CHAPTER – 1
INTRODUCTION

Modern sports are highly competitive and challenging. It is influenced by various physical, physiological, sociological and psychological factors. Top performers ought to be healthy, well balanced individuals to face the extraordinary physical and mental demands. Sports greatest fighters are always strong willed and single minded. Success demands not only a strong and healthy body but also strength of mind and heart. Often it is not the on-the field battle that is crucial, the more significant battle is the one to be fought within. Hence sports training requires a holistic approach. A holistic approach is required both when aiming for top competitive results as well as when seeking a greater sense of well-being and deeper unity of mind, body and spirit. There is a need for psychological preparation along with physical preparation.

Psychological preparation can be divided into two types. They are general and specific. The task of general psychological preparation is to develop basic mental skills such as goal setting, relaxation techniques, concentration and visualization. Specific psychological preparation readies the athlete for the upcoming competition. The ultimate goal of psychological preparation is self-mastery, control of emotions and control of the mind. In order to control one’s body and mind, one must first understand them. Self-knowledge is gained through self-study and self-observation. One must learn to listen to one’s body, learn the body language and understand one’s mind and how it works. Only then stress, the monster that affects the physical mental and emotional health, can be managed.

Stress is the strained feeling one gets. Selye (1974) the father of stress research defines stress as a response to actual demand or to the perception of an imbalance or discrepancy between the demands made up on the individual and individual’s ability to meet or cope with these demands. The three important sources of stress are frustration, conflicts
and pressure. The effect of stress on the endocrine mechanism is vital. Melissa C. Stoppler (2001) states that the hormone cortisol, which is released in the body during stressed or agitated states have gained widespread attention as the stress hormone. Cortisol the stress hormone is produced in the adrenal glands. It is essential to cope during times of stress. Without proper cortisol responses one cannot effectively meet the daily challenges of life. Cortisol levels exhibit a natural rise in the morning and fall at night. If this rhythm is disturbed all functions of the body especially, circulatory and metabolic functions will be affected. The stress tolerance refers to the amount of stress one can tolerate before breaking down under the pressure of stress. There are so many strategies for improving the stress tolerance abilities, among players. The yogic practices and aerobic exercises are of vital importance. Yoga is the oldest known science of self-development. It was developed thousands of years ago in India. Yoga literally means joining, the joining of the individual self with the universal self. Aerobics means exercises with oxygen. Brisk walking, swimming, jogging, running, steps climbing, skipping and cycling are prime aerobic form of exercises. Till now no specific study has been done on stress hormone and its associated gross metabolic and circulatory responses among college players. Therefore the training effects of yogic practices and aerobic exercises on stress hormone and some associated gross metabolic and circulatory parameter responses are studied.

**Objectives of the study**

Cortisol is the chief stress fighting hormone. When cortisol secretion is high the body shifts to a war footing. Therefore the stress hormonal response and its associated functions are one among the main cruxes of any player. As it is a psychosomatic factor, the relevance of yogic practices and aerobic exercises is now increasingly realised in stress tolerance. Hence the study aims to learn the effectiveness of yogic practices and aerobic exercises on stress hormone, circulatory and metabolic responses.
The following are the specific objectives.

1. To identify the overstress players and their levels of stress hormone.

2. To identify the circulatory and metabolic responses of overstress players.

3. To find out the effects of yogic practices and aerobic exercises on stress hormone, circulatory and metabolic responses of over stress players.

4. To establish the role of yogic practices and aerobic exercises on stress management.

In order to realise these objectives it is essential to have a birds eye view of stress, stress hormone, circulatory and metabolic responses, yogic practices and aerobic exercises.

**Stress : Meaning and Concept**

Stress is an important issue and is growing rapidly in every facet of life. Stress is something which makes one feel uncomfortable. It creates imbalance when an individual makes an effort to restore the state of balance. Stress is a concept borrowed from natural sciences. It was first introduced into Behavior Sciences by Selye in 1936. During the 18th and 19th century stress was equated with force pressure or strain exerted upon a material object or person which resists these forces and attempt to maintain its original state. Throughout the 19th and 20th centuries the twin words stress and strain has been used in everyday English language in a non-specific sense. Psychiatrists also described mental tension as nervous stress and strain (Selye, 1956).

Dunbar (1947) considered stress as a quality of the stimuli while Alexandar (1950) defined it both as quality of the stimulus and the individual response to it. According to Basowitz, Persky, Korchin and
Grinker (1955) “Stress refers to that class of stimuli which are more likely to produce anxiety, a conscious and reportable experience of intense, dread and foreboding”. According to Mechanic (1962) stress is a discomforting response of a person in a particular situation.

Lazaraus (1966) opines that stress exists when the demands on a person are perceived as taxing or exceeding that person’s adjustive capacity. According to Back and Bagdonoff (1967) Stress is commonly used in ordinary conversation to refer to all sorts of difficulties. The popular notion of stress seems to be rather vague and infinitive. It is something that every one feels from time to time, a problem that can be recognized from experience and need not be defined in precise terms. Stress has been identified with a variety of feelings and reactions: anxiety, intense emotional and physiological arousal and frustration. A state of stress, then, is composed of the threat called a stressor and a response which consists of a measurable alternation of the physiology and or the behaviour of an individual.

Sells (1970) defined stress as unavailability of adequate response which has important consequences. Defining stress as a condition of physical or mental strain. Wolman (1973) said it produces changes in the autonomic nervous system. Selye (1974) defines stress as ‘nonspecific’ response of the body to any demand. By this term Selye meant that whatever the external and or internal demand on the body, a person’s response to stress follows a universal pattern.

McGrath (1976) prefers to define stress in terms of a set of conditions as having stress in it. Stress involves an interaction of person and environment. Something happens “out there” which prevents a person with a demand, a constraint or an opportunity for behaviour.

Mason (1975) reviewed literature on stress and came to the conclusion that there was a lack of agreement over its definition and there was much confusion. The term stress has been used variously to
refer to, 1. stimulus (external force acting on the organism), 2. response (Change in physiological functions), 3. interaction (interaction between an external force and resistance opposed to it, as in biology) and 4. more comprehensive combination of the above factors.

**Stress Concept in India**

In a laudable effort, Ramchandra Rao (1983) has highlighted the origin of stress in ancient Indian thought. Tracing it back to the ‘Samakhyá’ and ‘yoga’ systems he pointed out two sanskrit words ‘Kelsa’ and ‘Dukha’ which correspond not only to the correct of stress in common use but also, to an extent, to the concept in its technical sense. The concept of ‘Klesa’ has its origin in the root ‘Khis’ which means to torment, to cause pain or to ‘afflict’. The ‘Klesa’ is not a mental process but is a set of ‘hindering load’ on mental process. Thus the concept ‘Klesa’ system views ‘Dukha’ to signify the stress that an individual experiences in the course of his interaction with the world around him. On the basis of a review of ancient Indian literature, Rao concluded that the conceptual model of appraisal of the self (Asmita), the object (Raga) and threat (Dwesha). In fact, the cognitive appraisal constituted the functional frame work for the conceptual model of stress not only in ‘samkhyá’ yoga system but also in ‘Vedanta’ Buddhism’. He has referred to three type of stress which ‘Samhyá’ speaks of viz ‘Adhyatmik’ (personal) ‘Adhibhoutik’ (situational) and ‘Adhidavic’ (environmental).

**Causes of Stress**

Stressors can be internal or external factors in the organism they are affecting. Stress often results from an individual’s inability to cope adequately with stressors, which determines the amount of stress that a person experiences (Townsend, 1998). David Almeida, a professor of family studies at the University of Arizona says, “A lot of our stresses are self-imposed, but others are from survival” (West, 1998). Stressors can be
divided into groups based on what area of life from which they stem. The two main categories of stressors are psychological and physical stressors, which encompass various subcategories from situational stressors to psychosocial stressors. According to Lovallo (1985), physical stressors are those events having a direct physical threat to one’s well-being, such as heat, cold, infection, and toxic substances. While psychological stressors are events that challenge our well-being because of our perception of them. Psychological stressors include events such as the death of a loved one, failure to achieve goals, obsessive compulsive traits, and irrational beliefs.

Significant types of stressors are also found within the two main categories. For instance, social stressors include job demands, interpersonal problems, and insufficient time and money (TMA, 1999). Philosophical or spiritual stressors include loss of value, meaning, and purpose in life, and issues concerning the belief in a higher power. Background stressors also play a major role, the biggest being change, which causes stress by forcing everyone to adjust their lives accordingly. Lastly, situational stressors include many experiences encountered in caregiver patient fields, ranging from lack of support to emotional burnout (TMA, 1999). Physical and psychological stressors are often intertwined with some physical stressors acting as psychological stressors, and vice versa.

How an organism responds to a stressor, known as the stress response, varies from situation to situation. Psychological factors are sometimes powerful enough to trigger a stress response on their own. Loss of control or predictability, loss of outlets for frustration, or the perception that things are getting worse are all examples of this phenomenon. Sapolsky Robert (1998) says humans deal better with stressors when they have outlets for their frustration, and even imagining an outlet can lead to relief. An example of the effects on stress level when provided with an outlet for frustration uses a rat study. In the study reported by Sapolsky (1998), a rat gets a series of electric shocks, and develops a
stress response of increased heart rate and glucocorticoid secretion. Another rat receives the same amount of shocks, but it is given a piece of wood on which to gnaw, acting as an outlet for frustration. By the rat taking out the stress of the electric shocks on something else, its stress level is reduced (Sapolsky, 1998). An equivalent outlet for frustration can also be social support, which has been found to reduce stressors and lessen cardiovascular stress.

Types of Stress

Stress can be divided into two subtypes: acute and chronic. Acute stress prepares us for fight or flight and is generally short term. Chronic stress lasts longer and is the main cause of stress-related health problems. Acute Stress is a short term response by the body’s sympathetic nervous system. How long acute stress can last may vary. The response can last for a few minutes or a few weeks. Chronic stress occurs when continuous acute stress responses keep the body on alert continuously, negatively affecting health. The ongoing stress response causes the hypothalamus and pituitary gland to release a chemical known as ACTH (adrenocorticotrophin hormone). ACTH stimulates the adrenal gland to produce and release cortisol known as stress hormone.

Stress and Performance

It is generally assumed and observed that there exists a negative relationship between stress and performance. But in fact, the effect of stress on performance varies with the degree of stress and the nature of the task performed. It has been empirically established that high level of stress causes a deterioration in performance McGrath (1976), Beehr & Newman (1978). But at the same time it has also been reported that very low or no stress is also associated with low performance level. In the absence of stress the individual lacks arousal and so the motivation to perform is also low. Hinkle (1973) has accordingly suggested that “to be
alive is to be under stress”. The best known and most thoroughly documented pattern in stress performance literature is the inverted “U” shaped relationship McGrath (1976), Anderson (1976) and Keller (1981). Moderate level of stress stimulated the body and increases its ability to react. In a situation of moderate stress individuals often perform curvilinear relationship between stress and performance can be traced back to the work of Yerks and Dodson (1908).

**Stress Management**

Though Stress has become an inevitable part of people's life in present world, it is not entirely uncontrollable and unmanageable. The individual cannot constantly remain in the state of stress, he certainly makes some sort of adaptive behaviour to cope with or get rid of the stressful situations. It might be fight or flee. Since their origin, the human beings have been encountering a situation of stress and using some remedies or strategies to cope with these situations. But these coping efforts were not well planned or systematic.

In the present era of stress and anxiety, when the cost of stress has markedly increased, the stress researchers and practitioners have concentrated on evolving systematic techniques for the management of the stress of life in general. The field of stress management has progressed substantially after Lehrer and Woolyolk published the first edition of principle and practice of stress management in 1984. Stress management is a global concept and involves quite a mix of techniques. Stress management interventions have been differently classified by various stress researchers and practitioners. Some have classified them on the basis of the stages of the process of stress, while others have classified it on the basis of orientation or location of the intervention programmes in individual and work setting, (Ross & Altmair, 1994).
Stress Tolerance Capacity

The term stress tolerance refers to the amount of stress one can tolerate before breaking down under the pressure of stress (Mangal, 1984). Observations reveal that different people react differently to stress. Some are able to handle the most threatening situation without much difficulty while others breakdown under relatively mild stressors. Therefore the severity of a given stress depends on one’s tolerance capacity. Individual differences in the stress tolerance capacity are not easy to explain. While a biological explanation may involve the assumption that more stable neuro-endocrine systems show greater resistance to stress situation, a psychological interpretation is much more complex. People learn to perceive stress events in the light of previous traumatic experiences which may condition a person to regard such life events as threatening. Consequently, such a person has been conditioned to regard such events in a more philosophical and less personal way and react accordingly. Hence stress tolerance capacity can be improved by focussing on the physical as well as mental factors.

Stress Physiology

Hormones and neurotransmitters are both involved in the stress response. They are both chemical messengers, but differ in their source and their target. A neurotransmitter is a chemical messenger that travels from a neuron to an adjacent cell and elicits a specific change in that cell. A hormone is a chemical messenger that is secreted and enters the blood stream, targeting effects in specific organs far from the site of release. The release of these messengers during stress response is controlled by the autonomic nervous system. There are two parts of the autonomic nervous system: the parasympathetic nervous system and the sympathetic nervous system. Both the parasympathetic and sympathetic nervous system control certain bodily activities, such as energy storage, digestion, and growth. The sympathetic nervous system is especially activated in response to exciting or alarming situations, such as stress. During emergencies and
other stress-related events, the sympathetic nervous system is turned on, nerve endings release norepinephrine (noradrenaline). Norepinephrine is released by sympathetic nerve endings throughout the body (Sapolsky, 1998) and acts to initiate the stress-response.

At one time it was thought that the pituitary gland beneath the brain controlled the release of hormones. The pituitary is a double gland with an anterior lobe and a posterior lobe. The posterior pituitary is responsible for much of osmoregulation within the body. It releases two hormones, oxytocin and vasopressin. Oxytocin acts on the uterine muscles, causing contractions and generating labor. Vasopression constricts the arterioles and raises blood pressure. It also stimulates the kidneys to reabsorb water. The anterior lobe produces many hormones. Prolactin is a hormone, which stimulates milk production in females as well as playing roles in reproduction, osmoregulation and growth. Growth hormone that promotes normal growth by aiding in cellular uptake of amino acids. Thyrotropic stimulating hormone (TSH) that stimulates the thyroid is secreted from the anterior pituitary. Other important endocrine organ controlling hormones are released. One is adrenocorticotrophin hormone (ACTH), which activates the adrenal cortex.

Now it is known that the brain actually controls the release of hormones via the pituitary. The section of the brain that controls the pituitary is the hypothalamus. This function is done with many releasing and inhibiting hormones, which direct the actions of the pituitary gland. The pituitary then controls the secretions of hormones from the peripheral glands. Stress can activate and also inhibit many of the hypothalamus-pituitary-peripheral gland links.

When a person is experiencing stress, the hypothalamus releases many hormones, but most importantly, corticotrophin releasing factor (CRF), into the hypothalamic-pituitary circulatory system. Afterward, the pituitary gland releases ACTH, which reaches the adrenal cortex and activates the
release of cortisol. The pancreas is also stimulated during stress and releases glucagon. Both cortisol and glucagon raise the amount of glucose in circulation. The higher blood sugar level is the source of energy needed during stressful situations. Cortisol, along with epinephrine and norepinephrine, are a large component of the body’s response to stress.

The pituitary also releases prolactin during stress. This hormone suppresses reproduction, and therefore, channels more energy for emergency. The brain and pituitary release endorphins which reduces pain perception and allow for fight or flight. During stress the pituitary gland also releases vasopressin, an antidiuretic hormone that blocks urine formation. The release of TSH is also increased during stressful experiences. Along with the enhanced release of these hormones during stress, the release of some hormones is inhibited. Hormones related to reproduction such as estrogen, progesterone, and testosterone as well as insulin are secreted in greatly reduced quantities.

All these hormonal reactions are the most common type of stress-related hormone change but the rate of release and the amount of hormones released vary according to the stressor. The release of norepinephrine by the sympathetic nervous system and cortisol from the adrenal glands is the most reliable stress-related effects. (Amy Beykirh, et.al., 1999).

**Stress Hormone**

The hormone cortisol, which is released in the body during stressed or agitated states, has gained widespread attention as the so-called “stress hormone”. The same view is reiterated by the following authors Kenneth B. Matheney, (2000); Srivastava, A.K., (1999) and Rita Agrawal, (2001). Cortisol is a steroid hormone made in the adrenal glands, which are small glands adjacent to the kidneys. Among its important function in the body includes its role in the regulation of blood pressure and cardiovascular function as well as regulation of the body’s use of proteins,
carbohydrates, and fats. Cortisol secretion increases in response to any stress in the body whether physical or psychological. When cortisol is secreted it causes a breakdown of muscle protein, leading to release of amino acids which are the “building blocks” of protein into the bloodstream. These amino acids are then used by the liver to synthesize glucose for energy by a process called gluconeogenesis. This process raises the blood sugar level so the brain will have more glucose for energy. At the same time the other tissues of body decrease their use of glucose as fuel. Cortisol also leads to the release of so-called fatty acids, an energy source from fat cells, for use by the muscles. Taken together these energy directing process prepare the individual to deal with stressors and ensure that the brain receives adequate energy sources (Melissa C. Stoppler, 2001).

The body possesses an elaborate feedback system for controlling cortisol secretion and regulating the amount of cortisol in the bloodstream. The pituitary gland, a small gland at the base of the brain, makes and secretes a hormone known as adrenocorticotrophin, or ACTH. Secretion of ACTH signals the adrenal glands to increase cortisol production and secretion. The pituitary, in turn, receives signals from the hypothalamus of the brain in the form of the hormone CRH or corticotrophin releasing hormone, which signals the pituitary to release ACTH. Almost immediately after a stressful event, the levels of the regulatory hormones ACTH and CRH increase, causing an immediate rise in cortisol levels. When cortisol is present in adequate or excess amount, a negative feedback system operates on the pituitary gland and hypothalamus which alerts these areas to reduce the output of ACTH and CRH respectively in order to reduce cortisol secretion.

**Measurement of Cortisol Level**

The body’s level of cortisol in the bloodstream displays what is known as a diurnal variation - that is, normal concentrations of cortisol vary throughout a 24 hour period. Cortisol levels in normal individuals
are highest in the early morning at around 6-8 a.m. and are lowest around midnight. Normal levels of cortisol in the bloodstream range from 6-23 mcg/dl (micrograms per decilitre). In addition to early morning, cortisol levels may be somewhat higher after meals. While the most common test is measurement of the cortisol level in the blood, some doctors measure cortisol through a saliva sample, as salivary cortisol levels have been shown to be an index of blood cortisol levels. Sometimes by-products of cortisol metabolism are also measured, such as 17 hydroxycorticosteroids, which are inactive products of cortisol breakdown in the liver. In some cases measurement of urinary cortisol levels is of value. For this test, urine is collected over a 24 hour period and analysed. Normal 24 hour urinary cortisol levels range from 10-100 micrograms / 24 hours (Mellissa C. Stopper, 2001).

**Fig. - 1 : Shows the Endocrine Mechanism of Stress**

![Endocrine Mechanism of Stress](image)

(Source: Jerrold S. Greenberg and David Pargman, Physical Fitness : A Wellness Approach)
Circulatory Response

The movement of body fluids, blood and lymph from one part of the body to the other parts is called circulation. The circulation of blood was first discovered by William Harvey in 1628. This system constitutes the heart, blood vessels and the blood which serve several functions. Other than the supply of oxygen, this system functions include the supply of the demanded nutrients to the cells of various organs, carrying the hormones to their target tissue or organ, removal of the several metabolic waste products and thus sustaining homeostasis in other parts of the body. Heart rate and blood pressures play a vital role in the functioning of the system.

Heart Rate

The number of cardiac contractions in one minute is called heart rate. The number of contractions ranges from 60 to 80 beats per minute. The rate and intensity of the cardiac contractions are affected by exercise, long term training, age, diseases, stress and environmental temperature. Generally 72 beats per minute is considered as a normal heart rate, but a lower resting heart rate is recorded in the trained individual. The heart’s functioning is regulated or controlled by several factors such as neural factors, hormonal factors and instinct factors.

Studies have detected a faster heart beat instantly at the start of an exercise. This first heart beat after the exercise is faster than the proceeding ones. Such a fast heart beat may probably, be caused by nerve reflex partly originating from the various proprioceptors such as muscle spindles and joint receptors. Therefore as the muscular contraction starts and the corresponding joints are put into action the impulses are transmitted in the muscle spindles and joint receptors. These impulses pass further to the spinal cord and to the cardiac regulating center of the brain. Such muscle/joint mechano reflexes cause the parasympathetic nerves to be inhibited and a corresponding increase in the heart rate occurs. There are few other factors such as higher centres of the brain, muscle chemoreceptor
reflexes, circulating hormones, intrinsic factors that influence an increase in the exercise heart rate.

**Blood Pressure**

The pressure exerted by the blood on the walls of the blood vessels is called blood pressure. It has two limits - the upper limit called 'systolic pressure' and the lower limit called 'diastolic pressure'. Systolic pressure is recorded when the blood is ejected into the arteries during ventricular contractions (systole). The diastolic pressure is obtained when the blood drains from the arteries during ventricular relaxation (diastole). In an adult, the systolic pressure ranges from 110-125 mm/Hg. and the diastolic pressure ranges from 65-85 mm/Hg. A blood pressure of 120/80 mm/Hg. is considered normal. However several factors like age, sex, emotion, exercise, and disease affect blood pressure. The pulse pressure is the difference between the systolic and the diastolic pressure. The mean arterial pressure is the diastolic pressure plus one third of the pulse pressure.

The varying range in the blood pressure occurs due to the changes in the varying circulatory parameters like the increased cardiac output. An increased cardiac output will increase the blood flow in the arteries which will increase the pressure within the walls of arteries. The size of the blood vessels also determine blood pressure. The resistance to the blood flow will increase with a decrease in the size of the blood vessels (vasoconstriction). The heart has to forcefully pump the blood through these small vessels thereby increasing the blood pressure. However with an increase in the size of the blood vessels (vasodilation) the resistance to flow will decrease thereby reducing the blood pressure. Blood volume is another factor influencing blood pressure. With larger volumes of blood, the blood pressure will increase and with smaller volumes it will decrease. However, other factors like age, sex etc. also influence the blood pressure.
**Metabolism**

Metabolism implies the chemical changes that take place inside the body. The process of metabolism begins after absorption and end with excretion. The chemical changes are of two kinds (a) synthetic changes taking place in the body called anabolism and (b) changes in the shape of breakdown called catabolism. Anabolism and catabolism is known as metabolism.

**Carbohydrate Metabolism**

Carbohydrates consists of carbon, hydrogen and oxygen united in certain proportions, but always containing twice as many parts of hydrogen as of oxygen. Besides some organic acids and salts many other organic compounds like urea and uric acid are also present. As a result of digestion and absorption, sugars and starches appear in the blood in the shape of glucose. Glucose possesses the characteristic of quick diffusion into the fluid and into the cells. There is a uniform concentration of glucose in the body fluid. In the shape of glycogen, glucose is stored in the liver and skeletal muscles. According to the needs of the body glycogen is reconverted into glucose. Insulin is required for the reconversion of glycogen in to glucose. During muscular activity muscle glycogen is consumed. The carbohydrates are the most easily digested and assimilated type of food. Hence the intake of carbohydrates is more than protein or fat.

Carbohydrates does many functions. It is a source of energy and also a storage of energy as it is easily digested and easily metabolized. It is the cheapest food and most easily available. It also helps to maintain the level of blood sugar and prevents ketosis.

**Fat Metabolism**

All fat which is not immediately required by the body for its purposes is stored away in fat depot of the body. After required quantity
of fat is absorbed, the rest is stored in the adipose tissue of the body. When the body feels the requirement of fat it is withdrawn from these depots. In the liver, the fat is converted into glycerol and fatty acids. The body utilises the fats in the form of fatty acids.

The stored fat may have its origin in any of the common food-stuffs, i.e., protein, carbohydrates and fats. Before undergoing further metabolic changes the depot fat is converted into phospholipid, which can be broken down by the enzyme esterase, which is present in all the tissues of the body. Lipase is not present in the tissue. Some of the liver fat are broken down by hydrolysis into glycerol and fatty acids with the help of the liver enzyme lipase. Fatty acids, before their oxidation undergo a preliminary distraction in the liver. Thereafter, they undergo oxidation.

Fat is necessary to the body as it is an essential constituent of all cells. It also acts as cushion and packaging tissues besides being a source of energy. One gm of fat releases 9.3 calories. So fat is stored-up in the body. The capacity of the body to store fat is unlimited. It can be stored in large quantities in adipose tissues. Fat helps in the synthesis of amino acids and facilitates conduction of nerve impulses besides being a gastric inhibitor. Finally it also beautifies the body.

**Protein Metabolism**

Protein consists of the elements carbon, hydrogen, oxygen, nitrogen and sulphur. In the oxidation process the carbon and hydrogen are converted to carbon-dioxide and water. A certain proportion escapes complete oxidation, being exerted by the kidneys in combination with nitrogen as the essential constituent of the urine, chiefly urea. When proteins are oxidised in the body there is a definite relation between the carbon-di-oxide which is produced and the oxygen consumed. As a result of protein digestion a number of amino-acids are formed. They constitute a pool, called the amino-acid pool from which the cells of the body obtain their protein requirement. The amino-acids are essential for the growth and repair of
the tissues of the body. When diets contain an excess of protein, the surplus amino acids dominate in the liver to remove nitrogen, leaving only carbon, hydrogen and oxygen, which can be used for the production of heat and oxygen. Contrary to this, when there is a lack of protein intake during starvation it leads to depletion of carbohydrates and fat along with a loss of body protein by the wasting action of the muscle.

Protein does vital functions in the growth and repair of body cells. The amino-acids help to distribute nitrogen and sulphur to each cell in the different parts of the body. The body cells possess the power to choose the amino-acids required by each for purposes of repair, of wear and tear and growth. The liver deaminates amino-acids and through the process of deamination urea is formed and the carbon compounds are released for oxidation. The waste product resulting from metabolism of protein in the tissue are urea, uric acid and creatinine, which are excreted in urine.

Yoga

Yoga is the oldest known science of self development as it gives mental, physical and spiritual control. It was developed thousands of years ago in India. Yoga literally means joining, the joining of the individual self with the universal self. This joining is achieved through the practise and mastering of specific physical postures, called asanas, breathing exercise called pranayama, and meditation.

There are numerous wonder stories about the remarkable abilities of yogis those adept in the disciplines of yoga. British doctors more than 200 years ago began studying certain Indians who could do some very unusual and interesting things. These people called yogis, apparently had predominate power of self-regulation of both mind and body.
The two most popular yoga systems are Hatha yoga (physical practice) and Rajayoga (mental exercise) practices of these yoga forms in the western world are used mostly to develop a healthy and flexible body, improve general health, and gain self control and inner peace.

Hatha yoga is composed of exercises for the body. It consists of asanas (body postures) pranayama (breathing exercises) relaxation and cleansing techniques. There are many styles of Hatha yoga, but all employ the same basic postures, or asanas and breathing exercises. Rajayoga is a practical system like Hatha yoga. The objective however, is to observe recognise and control the activity of the nervous system. Rajayoga is an old technique with many branches.

The Patanjali’s yoga sutras (the first) written synthesis of yoga from the second century (B.C.) describes the system of yoga in eight stages. 1. Yama which gives moral, ethical and health guidelines. 2. Niyama deals with observances that encourage positive qualities such as purity and contentment. 3. Asanas depict physical postures, exercise to facilitate concentration. 4. Pranayama teaches breathing through control of breath. 5. Pratyahara deals with control of senses, sense withdrawal. The mind is withdrawn from the outside world, from the object of the sense. A fine preparation for meditation, the above mentioned stages are dealing with the body and the senses. They are basic external preparation for Hatha yoga. 6. Dharana stresses the need for concentration on one object or idea. 7. Dhyana deals with meditation, steady concentration on one object or idea. 8. Samadhi is a state of super-consciousness. The individual self is united with the universal self.

Meaning of yoga

Yoga has a complete message for humanity. It is a message for the human body, human mind and human soul. Maharishi Patanjali, the father of modern concept of yoga and a great physician himself in the 300 B.C. defined yoga as the complete mastery of mind and emotions.
Unlike so many other philosophies of the world, it is a scientific philosophy that is wholly practical. Yoga is an exact science which has its foundation on certain immutable laws of nature and establishes “mind over body”. The gaining of a healthy body with a calm and steady mind under all circumstances is the common aspiration of every individual. The word yoga is derived from the Sanskrit word “Yuj” which means ‘control’ or ‘unite’. Both these words quite adequately give the meaning of yoga.

Bhagawat Gita refers to yoga in several places. Gita XI 50-51 states that “a yogi is one who renounces the concern of the consequences of his deeds”. In other words, a yogi is concerned only with the perfection of the action and not the consequence. He is not reward motivated and will overcome bondage for ever. Yoga is a science which enables one to learn to unite his jeevatma (individual soul) with paramatma (universal soul) and the final union is fulfillment of ‘yoga’. Even the techniques which promote one’s progress towards realisation of the supreme are called “Yoga” (Geeta, S. Iyengar, 1997).

**The Concept of Yoga**

Although the word ‘yoga’ has many connotations, etymologically it means ‘integration’. The term ‘samatva’ of Bhagavat Gita conveys the same meaning. Other terms like homeostasis, equilibrium, balance and harmonious development more or less suggest the same thing. The aim of yoga itself is an integration of personality in its all aspects. In order to help the development of such an integration, various techniques are employed. These techniques or practices enjoined in yogic literature and handed down through different traditions also go under the name of yoga (Gharote, 1976).

**Physiological aspects of Yogic Discipline**

It is possible to identify four main types of environment namely physical, mental, social and cultural environments. Yoga with its physical and mental disciplines can mould the behaviour of an individual promoting perfect harmony with the environment. Yoga is a discipline which seeks
to bring the internal environment of an individual under control thereby bringing a good adjustment of the individual with the surroundings.

Yogic exercises are confined to minimum motions involved with a low temperature (Isometric and Isokinetic) which is the direct opposite of gymnastics, calisthenics, Swedish drills, all of which emphasize on speed and rhythm. Further by influencing the automatic nervous system the yogic exercises ensure better food utilisation and improved nourishment besides proper relaxation and sleep due to superior voluntary control of such individuals.

**Psychological aspects of Yogic Discipline**

Yoga offers essential psychological benefits to the practitioner. It helps an individual to become self-controlled and less prone to extremes of behaviour by regulating endocranial functions. In adolescent practitioners it checks excessive aggressions and excitability through the regulation of the adrenal glands and correct brooding and melancholy nature by regulating pituitary and pineal functions. Besides driving away laziness and lethargy which sometimes characterises this phase. Yoga builds up self confidence, removes shyness and improve self-consciousness. It also controls the arousal of emerging sexual urge and direct the new found energy into creative outputs. Yoga creates predisposition towards yogic principles of yama and niyama thereby developing an individual’s moral and ethical development (Swathichan Chani, 1995).

**Asanas**

Asanas are mostly static body postures that should be executed slowly and without force. Learning and practising asanas is done step by step and on a regular basis. The postures help to learn autonomic control through passive attention. With the asanas it is possible to work body muscles and keep them in good condition. They can be used deliberately
for developing a definite muscle group. The effects can be directal, or localised, in a specific area of a muscle group or an organ. The influence of asanas on organ function is rather complicated. For example in reverse postures the force of gravity is used to attain better circulation and restore proper organ alignment.

Asanas are effective for developing correct body posture and for increasing flexibility in joints and the spinal column. Yoga increase strength, endurance, the ability to relax completely and promote concentration. The asanas fine tune the nervous and endocrine systems. They stimulate and massage the digestive track, cardiovascular system, pulmonary organs, especially the endocrine glands, and thus influence the metabolism of the organism and overall regeneration.

The most important characteristic of asanas is their static nature. If the posture were dynamic, it would not be possible to achieve the level of concentration and controlled breathing as it is possible in the static position. One of the basic principles of Hatha yoga is that there is a close relationship between the posture which develops physical activation by movement and the process of psychical activation. Psychical activation means concentration, conscious participation in the process and the effects of posture in each phase, including the phase of realisation.

In yoga exercise the principle of ideomotor reaction is important. Ideomotor reaction is based on the fact that an idea or image can indirectly influence the function of organs and glands. This phenomenon is reinforced by the pull, rotation and pressures of asanas on the tracks and plexuses of the body. Another characteristic of yoga exercises in general is the slow, fluid, harmonious, and controlled movement, and the co-ordination of movement with breath concentration and body awareness.
The main goal of Hatha yoga is to facilitate concentration and meditation that is preparation for achieving the final stage of yoga samadhi. Normal movements are usually executed mechanically. There is a lack of movement, control and introspective feedback. Yoga exercise stretching is different from them. Yoga requires concentration, introspection, experiencing and feeling the muscles, the proprioceptive sensations. Achieving the perfect position does not mean achieving ‘total stretch’ or an acrobatic position, but mainly that all four parts are in harmony. Therefore it is necessary to focus first on the dynamic phases. Latter the attention should be focussed on the breathing and relaxation, the concentrating on the focus point, and finally on the introspection. Then the synchronisation of all four phases should be emphasised.

**Pranayama**

Pranayama is an important, yet little known part of yoga. Its techniques have been practised for centuries by ardent students of yoga in remote ashrams, and have been preserved for us through many generations both in practice and in handwritten books. Until recently, this art and science of yogic breathing was almost completely unknown to the common man like many other ancient Indian arts. Those who knew it used to be very reluctant to share their knowledge and experience with any one, unless a student proved by tests that he was ready to receive it. It has been proved beyond doubt that pranayama is a very important means of preventing and curing many ailments.

Pranayama is also mentioned in the Gita, which is, by far, the most popular book on yoga. But a detailed account of how pranayama is to be practised is not found in the Gita or the ‘yugasutra’. For that we have to turn to the texts of ‘hatha yoga’ and to some later Upanishads which are called yoga-upanishads. These texts are approximately of the fifteenth century A.D. and later. It should not be conduced from this that the techniques of pranayama have been known only for the last five
hundred years. Many direct and indirect references to pranayama, what it can do, why it is practised, and what its importance is, occur in Vedic literature, in ancient upanishads, Smritis puranas, and treatises such as the yogavasistha. This shows that a knowledge of pranayama and its practise was known since the time of the Vedic rishis. But it seems quite certain that the practice of pranayama was taught to a very few. It was never widespread. Even the few who learned it, followed it more as a part of religious observations than as a discipline for the body and mind.

Pranayama may be defined simply as the control of the breath. Its essence lies in the modification of our normal process of breathing. Breathing is an act in which we take air from the atmosphere into our lungs, absorb the oxygen from it into our blood, and expel the air again into the atmosphere together with carbon-di-oxide and water vapour. This act of inhalation and exhalation is repeated every four to five seconds. Thus normally we breathe about fifteen times every minute. The normal breathing pattern shows marked changes under various conditions. For instance, while we are lifting or carrying loads, walking uphill, running or doing any physical exercise we breathe more rapidly and more forcefully. At high altitudes in a rarefied atmosphere our breathing becomes heavy. Its pattern changes with emotional excitement and in the case of disorders such as asthma, tuberculosis, bronchitis and other lung affections. Modification of breathing under these conditions is brought about involuntarily, and perhaps without awareness of it unless there is difficulty in breathing. In fact we are hardly ever aware of the fact that we are breathing. (Swami Sivananda, 1987).

Pranayama insists on modifications of the breathing process which are brought about deliberately and consciously. Breathing may be modified by inhaling and exhaling rapidly, taking shallow breaths and or by inhaling and exhaling slowly, taking long or deep breaths or by stopping the act of breathing altogether. The first way of modifying breathing is not usually included in pranayama proper, although it is sometimes closely associated
with it. The second and third ways mentioned above do belong to the domain of pranayama. In fact pranayama practice may very well be summarised in these two ways.

There is one more condition to be fulfilled if any breathing modification is to be called pranayama. That is regarding the posture. Pranayama is practised in a sitting posture. There are about half a dozen postures available for this purpose. They are called meditational postures, because they are very suitable for meditation. The most renowned among them is siddhasana. The simplest and most comfortable and less strenuous is swastikasana. Padmasana is one which is most recommended traditionally for pranayama. It may be enough to mention here that pranayama is defined by Patanjali as a modification of breathing in a sitting posture which is steady and comfortable. Such a postures is an essential part of pranayama.

Thus pranayama is a contemplated act in which after assuming a suitable posture the student inhales and exhales slowly, deeply, and completely and also stops the breath. Inhalation in pranayama is called ‘puraka’ which literally means ‘the act of filling’. Exhalation is called ‘rechaka’ meaning ‘the act of emptying’. Retention of breath is called ‘kumbhaka’. Kumbhaka means a water pot. Just as a water pot holds water when it is filled with it, so in kumbhaka the breath is held after filling the lungs.

**Effects of Pranayamic Breathing :**

Among the various activities going on in our body some are fully under control while others are not. Those activities which are brought about by voluntary muscles can be done at our will, For instance, we can raise a hand and bring it down whenever we like. Movements of the limbs, mouth, eyelids, neck and so on can be done as and when we wish. But this is not the case with all activities, those activities which are governed by the automatic nervous system cannot be modified by us
working of the heart, circulation of blood, secretion of digestive juices and hormones, digestion and assimilation of food, are some of the activities which are not under our control. Modification in these activities come about not by our will but by the homeostatic balance systems in the body.

Respiration is an activity which falls midway between these two types. It is usually modified automatically according to requirements of the body and this happens without awareness to some extent. We can also modify it voluntarily. If we so desire, we can breath rapidly or slowly, deeply or superficially and we can even stop breathing for a short time. This is possible, first, because there are respiratory centers which govern the activity by impulses from the brain. That is why pranayama is possible at all.

For bringing out the effect of pranayamic breathing we must consider what things we specially do in pranayama and what their effects are. The special features of pranayama are 1. an erect sitting posture, 2. realisation of the body and mind, 3. complete filling and emptying of the lungs, 4. changes in line ventilation, 5. pressure changes in the thoracic and abdominal cavities, 6. exercise of the muscles of respiration and 7. activation of hitherto silent areas of the nervous system (Joshi, K.S., 2001).

Meditation

Meditation simply means quietening the mind. It has a beneficial effect on body and mind. We have forty two types of meditation propounded by various schools of thought. The aim of all of them is the same, to achieve peace of mind and move closer to God. Psychologists have studied the effectiveness of meditation on alleviating psychological problems such as anxiety, depression and stress. There are two types of meditation - concentration and contemplation (Aladar Kogler, 2003).
Concentration techniques are all those which involve effort to focus mind on a particular thought, sensation, image, part of the body or other object of experience. Typical concentration techniques require that a person counts his breaths, concentration techniques waste energy in controlling and focussing mental activity, there by increasing stress and strain, a distinguishing mark of concentration whenever the mind tends to wander. The concentration techniques are widely practised in India because it produces a detached and unrealistic attitude towards life. Maharishi comments that many concentration techniques tend to dull the mind and inhibit the natural process of evolution. Enlightenment is the ultimate goal of concentration technique. Most teachers of such techniques warn that their techniques require many years of disciplined practise to produce any progress toward full human development.

Contemplative techniques is another category of meditation methods. Contemplation involves thinking about an important idea or question like what is God, love, who am I in a free and unconstrained manner. It is usually; practised by philosophers and monk. Contemplation does not seem to hold any of the challenges of concentrative techniques, but does achieve ends wholly; different from those resulting from the transcendental meditation technique. The effects of contemplation remain confined to intellectual understanding or a pleasant felling.

Many religions have traditions of healing and offer specific processes about meditation. The ultimate objective is to suit the needs of the individual and his mental well-being. Meditative techniques have been found to be effective in managing, controlling and reducing stress and strain.

**Aerobic Exercise**

The word ‘aerobic’ literally means ‘with oxygen’. The term aerobic exercise refers to energetic physical activity that requires high levels of oxygen over an extended number of minutes, say 30 minutes. Aerobic exercise directly affects the physiology of human being, it helps a lot in the maintenance of physical and psychological health. It helps in the
prevention of many bodily problems such as obesity, arthritis and muscular cramp by developing a healthy body and healthy mind. The process of aerobic exercise is very simple. It involves rhythmical action that moves the body over a distance or against gravity as occurs in dancing, jogging, bicycling, swimming or certain callisthenics. It is a kind of complete physical workout without the feeling of fatigue. Performing aerobic activity with sufficient intensity and duration on a regular basis increases the body’s ability to extract oxygen from the blood and burn fatty acids and can reduce the cholesterol level in the blood and can also help in the prevention of arteriosclerosis or arterial thrombosis.

The specific benefits of aerobic exercise include a better attitude, an emotional lift, thereby increasing the ability to handle stress. They also increase the aerobic threshold and oxygen pickup in lungs which causes to do more exercises with ease. They help to increase fat burning enzymes which induce fat deposits to release fatty acids and burn more fat to produce more calories even while at rest resulting in better hunger control. Aerobic exercise develops better resistance to cold by the improved handling of excess heat. Besides that they decrease triglycerides low density lipoprotein, and increase high density lipoprotein which help in guarding coronary ailments. They reduce the conversion of sugar to fat leading to decrease in body fat resulting in reduced incidence of hypoglycemia. They also help to raise glycogen storage, hemoglobin levels and muscle mass.

**Statement of the Problem**

A few players have perceived stress by their own self due to unfavourable basal concentration of stress hormone. These players can be given stress reduction training and thereby enhance their stress tolerance capacity. For this purpose, the present investigation tries to find out the training effects of yogic practices and aerobic exercises on stress hormone, circulatory and metabolic responses of players.
Hypotheses

1. Practicing yoga has significant and positive influence on stress, stress hormone, circulatory and metabolic responses.

2. Practicing aerobic exercise has significant and positive influence on stress, stress hormone, circulatory and metabolic responses.

3. As far as treatment of yoga practices and aerobic exercises are concerned, yogic practices have high level impact on stress, stress hormone, circulatory and metabolic responses.

Significance of the Study

The present study may be considered significant because of the following benefits.

1. The research would be helpful to suggest ways and means for improving physical, physiological and physiological capacities by introducing yoga in the curriculum.

2. The result of the study would be of interest to physical educationists and players as it would suggest ways for the improvement of general health and fitness.

3. The study would highlight yoga and aerobic exercise as an effective component of the training schedule for better performance.

4. The findings of the study would be of great value in designing and administering yoga camp, yoga awareness camp, fitness and remedial programmes.

5. The result of the study would be of specific use to the players while performing tough task in high level competitions.
Delimitations

1. This study was restricted to the players of Thiru. Vi. Ka. Govtenment Arts College, Tiruvarur, Tamilnadu State.

2. The subjects selected were only from the age group of 18 to 25 years.

3. To test the hypotheses only 45 overstress players were randomly selected from the population of 420 college players.

4. Only selected circulatory and metabolic responses have been chosen for this study.

5. The duration of the experimental period was only twelve weeks.

6. The study was confined only to selected yogic practices and aerobic exercises.

Limitations

1. The factors like personal habits, life style, daily routine diet, climatic conditions and environmental sources which might have an effect on the results of this study could not be taken into consideration.

2. Hereditary, social and psychological factors could not be controlled.

Definition of the Terms

Yogic Practices

Yoga is an exact science which has its foundation on certain immutable laws of nature and establishes ‘mind over body’. The gaining of healthy body with a calm and steady mind under all circumstances is the common aspiration of every individual. The word yoga is derived from the Sanskrit word ‘Yuj’ which means control or unite. Both these words quite adequately give the meaning of ‘yoga’. (Krishna Raman, 2003).
**Aerobic Exercise**

Aerobic exercise is any activity that uses large muscle groups. It can be maintained continuously and rhythmically in nature. It is a type of exercise that overloads the heart and lungs and causes them to work hard than at rest. (Martha Davis, 1996).

**Stress Hormone-Cortisol**

Cortisol is a major steroid hormone produced in the adrenal glands. It is essential for allowing the body to cope during times of stress. So it is called stress hormone. (Aeron, 2001).

**Heart Rate**

Number of heart contractions per minute is usually expressed as beats per minute. (Giam, C.K., 1998).

**Systolic Blood Pressure**

'The highest level to which the arterial blood pressure rises following the systolic ejection of blood from the left ventricle'. (Shaver, 1975).

**Diastolic Blood Pressure**

The lowest level in which the arterial blood pressure falls in between the successive heart beat. (Shaver, 1975).

**Blood Sugar**

Blood contains sugar in the from of glucose and the gulcose present in the blood is called blood sugar. The glucose in the blood is distributed evenly between RBC and the plasma and can freely pass from one to the other. (Mariakkuttikan, A., 2003)

**Cholesterol**

A group of fat includes substances derived from the simple and compound fats. The most widely known of the derived fats is cholesterol,
a sterol found only in animal tissue that contains no fatty acids but exhibits some of the physical and chemical characteristics of fat. (William D. McArdle, 1991)

**Protein**

An organic compound formed from amino acids. A basic foodstuff which forms muscle tissue, hormones, enzymes, etc. (Mariakuttikan, A., 2003).

**Operational definition of the terms**

**Stress**

The managerial model of stress has been accepted in this study. Matterson and Ivanceviche (1982) on the basis of years of research and experience have proposed the managerial model of stress. This model considers stress to be a part of a complex and dynamic system of transaction between the individual and environment. The model emphasis that stress is an individual perceptual phenomenon.

**Over Stress Players**

It refers to those players who have a score below the median on a composite weighted scale derived on their own subjectively perceived state of well being.

**Stress Management**

This study employs yogic practices and arobic exercises as coping strategies to reduce the stress level and be able to overcome stress so that the stress tolerance capacity is enhanced and an improved well-being status of player is attained.

**Yogic Practices**

Yoga is a complete science of health which deals with the adequate functions of all systems of the body and appropriate co-ordination between
them, along with the healthy functioning of the mind. The techniques of yoga are designed in such a way that they not only keep the body healthy and fit but also prevent physical, mental and emotional imbalances.

**Aerobic Exercises**

Aerobic exercises are repetitive, rhythmic and varied. They involve sustained use of the large muscles in the body, especially the legs and arms. The goal of aerobic exercise is to strengthen the cardiovascular system and it is one of the simplest and most effective means of stress reduction.