomes irresistible, instead of breathing in, exhale a little more air.

The second urge:

The second urge is to perceive the movements of the respiratory apparatus, i.e. the chest wall and the diaphragm. The sensations of movement are perceived through the spinal nerves supplying the intercostal muscles, costovertbral joints, parietal pleura and the phrenic nerve supplying the diaphragm. In addition, hypoxia of the respiratory muscles is an important input in the perception of dyspnea.

Yogic way to resist the second urge:

It can be easily demonstrated that while breath holding either in inspiration or in expiration when it becomes irresistible, some more time can be gained by performing false movements of the chest and the diaphragm, i.e. movements without allowing air to
either enter or leave the thorax. Such movements can be done in different forms, as under. All these maneuvers should be done in full expiration with a closed glottis.

Repeated synchronous contraction of rectus abdominis muscles. In yoga, this is known as Vahni-sara. It has several other effects as well.

Rotation of the abdomen, by alternate contraction of rectus abdominis muscles. In yoga this is known as Nauli Kriya.

Sucking in movement of the chest wall. In yoga this is known as Uddiyan Bandha.

Repeated contractions of the diaphragm. In yoga, some people call it sakticalana, although this is controversial.

In the pulse oximetric studies done at the Antar Prakash Center for yoga, it was identified the most effective ways of producing hypoxia. Breath holding in full inspiration does not produce hypoxia in any individual. Bahya Kumbhaka (Breath holding in full expiration) is effective in some individuals. Prolonged breath holding required to produce hypoxia is possible only either after a few minutes chanting of AUM in which the breath is naturally prolonged beyond about 30 seconds, or using a single sequence Bhashrika-followed by Bahya Kumbhaka (hyperventilation followed by breath holding in full expiration). This is the maneuver is effective in almost all individuals. It was seen that hypoxia of Spo2 80% can be easily produced by this method.

The effect of hypoxia hypothermia combine is important in hibernating mammals. It drives the creature into hibernation. The genes related with hibernation are also present in the human genome. It is possible that yogis while undertaking underground Samadhi actually enter hibernation.

*Importance of carbon dioxide*
Oxygen flows in the direction of its partial pressure gradient from atmosphere to the blood, reverse occurs with carbon dioxide which flows from blood to the atmosphere. The partial pressure (mm.Hg) and direction of flow are as follows:

**Oxygen**

<table>
<thead>
<tr>
<th></th>
<th>Atmosphere</th>
<th>Lung Alveoli</th>
<th>Venous blood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen</td>
<td>153</td>
<td>108</td>
<td>40</td>
</tr>
</tbody>
</table>

**Carbon Dioxide**

<table>
<thead>
<tr>
<th></th>
<th>Atmosphere</th>
<th>Lung Alveoli</th>
<th>Venous blood</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂</td>
<td>0.03</td>
<td>40</td>
<td>46</td>
</tr>
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</table>

The atmospheric air while reaching the lung alveoli gets diluted with the alveolar air and therefore the partial pressure of oxygen comes down a little. This is easy to understand. More difficult to understand is that while the atmospheric air contains negligible partial pressure of carbon dioxide in the alveolar air it is maintained quite high, at 40 mm with which the pulmonary venous blood is equilibrated. So while the gradient of oxygen between the atmosphere and the alveolar air is 153:108 that for carbon dioxide is 0.3:40 isn’t it somewhat disproportionate? Traditionally we have been taught that carbon dioxide is a waste gas that has to be eliminated from the body, but this is not the whole truth. If carbon dioxide was totally a waste product, the body could have eliminated much more of it. It would have been in the interest of the body to maintain a much lower partial pressure in the lung alveoli.

In fact if you imagine that we modify the respiratory system removing all the branching airways and somehow bring the whole alveolar surface in contact with the atmospheric air, the pulmonary venous blood will not be left with any carbon dioxide at all. This may bring about drastic changes in the pH of arterial blood which is maintained at 7.4 due to interplay between levels of carbon dioxide (carbonic acid) and bicarbonate ion, the two important limbs of buffer system of plasma.
The respiratory physiology has it that the airways dilate a little during inspiration while they constrict a little during expiration. This only reflects the intention of the body to maintain a high partial pressure of carbon dioxide in the lung alveoli, and thereby in the arterial blood.

The partial pressure of oxygen in the arterial and venous blood is, respectively 100 and 60 mm Hg. At 100 mm partial pressure the hemoglobin is 98% saturated. Oxygen diffuses down the partial pressure gradient. When blood leaves the alveoli which have Po2 108 mm, the hemoglobin is fully saturated. In other words, if we require only about 120 mm of po2 in the inhaled air for our hemoglobin to get saturated fully, it seems that we are living under a tremendous abundance of oxygen. Hill atmosphere may be more favorable for health due to its lower atmospheric pressure and consequently a lower po2. A day may not be far away when like air conditioners, our rooms will be fitted with equipments to reduce the ambient oxygen concentrations, room hypoxicators machines that will throw out some of the oxygen from the room air.

1.3 Preparation of Pranayama

Pranayama is the next Yoganga after Asana. After attaining the comfort and stability through the practice of Asanas one starts on Pranayama. The words 'Tasmin sati’ in the P. Y. S. on Pranayama which means 'Asane sati’ and 'Athasane drdhe’ in H. P. II—1 indicate the propriety of preparing the ground for Pranayama through the practice of Asanas. So the first requisite for Pranayama is a stable and comfortable posture. If one suffers from the imbalance in the form of excess of fat, mucus or bile one should undergo purification of the body by resorting to the cleansing processes as may be necessary.

It is necessary to see that the metabolic and emotional disturbances are brought to the minimum. During the practice of Pranayama all the excesses that create disturbance in the psychophysical background of an individual should be avoided. For this Yoga texts suggest the consideration of place, time, moderation of food and purification of the Nadis (cf Gheranda Samhita V-2, H. P. 1-61). Nadisuddhi is considered preliminary to Pranayamain Gheranda Samhita It is said to be of two kinds—Samanu and Nirmanu. The
Samanu process consists of three Pranayamas done with the recitation of Yam, ram, tham and keeping the ratio of 16: 64: 32 matras for Puraka, Kumbhaka and Recaka respectively. Nirmanu process involves different purificatory techniques such as Dhauti etc. The use of bijamantras is not prescribed by Hathapradipikawhile describing the process of Nadis'uddhi Pranayama. Vasistha Sarhita H-64-64 gives a procedure of Nadis'uddhi which includes controlled inhalation and exhalation without retention of breath. The results of Nadis'uddhi described by the Vasisthasarhita 11.68, 69 and H. P. 11-78 are: (1) Slimness of body 2) Stimulation of gastric fire, (3) lustre, (4) experience of internally aroused sound.

Judicious (Yukta) Pranayama and Injudicious Pranayama:

Judicious Pranayama alone is helpful. Injudicious Pranayama brings the student to troubles. Judicious Pranayama has been described by Hathapradipika in the following words: (Yuktam yuktarh tyajedvayum yuktarh yuktam ca purayet/Yuktam yuktam ca badhniyadevam siddhimavapnuyat //) H. P. 11-18. "One should exhale, retain and inhale in a regulated manner and should thus attain success (m Pranayama)." Every phase of Pranayama should be judiciously practised. One should inhale neither too much nor too little and according to the technique prescribed. The inhalations should be slow, smooth and complete. The exhalation should be slower, continuous and complete. The exhalations should be invariably through nose and never through the mouth. Holding of the breath should be accompanied by the three Bandhas, namely, Jalandhara, Uddiyana and Mula. Jalandharabandha is applied after inhalation (Puraka), Uddiyanabandha is to be applied after inhalation Puraka), but before the Recaka staits and Mulabandha is applied throughout the practice. Three phases of Pranayama, namely, Puraka, Kumbbaka and Recaka must be performed with an adequate ratio of 1 : 4 : 2. During the period of the practice of Pranayama one should subsist on very moderate diet consisting of more milk and rice mixed with ghee (clarified butter). With the practice of Yukta Pranayama one gets rid of all the ailments. However, with the Ayukta Pranayama one is likely to contract all the
diseases due to the disturbances of wind like hiccup, asthma, cough, various kinds of pain etc.

1.4 Rationale of Pranayama

The purpose of Pranayama has been given in nutshell by Patanjali as "Prakas'avara.naksaya " and "Dharanasuca yogyata manasa." It means that Pranayama is practiced to rid the mind off the domination of egoistic thoughts which prevent a proper impersonal appreciation of Reality, and to qualify the mind and make it competent enough to engage in concentration.

Pranayama has a far-reaching effect both on the body and the mind. As Hathapradipika tells us, it purifies the body and as such is a substitute for the cleansing processes. But its greater effect is on mind. The idea of purificatory effects, especially, on psychological level has been prevailing since long which can be seen in the prescription of number of Pranayama as rite of expiation.

Varieties of Pranayama:

Pranayama may be classified as voluntary and involuntary. Patanjali mentions four types of Pranayama out of which the Bahya (external) and the Abhyantara (internal) are of voluntary type. The Stambha and Caturthaare of involuntary type. In other terminology Pranayamasis referred to as Kumbhakas. These are also of voluntary and involuntary type. The former is called Sahita Kumbhaka and the latter as Kevala Kumbhaka. The Bahya Pranayama mentioned by Patanjali seemsto have been relegated into the background in course of time and Abhyantara Pranayama was preferred more. Later in Hathayoga tradition we do not get even the trace of Bahya Pranayama. Different varieties of Pranayama mentioned in Hatha texts are all of Abhyantara Pranayama.

These varieties are to be practised in order to reach the stage of Kevala (involuntary) Kumbhaka. Hathapradipikasays:("Yavatkevalasiddhiih syatsahitam tavadabhyaset") "Sahita is to be practised until one attains Kevala Kumbhaka" H. P. II.
The nature of Kevala Kumbhaka as mentioned in Hathapradipta is the absence of inhalation and exhalation. "Recakarh purakarh muktva sukharh yadvyudharanam /pranayamo' yamityuktah sa vai kevalakumbhakah//"'Pranayama without any inhalation or exhalation", in which the breath is retained with ease is known as Kevala Kumbhaka. H. P. 11.71-72. Hathapradipta has describes 8 types of Sahita Kumbhaka i.e. Ujjayi, Suryabhedana, Bhastrika, Murchha, Brahmari, and Plavini. Plavini is omitted from Gheranda Samhita and Sahita and kevali are included in it. Thus, having 8 types of pranayama are included in Gheranda Samhita. Important aspects of different pranayama are described as follows:

Suryabhedana: In suryabhedana, inhalation is done through right nostril first. ‘Surya’ stands for right nostril and ‘bhedana’ stands for pierce. After inhaling through right nostril, breath is held for a while and exhaled through left nostril.

Ujjayi: Both nostrils are involved in inhalation, and the inhaled breath is held for a while, and exhaled through left nostril. The glottis is closed partially while producing the sound during inhalation and exhalation.

Sitkari: In this type of pranayama, air inhalation is done through crevices of teeth, retained for a while and then exhalation is done using both the nostrils.

Sitali: Tongue is folded like the beak of a bird and air is sucked up through this channel of tongue. Air is exhaled through two nostrils after comfortably holding the inhaled air.

Bhastrika: This pranayama involves performing kapalabhati first which is followed by Kumbhaka. Bhastrika is of different types. As per Gheranda Samhita, 20 strokes of kapalabhati are followed by air inhalation using both nostrils and air exhalation through left nostril after retention. As per Hathapradipta, one should perform kapalabhati until fatigued and then inhale through right nostril and exhale through left nostrils after retention. In these varieties, there is little difference in kapalabhati pattern except in the method of exhalation and inhalation. Brahmananda describes in Jyotsna (his commentary on Hathapradipta), two more types of Bhastrika wherein kapalabhati is
done by manipulating the nostrils for exhalation and inhalation. It is the most favorite pranayama which is practiced by yoga students.

Bhramari: Bhramari pranayama involves production of humming bee sound which resembles male bee while inhalation and female bee while exhalation. The breath is retained for a while in between inhalation and exhalation. The humming bee sound appears as a nasalized sound which is produced by pronouncing the word such as ‘king’ along with vibrations of soft palate.

Murchha: After the inhalation using both the nostrils, one should practice kumbhaka along with Jalandhara bandha which is fixed tightly and should be retained even while exhalation. A pleasant stupor is felt due to this which is helpful in concentration.

Plavini: In this type of pranayama, stomach is filled with inhaled air and regular inhalation, retention and exhalation technique is followed.

Keval: Keval kumbhaka is abhyantara kumbhaka which is preceded by an inhalation using both nostrils, as per Gheranda Samhita, V-87-91. Soham mantra is repeated mentally in this kumbhaka.

1.5 Statement of the Problem

Discus throw is the oldest field event in the sport of track and field that depends on explosive strength (Zatsiorsky et al., 1981). However, it is not just muscle power that helps athletes dominate their sport, discus throwers also need quickness to generate momentum along with required morphological set up, required physical fitness, psychological determination and readiness of physiological functions. In fact, research studies regarding muscular power of discus throwers and its association with performance are rare (Stone et al., 2003). Earlier studies examined the release and throwing events like speed & angle, height (Linthorne, 2001; Lichtenberg & Willis, 1978; McWatt, 1982; Hubbard et al., 2001). Further, it has been observed that not only speed, strength, endurance and flexibility plays an important role in discus throw but different coordination abilities such as reaction time, concentration and agility along with stance,
body torque, throwing angles etc. are equally important for success in discus throw event. Additionally, for the execution of peak performance breathing technique is an important task. Although breath is a subconscious process and takes care of itself, conscious control of it while performing certain moves can improve power output and prevent injury. Therefore, the researcher of this study intends to assess the effect of specific breathing exercises and pranayama (controlled breathing) on performance of discus throw.

1.6 Problem and its relevance

Discus throw event demands high power production (Terzis et al. 2003). Muscular strength is one of the parameter, which determines the power production of a muscle group. In fact, explosive power of muscles, coordination, speed and balance is very important for discus throw performance for both the untrained and the trained individuals. Nevertheless, the role of exercises for discus thrower is well-known, but unfortunately specific exercises, with or without loads, receives little attention. In fact, musculoskeletal alignment and flexibility can improve physical activity along with enhancing parasympathetic activity and thus calming the mind has a insightful outcome on recovery. If mind experiences very stressful conditions, the the reaction in body is comparable to that of strong training. Practice of yoga brings homeostasis in mind and body and reduces sympathetic activity, enhancing quality of the often-limited time we have for recovery. It is effective not only to prevent injury but also to improve performance and be a better athlete. Further, past researchindicates that yoga practices improve endurance, strength, and VO2 peak (Telles et al., 1993; Madanmohan et al., 2003; Dash & Telles 2001; Manjunath & Telles 1999). In addition to this, it is a well documented fact that injury risk and physical performance can be prevented by static and passive exercises (warm up) before beginning intense physical work (Woods et al., 2007). Static stretching also improves range of motion and decreases musculotendiuos stiffness of the athletes (Bacurau et al., 2009; Cronin et al., 2008).
Furthermore, pranayama or controlled breath improves cardiorespiratory functions, which is the most important aspect of performance improvement. Cardiorespiratory fitness is the capacity of heart, lung, veins, and arteries to bring nutrients and oxygen for muscles during particular time (Rogers et al., 1990). Undoubtedly, a large amount of the victories and records registered in competitive sports & also having physical healthiness is due to Cardiorespiratoryt fitness which in directly related to efficiency of cardio-respiratory and rate of maximum oxygen consumption of a person (Asadmanesh 1997). Resistance performance is assessed through maximum oxygen consumption (Chaterjee et al., 2005). Aerobic fitness is measured through Vo2 max. vo2 max is nothing but the maximum amount of oxygen that is utilized by a person during exercise. Therefore, many researchers use this parameter for evaluating aerobic fitness of athlete. Cardiorespiratory fitness & maximum oxygen consumptions are one the important and plausible variable of healthy, physical fitness and endurance capacity (Zahrayee 1996; Haghhravan 1993).

Earlier research studies showed improvement in hand grip strength (Madanmohan et al., 1992), maximal oxygen uptake (VO$_{2\text{max}}$) (Balasubramanian, and Pansare, 1991), flexibility (Gharote, Ganguly,1979) and muscular endurance (Ray, Hegde, and Selvamurthy, 1986) after yoga practices. Additionally, reduction body fat percentage (Bera and Rajapurkar 1993) and enhancement in forced vital capacity (FVC) & forced expiratory volume in 1 second (FEV$_{1.0}$) (Bhole, Karambelkar andGharote 1970; Joshi, Joshi andGokhale 1992; Makwana, Khirwadkar andGupta 1988) have also been observed. Further, Tran et al., (2001) reported improvement in knee flexion endurance, trunk extension, trunk flexion, shoulder elevation and ankle flexibility.

Although numerous studies shows effect of yoga practices on sports performance however, there are no studies conducted in respect to breathing exercises, pranayama in relation to discus throw performance. Hence, the investigator has undertaken this study entitled “Effect of breathing exercises and pranayama on performance in discus throw”.

1.7 Objectives of the study

- To assess the selected morphological, physical fitness, psychological and physiological components as required for optimizing discus throw performance.

- To prepare specific breathing exercises and pranayama training schedules considering the enhancement of the selected components for optimizing discus throw performance among elite athletes.

- To conduct a controlled experiment for evaluating the efficacy of selected breathing exercises and pranayama training schedules on the selected variables so as to exhibit top performance in discus throw.

1.8 Hypotheses

On the basis of literature available, so far, it is hypothesized that:

\( H_1 \): The training of ‘breathing exercises’ may be effective in improving the selected components required for improving discus throwing performance among the athletes.

\( H_2 \): The training of ‘pranayama practices’ may be effective in improving the selected components required for improving discus throwing performance among the athletes.

\( H_3 \): The combined stimulus i.e., ‘breathing exercise plus pranayama practices’ may be effective in improving the selected components required for improving discus throwing performance among the athletes.

\( H_4 \): The combined stimulus ‘breathing exercises plus pranayama practices’ may be more effective than other ‘two stimuli’ (i.e., ‘pranayama’ as well as ‘breathing exercises’ separately) in improving the selected components required for improving discus throwing performance among the athletes.
1.9 Significance of the Study

- The study may bring an excellent result in showing improvement on selected components of morphological, physical fitness, psychological and physiological abilities as well as improvement in discus throw performance of the athletes.

- The newly designed training schedule of breathing exercises and pranayama, as a result of this study, may be beneficial for the athletes participating in national and international events in discus throw.

- The result of this study may encourage the athletes of track field events to maintain the required level of morphological, physical fitness, psychological and physiological status to compete national and international competitions.

- The athletic coaches may get readymade experiment-based schedules on breathing exercises and pranayama practices that may be additionally incorporated in the training programme exclusively useful for the discus throwers in track and field athletics.

1.10 Delimitation of the Study

The present investigation has been delimited to the college level male elite athletes, aged 18 to 20 years, who are specialized in discus throw event.

Major variables delimited for measurements are morphological, physical fitness, psychological, physiological and discus throw performance.

1.11 Scope of the Study

This experiment is conducted in such a way that it has wide scope for other researchers to conduct similar experiments with yoga intervention in varied sports activities. Further, it will also help other researchers, sport scientist, and scientists of physical education to
conduct similar studies for the benefit of athletes participating in other throwing events too.

1.12 Operational Definitions of the Terms

**Discus throw**

Discus throw is included in track and field event where thrower tries to throw a disc as far as possible by following all the rules and regulations of this game.

**Yoga**

Yoga is an extremely efficient way of toning vital organs and muscles which is a very good method of ensuring fitness and good health. Yoga leads to homeostasis, which causes a person to have a balanced personality. Hathayoga involves asanas, pranayama, bandha, kriyas, and mudra.

The final goal of yoga is self realization which will in turn help an individual to attain his total physical, emotional, mental and spiritual potential.

**Pranayama**

It is a voluntarily controlled breathing. Maharshi Patanjali, the father of classical yoga, has stressed pranayama as “kumbhaka.” In fact, ratio of Kumbhaka is scientifically significant for achieving respiratory and cardiovascular functions. Therefore, the investigator has included the particular ratio of Kumbhaka (*Anuloma-Viloma, Surya Bhedan, Bhasrika, Sitali, Sitkari, Bharamari etc.*) in this experiment.

**Breathing Exercise**

In many cultures, the breathing process is considered as core of being. It is a rhythmic course of contraction and expansion, consequently breathing is an instance of reliable polarity observed in Mother Nature like day and night, sleep and wake, growth and decay, and finally life and death. Breath is also known as prana in yogic literature. It can
be utilized to obtain a balance between body and mind, conscious and unconscious and sympathetic and parasympathetic nervous system. Breath is used to communicate among these systems, unlike other body functions, which gives us an important tool to help in facilitating positive change. The breath is the only body function which is voluntary and involuntary. Breathing can be used consciously to influence involuntary i.e. sympathetic nervous system that control blood pressure, heart rate, circulation, digestion & other body functions.