CHAPTER I

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The word ‘yoga’ has two Sanskrit roots, and thus has a double sense. One meaning is ‘to immerse’ – ‘to immerse in God’. The other is a parent root of the English word ‘yoke’ and means ‘to couple’, ‘to connect’. The relationship between the Sanskrit word ‘yoga’ and the English ‘yoke’, German ‘joch’, Latin ‘jugum’ and Hungarian ‘iga’ is most instructive. The words of Jesus ‘take my yoke upon you.... for my yoke is easy and my burden is light’ (Matthew 11: 29-30) are also to be considered in this light (Yesudian and Haich, 1970).

Such union or oneness is experienced only when the highest state of non-dual consciousness is reached. In order to experience the state of eternal bliss, the conscious self must merge into the divine, super conscious Self. That transcendent Self is beyond the cycles of birth and death, beyond time and space, and beyond even the concepts of bondage and release, that is Brahman, the Ultimate Reality, which is Non-dual, Eternal, Changeless, All-pervading, Unshakable, Transcendent and Infinite (Rajarshi Muni, 1995).

In India from time immemorial, many great sages have devoted their entire lives to the study of the secrets of the human nature and existence. They searched with inexhaustible effort and iron endurance. For this, they completely withdrew themselves from the commotion of the world and concentrated all their efforts solely upon this inner quest. Ultimately, their dedicated efforts bore fruit as they experienced the higher Truths. Thus, they understood through experience the
deepest secrets of life and the mysteries of Being. This discovered hidden inner path leading upward to freedom and emancipation collectively was named as Yoga (Rajarshi Muni, 1995).

An individual can attain the goal of yoga through various ways according to one's temperament. They are known as different types of yoga. The essential features of the important varieties of yoga are Bhakti Yoga, Karma Yoga, Hatha Yoga and Jnana Yoga.

**BHAKTI YOGA (love and devotion)**

It is based on the conviction that there exists a higher power (called God) that has willfully created the universe which is all-powerful and merciful that may shower grace and mercy on the devotee, thereby protecting him from harms and evils. All that the devotee is expected to do is to make himself fit for obtaining the grace and mercy of God, the Supreme Creator, through devotion and the practice of virtue (Joshi, 1987).

**KARMA YOGA (Action and Service)**

*Karma*, in Sanskrit, means action and this variety of yoga derives its name from the fact that even after attainment of the goal of yoga, i.e., one does not renounce the various acts themselves. A *Karma Yogi* behaves with indifference which is the product of cessation of desire and an awareness of the real significance of happenings in the world (Joshi, 1987).
**Jnana Yoga (Knowledge)**

Jnana yoga or the path of wisdom is most difficult because it requires tremendous moral and intellectual strength. Jnana yoga enquires into the nature of everything through discrimination and determination (Singh, 1996).

**Hatha yoga (Mastery of Body)**

It is supposed that a practice of the techniques included in this yoga brings about a union of what are called the sun and the moon in our body. The moon is situated in a region above the hard palate and is believed to exude a fluid that percolates down and is swallowed by the sun that is situated at the navel. It is due to the swallowing up of this elixir by the sun, that we are said to suffer from old age and death. Hatha yoga, in short, is a way of tackling these two, that is, the sun and the moon in our body, so as to bring about an union of them (Joshi, 1987).

**Ashtanga yoga (Eight fold path)**

It was Rishi Patanjali, rightly called as the father of Yoga, who compiled, synthesized, modified, systematized and refined Yoga in a metaphysical whole and laid down eight steps which form the basis on which the whole system of Yoga works. It was indeed the first classical attempt to interpret the subject. The eight steps consist of Yama, Niyama, Asana, Pranayama, Pratyahara, Dharana, Dhyana and Samadhi. These steps in perfect order, as they are, formulated the basis of psychological understanding of the human mind. Yoga had recognised and accepted the importance of the mind and the subconscious over the total human personality, much earlier than did the modern psychology in its present
form. In the methodology of Patanjali, all the eight limbs or constituents are to be present in the same sequence to make the process of Yoga successful. Yoga, thus, is a step-wise, stage-wise eight-fold path to final liberation from pain and suffering. These steps progressively take you to the highest state of creativity, of discriminative knowledge and towards attaining the desired perfection. This classic yoga, commonly known as the eight-fold path (*Ashtanga Yoga*), covers both the yoga ideology and technology. The eight steps are

- **Yama** - conditioned yoga behaviours, both personal and social
- **Niyama** - attitude sublimated to yoga norms
- **Asana** - discipline of the physical body
- **Pranayama** - control over bio-energy through respiratory action
- **Pratyahara** - withdrawal of the senses inwards through abstraction
- **Dharana** - concentration
- **Dhyana** - meditation
- **Samadhi** - consciousness absolute or transconsciousness

Of these, the first five which border on the psychosomatic approach are referred to as External (*Bahiranga*) Yoga, popularly known as *Hatha* Yoga, while the latter three which directly affect the psyche are known as Internal (*Antaranga*) Yoga, popularly known as *Raja* Yoga. It is almost impossible to try Internal Yoga
(Raja Yoga) for the average man before accomplishing the external one (Hatha yoga). The respective sequence of the eight steps as the standard methodology of yoga has been so adopted that each step helps the succeeding one until the final culmination of yoga (Shambunath, 1988).

**Asanas**

Before mental concentration is attempted, the body must be placed in a favorable and comfortable position, and one in which it can remain for a long time. The bodily postures help to strengthen the body and stabilise the mind. That posture, in which a man can remain longest without effort, is for him the best. The very word "asana" means 'easy, comfortable', and so the postures should be to have their full effect.

The aim of the bodily postures is secured when the physical reactions of the body are eliminated and the mind dissolves into the Infinite.

The third limb of *Ashtanga* Yoga is *asana* or posture. A steady and pleasant posture produces mental equilibrium and prevents fickleness of mind. *Asanas* are not merely gymnastic exercises; they are postures. To perform them, one needs a clean airy place, a blanket and determination. For other systems of physical training, one needs large playing fields and costly equipment. *Asanas* can be done alone, as the limbs of the body provide the necessary weights and counter weights.

*Asanas* have been evolved over the centuries so as to exercise every muscle, nerve and gland in the body. They secure a fine physique, which is strong
and elastic without being muscle-bound and they keep the body free from disease. They reduce fatigue and soothe the nerves. However, their real importance lies in the way they train and discipline the mind.

While Swedish gymnastics and sports, which are based on external action, develop the muscles, *asanas* work in depth in our interior being, partly on the physical plane (viscera, endocrine glands, brain, voluntary and involuntary nervous systems) and also on the mental level where they produce the sort of calm and serenity which may be the key to energy and happiness (Lysebeth, 1993).

*Asanas* are influencing on the endocrine glands thereby they control the hyper or hypo secretion of human hormones (Lysebeth, 1993). A group of selected asanas may positively be effective in regulating the psychosomatic activity through controlling the endocrine glands (Yogeshwar, 1982).

**Endocrine glands**

Both invertebrates and vertebrates have specialized tissues that secrete regulatory molecules into the blood and act on target cells within the same organism. These tissues constitute the various endocrine glands. The messenger molecules they secrete are called hormones. Many hormones are found to act as the first messenger in a series of two or more sequential messengers that lead to a specific response in the target tissue. In the course of their circuit in the blood and interstitial fluid, the hormone molecules encounter receptor molecules, which are specific for the hormone and which reside at the surface of the target cells or
within them. By an interaction of hormone molecule with receptor molecule, there
is initiated in the target cells a series of steps that influence one or more aspects of
the physiology or metabolism of those cells. Although hormone molecules come
in to contact with all the tissues in the body, only cells that contain receptor
specific for the hormone are affected by the hormone.

Because the amount of hormone produced by an endocrine gland is
generally very small, its concentration in the blood remains very low. The target
cells however are extraordinarily sensitive to the hormone. Endocrine systems are
best suited for regulatory functions that are sustained for minutes, hours, or days,
such as maintenance of blood osmolarity, blood sugar and metabolic levels, for
control of sexual activity and reproductive cycles, and for modification of
behavior. It seems apparent, then, that the slow, steady actions of the endocrine
complement the more rapid performance of the nervous system in coordinating
body functions

Hormones are characterised by the following:

1. Hormones are produced and secreted into the circulation by
   endocrine cells in trace amounts.

2. They are earned in the blood to the target tissue.

3. They react with specific receptor molecules present in certain
target cells.
The endocrine glands include the hypophysis or pituitary, the epiphysis cerebri or pineal, the thyroid, the parathyroid, the thymus, the islet part of the pancreas, the adrenals and the excretory part of the sex glands (testes and ovaries). Each gland consists of glandular epithelial tissue and has an extensive network of blood vessels and a large number of nerve fibers.

The hypophysis is the chief gland of this system; it produces special substances that stimulate the activities of the other endocrine glands. The influence of various substances (mainly hormone) acting on the organism through the blood is called humoral regulation. The activities of endocrine glands are regulated by the nervous system. The nervous system exercises direct control over the endocrine glands through the nerves and neurohumoral control, particularly through the hypophysis. The hormones in their turn affect the functions of the different parts of the nervous system (Myshne, 1978).

The adrenals

The adrenal glands, which lie at the superior poles of the two kidneys, are each composed of two distinct parts, the adrenal medulla and adrenal cortex. The adrenal medulla is functionally related to the sympathetic nervous system and it secretes the hormones, epinephrine and nore-epinephrine, in response to sympathetic stimulation. In turn, these hormones cause almost the same effects as direct stimulation of the sympathetic nerves in all parts of the body.
The adrenal cortex secretes an entirely different group of hormones called corticosteroids. These hormones are all synthesized from the steroid cholesterol and they all have similar chemical formulas. However, very slight differences in their molecular structure, give them several very different but very important functions.

**Mineralocorticoids and Glucocorticoids**

All adrenocortical hormones do not cause exactly the same effects in the body. Two major types of hormones, the mineralocorticoids and the glucocorticoids are secreted by the adrenal cortex. In addition to these, small amounts of sex hormones are secreted, especially androgenic hormones that exhibit the same effects in the body as the male sex hormone ‘testosterone’.

The mineralocorticoids have gained this name because they especially affect the electrolytes of the extracellular fluids – Sodium and Potassium in particular. The glucocorticoids have gained this name because they exhibit an important effect in increasing blood glucose concentration. However, the glucocorticoids have additional effects on both protein and fat metabolism, which may be equally as important to body function as are their effects on carbohydrate metabolism.

Over thirty different steroids have been isolated from the adrenal cortex, but only two of these are of major importance to the endocrine functions of the body. Aldosterone, which is the principal mineralocorticoid and cortisol, which is the principal glucocorticoid are present in human body (Guyton, 1986).
Biological Effects of Mineralocorticoids

Aldosterone, the principal mineralocorticoid, stimulates reabsorption of Na⁺ in the collecting tubules of the kidney. When Na⁺ is reabsorbed from tubular fluid, electrical neutrality must be maintained by the secretion of K⁺ or H⁺ or by concomitant reabsorption of an anion Cl⁻. The exchange of K⁺ and H⁺ for Na⁺ will be greater when the quantity of Na⁺ reaching the collecting tubule is increased. When extra-cellular fluid volume is decreased, activation of the renin-angiotensin system increases aldosterone to promote Na⁺ conservation. With adrenal insufficiency, Na⁺ conservation in the distal tubule is defective so that excessive Na⁺ is lost in the urine, with resultant hyponatremia and contraction of extracellular fluid volume. Although most Na⁺ is reabsorbed in the proximal tubule, with aldosterone deficiency up to 240 mEq of Na⁺ may be lost per day because of failure of Na⁺ conservation by the collecting tubules. The diminished extra-cellular fluid volume results in decreased blood pressure and reduced cardiac output. Mineralocorticoid deficiency is a strong contributor to the muscle weakness characteristic of adrenal insufficiency and contributes to poor growth in children.

Aldosterone also regulates ion transport in sweat glands, salivary glands and the gastrointestinal tract. When aldosterone is produced or administered in excessive amounts, there is increased Na⁺ reabsorption and facilitated K⁺ and H⁺ exchange, resulting in hypokalemia and alkalosis.
Biological Effects of Glucocorticoids

Cortisol, the principal glucocorticoid in man, has widespread effects on most organs of the body to regulate metabolism of protein, nucleic acid and fat as well as carbohydrate. Physiologically, cortisol mediates adaptive responses to stress and fasting. Cortisol is pharmacologically used to suppress the inflammatory response. In fasting, which is the best-studied paradigm, cortisol maintains blood glucose by stimulating gluconeogenesis. The liver is the principal site of gluconeogenesis. Cortisol also increases glycogen synthesis and accumulation in the liver. In muscle, cortisol inhibits protein and nucleic acid synthesis and enhances protein breakdown to provide amino acids by the liver.

The catabolic effects of high concentrations of cortisol are evident on muscle where there is loss of muscle mass and development of weakness. In response to severe stress, adrenal production of cortisol may rise as much as 10-fold. This is an adaptive response, which favors survival (West, 1981).

Cortisol has some aldosterone-like action; although the action is weak compared to aldosterone. Nevertheless, since about 25mg cortisol is produced in a normal man per day, the total mineralocorticosteroid-like activity of cortisol is considerable. Thus, cortisol causes Na\(^+\) retention and K\(^+\) excretion from the body (Chaudhuri, 1991).

Antistress action

'Stress’ is an ill-defined term. The danger of stress is that, if not controlled, stress causes derangement of homeostatic mechanisms that may lead to
death. Stress develops when the person develops acute pain or severe infection, fever or receives injuries or develops acute anxieties. These are all noxious stimuli. In all such conditions, a rise of plasma cortisol level occurs. This rise is often spectacular in severe mental agonies. It appears that an elevated cortisol level is needed to battle with the stress (Chaudhuri, 1991).

Selye's concept of stress effects

Adrenalectomised animals have very little ability to tolerate stresses such as temperature extremes, excessive muscular activities, trauma, infections, intoxications etc. These animals markedly regain the ability to withstand such stresses if they are administered with adrenal corticoids.

Thus in normal animal, stress activates the pituitary adrenal axis with subsequent release of the steroids which in turn enables the animal to withstand stresses. The response of the organism to nonspecific stress has been called as general adaptation syndrome. The endocrine adjustments that occur during stress must be of utility to the organism in its attempt to maintain homeostasis (Nagabhushanam et al. 1983).

Various types of stimuli lead to an increase adrenocortical secretion in man. For example, increased 17- hydroxy corticosteroid level in the plasma and increased excretions in the urine occur before and after surgical operations, and for several days after severe burns. The increased corticoid secretion is largely psychogenic in origin. This may be so in muscular exercise. In a boat race at an
American university, the urinary excretion of corticoids was increased not only in the oarsman, but also in the cox and manager of the crew (Keele and Neil, 1962).

Aldosterone regulates water balance by causing sodium reabsorption, which causes water to be drawn passively into the capillaries. Thus, how aldosterone is controlled during exercise is an important concern of those involved in endurance sports and sports in which water loss is excessive, for instance, football players playing in hot climate (Noble, 1986).

Cortisol has a multitude of other activities, including the induction of several enzymes, promotion of fat deposition in faciocervicotrunkal areas, promotion of uric acid excretion, promotion of appetite, reduction of circulating oesinophils and maintenance of muscular work capacity (William, 1981).

A basketball player performs a variety of tasks in a game. Some of the movements involve primarily relative power, anaerobic- aerobic endurance, and aerobic endurance but are continuous and repetitive. Dribbling the ball while moving rapidly, jumping in the air while shooting or recovering rebounds, faking out an opponent and chasing a loose ball are moves that involve relative power. This makes the player moves vulnerable to the effects of excessive body contact by opponent (Berger, 1982).

Yoga is a giant leap of Indian, which is not fully understood by us. Our scientists have penetrated the heart of an atom and even they have successfully landed on the Mars but we are unable to find out the scientific facts
behind yoga. As there is a lacuna in the scientific approach of Yoga, it is essential
to give scientific approach particularly connected to how far asana practice is
helpful in correcting adrenal cortex levels of Basketball players.

**STATEMENT OF THE PROBLEM**

The purpose of the study was to find out the influence of asanas on
adrenal cortex prior to and after competition. The purpose was also to find out the
influence of competition on adrenal cortex prior to and after competition. It was
also to find out the difference between the two groups during rest, just five
minutes prior to competition and immediately after competition among
intercollegiate basketball players.

The influence on adrenal cortex would mean the changes that take place
on its secretions such as plasma cortisol, plasma sodium and plasma potassium.
HYPOTHESES

PLASMA CORTISOL

It was hypothesised that

1. There would be significant influence of asanas on plasma cortisol among trained basketball players.

2. There would be significant influence of competition on plasma cortisol among trained basketball players.

3. There would be significant differences in the plasma cortisol between control group and experimental group.

PLASMA SODIUM

It was hypothesised that

4. There would be significant influence of asanas on plasma sodium concentration among trained basketball players.

5. There would be significant influence of competition on plasma sodium concentration among trained basketball players.

6. There would be significant differences in the plasma sodium concentration between control group and experimental group.
PLASMA POTASSIUM

It was hypothesised that

7. There would be significant influence of asanas on plasma potassium concentration among trained basketball players.

8. There would be significant influence of competition on plasma potassium concentration among trained basketball players.

9. There would be significant differences in the plasma potassium concentration between control group and experimental group.

DELIMITATIONS

The following factors were considered as delimitations in the study by the investigator.

1. For the purpose of this study, only twenty-four male basketball players were selected from the colleges affiliated to Madurai Kamaraj University, Madurai, Tamil Nadu State, India.

2. The subjects were randomly divided into two equal groups (n=12) in which Group-I acted as control group and Group-II, the experimental group, had undergone twelve weeks practice of asanas.

3. The subjects in the experimental group underwent the practice of asanas for five days a week for a period of twelve weeks.
4. The age of the basketball players ranged from eighteen to twenty-five years.

5. The criterion variables tested were plasma cortisol, plasma sodium concentration, and plasma potassium concentration.

6. Plasma cortisol was tested by ELISA plate reader.

7. Plasma sodium and potassium were counted through Flame photometer.

LIMITATIONS

The following factors were considered as limitations in the study by the investigator.

1. The subjects were oriented verbally, and no attempt was made to differentiate motivation level between groups during testing and practice of asanas.

2. No effort was put in to find out the differences in environmental conditions during tests; however, dry weather prevailed during the tests.

3. All the subjects were fully residential students and they had similar routine of diet. No effect was made either to control or assess the quality and quantum of the food ingested, their lifestyle, psychological stresses and other factors that may affect the study, as this was recognised as a limitation.
4. Participation in the intramural and recreational activities by the subjects could not be controlled.

5. The specific fitness components were not considered while dividing the groups.

6. Blood samples were only taken during the preliminary rounds of Madurai Kamaraj University Inter-collegiate Basketball Tournaments

**DEFINITION AND EXPLANATION OF TERMS**

**Asanas**

These are special patterns of postures that stabilise the mind and the body through static stretching. Their aim is to establish proper rhythm in the neuromuscular tonic impulses and improve the general muscle tone (Gharote and Ganguly, 1988).

**Body fluid homeostasis**

Homeostasis is a phenomenon by which a steady state composition of the body fluid is maintained. The volume and composition of intracellular and extracellular fluids are maintained relatively constant for most species. Constancy in turn is needed in order to permit optimal enzymatic activities, membrane permeability, electrical excitability and other functions (Nagabhushanam et al. 1983).
Competition

The preliminary round matches of Madurai Kamaraj University intercollegiate Basketball Tournaments are considered as ‘competition’ in this study.

Hormones

Hormones are substances which are secreted by highly specialised cells and carried by the extracellular fluid (mainly blood), and act on the target organs where they alter the activities of the cells quantitatively, so as to influence the metabolism, growth, reproduction, adaptation to the environment of the body, and so on (Chaudhuri, 1991).

Hyperkalemia

In clinical medicine, hyperkalemia can be divided into two categories. The first one is inappropriate internal distribution between the intracellular and extracellular fluid compartments.

The second category includes the pathologic status associated with the inability of the kidney to excrete potassium appropriately (Sodeman and Sodeman, 1979).

Hypokalemia

The excessive loss of potassium ions from extracellular fluid into urine under the influence of aldosterone causes a serious decrease in the plasma potassium concentration. This condition is called hypokalemia (Guyton, 1971).
Hyponatremia

Hyponatremia is one of the more common fluid and electrolyte anomalies seen in the practice of clinical medicine. Dilutional hyponatremia is the most commonly occurring disorder of sodium metabolism. With dilutional hyponatremia, the total body sodium in relation to ideal body weight is normal, but the patient is incapable of excreting a water load (Sodeman and Sodeman, 1979).

Osmolarity

The units of osmoles per liter and osmoles per kilogram water are respectively termed osmolarity and osmolality (West, 1981).

Stress

Selye defined stress as the state manifested by the specific syndrome, which consists of all the nonspecifically induced changes within a biologic system or more simply, as the rate of wear and tear in the body (Devries and Housh, 1994).

Yoga

Yoga, the science of man-based on our ancient wisdom and culture-has laid down a technology consisting of various psycho-physiological processes for dealing with the body-mind complex. It tries to harmonise and integrate the human personality at all levels and stages of life. It shows the way out of
complexities and problems of life and holds the key to better living (Shambunath, 1988).

SIGNIFICANCE OF THE STUDY

Yogic literature shows that any malfunction of a body system can be corrected through yogic practices. Asanas influence the endocrine glands thereby increase or decrease the amount of hormones. Hormonal levels are enhanced by the physical vigorness. Hence, this study was undertaken to find the influences of asanas on the concentration of plasma cortisol, Sodium and Potassium of basketball players.

1. The findings of this study would enable the coaches, physical educationists and players to gain definite faith in the practice of asanas for controlling endocrine glands, if it proves that asanas could control and balance secretions to increase performance.

2. The results of the study, if prove to correct the malfunctioning of endocrine glands, would be helpful to medical practitioners for prescribing specific suitable asanas.
3. The study would also be helpful to the sports physiologists and psychologists to prescribe specific asanas suitable for curing the malfunctions of endocrine glands.

4. The results of the study would also add quantum of knowledge to sports physiologists and sports trainers.