Chapter - I

INTRODUCTION

Physical education is a body oriented discipline based on scientific facts and principles. It provides knowledge about the physiological effects of activity, the mechanical efficiency of motor skills, the psychological effects of participation, the sociological implications, the aesthetic aspect of movement and therapeutic value of exercise. The development of physical program is brought about keeping in biological, physiological, psychological and sociological aspects of growth and development.

Wealth can be inherited and transferred, but health is to be earned through proper habits of daily life. The word health can be defined as a state of physically fit, mentally alert, socially sound, emotionally balanced and spiritually enriched, and not merely free from disease.

One of the most important aspects of health-related fitness is the aerobic capacity or the Cardiovascular endurance of an individual. Aerobic capacity can be defined as the ability to take in, transport and utilize oxygen efficiently. Since aerobic fitness involves so many important organs and systems, it tells much about the health of these components and about the health in general. Therefore, when aerobic fitness is high, physical and mental health is enhanced.  

1 Mowley and Frank, Health /Fitness Constructors, (USA: Human Kinetics Publishers, IMC Campaign, 1943) p.82.
Aerobic exercise is any rhythmic activity maintained continuously for a period of time that uses large muscle groups. The common examples of aerobic exercise include walking, jogging/running, swimming, rowing, stair climbing, bicycling, cross-country skiing, step and dance exercise, roller-skating, and the more continuous forms of tennis, racquetball and squash.

Aerobic activity trains the heart, lungs and cardiovascular system to process and deliver oxygen more quickly and efficiently to every part of the body.

The benefits of aerobic exercise and fitness include improved circulation and respiration; reduced risk of heart diseases; improved fat metabolism and reduced body weight (fat-free body mass); strengthened bones, ligaments and tendons; personality changes like enhanced self concept, body image and emotional stability. The increased capacity and adaptability associated with aerobic fitness can add life to your years, not just years to your life.

Regular physical activity improves more than fifty different physiological, metabolic and psychological aspects of human life. The recent surgeon general’s report on physical activity and health indicates that physical activity need not be strenuous in order to achieve health benefits, and that women and men of all ages benefit from a moderate amount of physical activity.

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3 L.Kravitz and R.Robergs, “To Be Active or Not to Be Active”, IDEA Today, March (1993), p.47-53
Sedentary life style is associated with increased risk of disease and reduced functional capacity. It has been established that significant health benefits can be gained from moderate level of regular physical activity for all ages.

Regular physical activity has been linked to lower incidences of high blood pressure, cancers of the colon and reproductive organs, bone fractures as a result of osteoporosis and depression. Many of the risk factors for coronary artery disease, hypertension and osteoporosis first appear during childhood, adolescence, or young adulthood, many of these risks can be reduced through exercise⁴.

Aerobics is a form of physical exercise that combines rhythmic exercise with stretching and strength training routines with the goal of improving all elements of fitness (flexibility, muscular strength, and cardio-vascular fitness).

Care and consideration should be given in selecting types (modes) of aerobic exercise. Depending on goals, physical condition and injury/illness history, different types may prove to be preferential for particular situation. However, in general, it is a good idea to “cross train” i.e alternate between and among several appropriate exercises. This strategy reduces the chances of overuse injuries, important to alternate forms of high impact exercises (running, dance exercise, tennis, racquetball, squash) with low/moderate impact aerobic exercises (walking, swimming, stair

climbing, step classes, rowing, cross-country skiing). Prudent advice is no more than every-other-day for high-impact activities; perhaps less if overweight, reconditioned or have an injury history or current problems with feet, ankles, knees, hips or low back.

Time we spend for aerobic exercise depend on our goals, schedule, and physical condition: 10 to 60 minutes is an acceptable range of time. Recent research shows that aerobic fitness levels can improve with as little as 10 minutes duration as long as exercise is performed often: 2 to 3 times a day 5 days a week. To balance general fitness, health, body composition, and scheduling concerns, 30 minutes is optimal for many people.

Warming up and cool down is important to reduce discomfort and the chance for injury. Warm up for aerobic exercise by performing the exercise at a very low intensity and gradually build up over 2 to 10 minutes at the end of our workout. It is a common misconception that aerobic exercise tones/firms muscles. Actually it accomplishes very little toning/ firming. Resistance exercise (weight training) is where real toning / firming of muscles occurs. Another misconception is that one must exercise aerobically at a low intensity to lose fat. Recent research has shown that we may exercise at any intensity for effective fat loss.

Beginning Aerobic Dance/Exercise places an emphasis on developing cardiovascular endurance, flexibility, strength and muscular endurance through traditional aerobics, step, and circuit/interval aerobic workouts. Intermediate Aerobic Dance/Exercise emphasizes continued improvement in the level of
cardiovascular endurance, flexibility, strength and muscular endurance.  

Regular aerobic exercise has been shown to reduce high blood pressure, serum lipid levels (fat in the blood), body fat and emotional stress. Exercise favorably alters HDL (good) cholesterol to overall cholesterol ratio. Exercise can help to improve special health disorders such as diabetes, arthritis, and asthma. Exercising regularly helps to lose weight, re-sets the body’s metabolism, countering the effects of calorie restriction.

Aerobic exercise will significantly improve the efficiency with which the body performs, general body flexibility, cardiac efficiency, breathing capacity and overall quality of life.

Yoga is a very ancient discipline. It is recognized as one of the most important and valuable heritage of India. Yoga is an art, science and philosophy, which influence the life of man at each level. Yoga is a way to achieve total health, peace, bliss and wisdom. Physical, mental and spiritual aspects of yoga help to make one’s life purposeful, useful and noble.

Today, the whole world is looking to yoga for the answer to various problems modern man is facing. Yoga is the art of living and yogasana is a scientific procedure. Yoga develops the personality of an individual, physically, mentally, morally and intellectually.

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Yoga is a unique Indian tradition of ancient origin for health and happiness. It imparts both sound body and sound mind to the practitioner. Yoga is a Sanskrit term. It represents Yoke, which symbolically means to join or to unite. Yoga is intended for union or harmony of mind and the body. Yoga is the science of physical and mental health. It synchronizes the functions of the muscle and the mind. It is the only path that can lead to holistic health.  

Yoga eliminates stress and strain which improves physical and mental fitness. Physical fitness prepares the body to perform strenuous activity without getting fatigue. Mental fitness prepares the mind to face tough task and challenges.  

Yoga benefits people of all ages. The study of yoga is fascinating to those with a philosophical mind and is defined as the “silencing of the mind’s activities which leads to complete realization of the intrinsic nature of the Supreme Being”.

Yogic exercises and techniques have significant, direct effects on the physical, psychological, theoretical preparation and on the regeneration of the strength process. Yogasanas can be used for warm-up, cool-down, regeneration, synthesis of mind and body, activation or deactivation of the body and as supplemental exercises.

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In recent times yoga has become an integral part of physical education. Athletes and sportsmen are mentally prepared and physically warmed up by yogic techniques to improve their efficiency in their performance in the playground.

Over the centuries four different paths of yoga have been developed. They are:

1. Karma Yoga - Active path - It is selfless service, works in both physical and mental, eliminates ego, but it works on spiritual levels.
2. Jnana Yoga - Philosophical path - An Intellectual approach (Viveka - discrimination, Vairagya - dispassion to spiritual).
3. Bhakthi Yoga - Devotional path - teaches techniques for their sublimation such as Chanting, Prayer and repetition of Mantras. Emotional energy is channeled into devotion, turning anger, hatred and jealousy in a positive direction.
4. Raja yoga - Scientific path - It prescribes a Psychological approach, based on practical system of concentration and control of the mind Right conduct, a healthy body and steady posture, breath control and withdrawal of senses.

Ancient sages have suggested eight stages of yoga to secure purity of body, mind and soul and finally communion with god. The eight stages or limbs of Raja yoga are known as `Ashtanga yoga’. They are as follows:
1. Yama - (discipline)
2. Niyama - (punctuality)
3. Asana - (Posture)
4. Pranayama - (Breathing Practice)
5. Pratihayaha - (Withdrawal of senses)
6. Dharana - (Concentration)
7. Dhyana - (Meditation)
8. Samadhi - (Cosmic realization/super consciousness).

The first four are basic and physical, and next four are psychic and Meta physical.¹⁰

Yama (Social Discipline): Yama involves behavioral commitments in life for positives reinforcement of the psyche at the intellectual level. These commitments include ahimsa (non-violence), satya (truthfulness), asteya (non-stealing), brahmacharya (celibacy) and apaertigraha (non-hoarding).

Niyama: Niyama involves behavioural commitments in life for positive reinforcement of psyche at the emotional level. These commitments include saucha (purity, cleanliness); santosha (contentment), tapas (austerity), swadhyaya (understanding oneself through study) and iswarpranidhana (surrender of God).

Asana: Asana means a steady comfortable posture. The great exponent of yoga of ancient times, saint pathanchally defines asana as sthiram sukham asanam meaning position which is comfortable and steady. A steady and pleasant posture produces

mental equilibrium and prevents fickleness of mind. Various yogic asanas are the most popular aspect of yoga.

**Pranayama** : Pranayama involves tackling of life energy (prana) through breathing discipline in order to sensitize the mind to the process of self-realization.

**Pratyahara** : Pratyahara involves concentrating the attention of sense organs towards the inside of the body by losing effective contact with external objects.

**Dharana** : Dharana is also a discipline of sense organs and involves concentration one aspect of self-existence at a time.

**Dhyana** : Dhyana is further refinement of control over sense organs and involves continuous awareness of the same aspect of self-existence for a longer time.

**Samadhi** : Samadhi is the final stage in achieving control over sense organs. It involves persistent awareness of balanced condition of the self. When the mind is no more a screen, the soul (Atma) is free and it shines as pure crystal with no reflection on it. As the self is free from contact of things, that is the state of experiencing Samadhi.

If these eight stages are practiced and followed in life, virtues like morality, (morally sound conduct) and good character would develop in man. Besides, there would be an all round progress in human life- physically, intellectually and spiritually and man would attain physical fitness and mental equanimity.\(^{11}\)

However yogasana is not mere physical training but it prepares the mind and the body for meditation and Samadhi.

Meditation soothes the emotional strain, removes stress and calms down the mind. Hence meditation is aptly termed as harmless tranquilizer.

The mind, the body, the society and the environment are always constantly interacting with each other. The body has to withstand the climatic fluctuation, the mind has to establish healthy coexistence in the society. Sound body and sound mind are interdependent and intrinsically interwoven with each other. Mental status influences the body; physical fitness reflects on mind. The mind is the master of the body. All the actions of the body are preceded by psychic command.

Siddha Samadhi Yoga is recognized as a most important technology for mankind for an effective elimination of mental problems and restoration of peace and happiness. It is a state of The deriving force that moves blood through the circulatory system. Systolic pressure is obtained when blood is ejected into the arteries, diastolic pressure is obtained when the blood drains from the arteries. High blood pressure is a trait as opposed to a specific disease and represents a quantitative rather than a qualitative from the norm ‘Any definition of hypertension is therefore arbitrary’.

Systemic blood pressure rise with age and the incidence of cardiovascular disease is closely related to average blood pressure at all stages even when BP readings are within the so called normal
range in the intellect with no kama (Attraction) or Krutha (Aversion).\textsuperscript{12}

Siddha Samadhi is an absolute effect less state with more effective benefit to the mental problems of mankind.\textsuperscript{13}

Hatha Yoga is a form of Raja yoga which emphasizes only Asanas and Pranayama.\textsuperscript{14}

Yogasanas are to bring the whole body to the peak of physical perfection and top efficiency by a series of carefully designed position. All the asanas, which have an effect on the diaphragm, help to massage the heart and abdominal organs. They have a curative, recuperative and preventive effect because they are based on deep breathing which can work wonders. Asanas are postures, which contribute to stability and sense of well-being.

Asana can be classified into three major groups namely Cultural Asana, Relaxative Asana and Meditative Asana:

**Cultural asana:** This group includes maximum number of asanas, which are meant for re-conditioning of the body and mind so as to bring stability, peace and a sense of well being.


\textsuperscript{14} Sivananda Yoga Vendanta Centre, *Yoga mind & Body*, (Montreal, Canada: Dorling Kindersley Ltd, 1996), pp. 6-7.
Relaxative asana: Shavasana and makarasana are two important relaxative asanas, which bring about relaxation of the body and mind. They eliminate the physical as well as mental tensions.

Meditative asanas: These asanas provide a comfortable and stable sitting position of the body to make the mind more steady for the process of meditation.\textsuperscript{15}

The physical training of yoga is named Hatha yoga which comprises a series of yogasanas. The word hatha yoga consists of two syllable namely “ha” and “tha”. “Ha” means sun and “tha” means moon and they represent bingala the right nostril and idagala the left nostril. Bingala refers to heat and Idagala refers to cold. Health is the balance of warmth and cold which Hatha yoga ensures in the body. It is also interpreted that “ha” refers to positive charge and “tha” refers negative charge, which imply to balancing of positive and negative emotions. It is also said that “ha” means male and “tha” means female implying that hathayoga is common to both the male and the female.\textsuperscript{16}

Negative emotions – hate, fear, panic, despair, depression exasperation, exertion, frustration, anxiety, failures, worries and disappointments could produce powerful changes in the bodies’ chemistry and set a stage for intensified illness. The negative


emotions produce innumerable number of psychosomatic diseases and disorders. Many of the modern disease of the man kind are psychosomatic in origin. Chronic illness like diabetes, asthma, migraine, ulcer, allergy, uterine dysfunction and hypertension, are mainly related to stress and strain. Yogasansa and meditation are proved to activate hypothalamus and enhance the secretion of neurohormones which in turn sets right, the sympathetic and parasympathetic imbalance leading bronchial asthma.\textsuperscript{17}

Negative thinking causes problems. Positive thinking brings solutions. One chronic stress caused by habituated negative thinking is a silent killer. Prolonged negative attitude produces negative chemicals which in turn impair immune system. Positive thinking promotes health and this is the key for health and survival.\textsuperscript{18}

Health is often mistaken as a state of being free from diseases and confused with strength and stamina. In true sense health may be defined as a state of physical mental and social well being.\textsuperscript{19}

Yoga advocates purity and self-restraint. Yoga advocates in virtues of progress, which includes adoptability, courage, money, generality, tolerance, patience, perseverance, sincerity, intensive faith, vigilance, diligence and complacency.\textsuperscript{20}

Asanas and physical exercises enabling the body to be physically fit. These exercises in physical education play an important part in helping the pupils to maintain a slim and youthful

\textsuperscript{17} H.R. Nagendra and K. Nagendra, \textit{A New Light for Asthmatics} (Calcutta: Vivekananda Kendra Yogas Publication, 1986) p. 82.
\textsuperscript{18} Nagendra and Nagendra, \textit{A New Light for Asthmatics}, p. 98.
body. Several tests and experiments have been conducted to know the values and importance of asanas. The most important point to realize before starting the practice of yoga is that, the asanas are not just simple exercise but sustained scientific pattern of postures.21

Yoga is a most ancient system or education, based on a higher philosophical knowledge and a spiritual concept of man, for the harmonious development of the body and mind. It recognizes the necessity of developing healthy, vital and well controlled body for the attainment of a high order of mental life. While, health is a state of organism in which all organs function uninterruptedly and vigorously and in full co-operation with one another for a longer survival and the best development of the body. It helps the man to express his best through his intellectual, moral, spiritual and physical activities. A vital body and dynamic mind are intimately associated with vital health. When health is established, the body becomes a fitter machine, more enduring, more powerful better developed and better controlled, the mind becomes alert, more imaginative better balanced and more contemplative and the emotions more normalized and spiritualized.22

The greater thing about yoga is that the asanas can be harnessed for a variety of purpose. There are asanas for various

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diseases such as asthma, piles, diabetics, low back pain etc. There are no side effects or after effects and longevity of life is considerably increased.23

Yoga helps to decrease the pain in lower and upper extremities. It involves stretching and strengthening the different parts of the spine, the backbone of our structure and the whole body becomes agile. It promotes the health of the endocrine glands which is associated with nervous system and maintains the overall functional efficiency of the different systems of the body. It puts certain groups of muscle tone which is closely related to one’s own emotional behaviour.24

Yogic techniques, which aim at physical and mental self-culture, have convincing scientific bases and produce consistent physiological changes. It has been reported that yogis are capable of achieving remarkable feats of endurance and controlling their autonomic functions. There is evidence that the practice of yoga improves cardio-respiratory efficiency and performance quotient.25

Yoga is the master key to unlock the mysterious human health complications. Yoga can unravel the secrets of health hazards of


human beings. Yoga is the destroyer of sorrows and miseries. It regulates the functions of various organs. It corrects psychosomatic ailments, digestive, metabolic, and organic disorders. It supplies energy to every cell, expels toxic wastes and gives protection against neuristhalnia and insthalnia.\textsuperscript{26}

Regular practice of yoga results in the following physiological, biochemical and psychological benefits.

**Physiological benefits**: Yoga improves endurance, cardiovascular endurance, respiratory efficiency, breath holding time, immunity, postures, muscular flexibility and muscular strength. It decreases Pain, Pulse rate, Respiratory rate and Blood pressure.

**Biochemical benefits**: Yoga increases the level of HDL Cholesterol, Cholinesterase, Vitamin C, Total serum protein, Thyroxin, Lymphocyte count, Hemoglobin, Hematocrit, ATPase. However, it decreases the level of Glucose, Sodium, Total Cholesterol, Triglyceride, LDL Cholesterol, VLDL Cholesterol, Catecholamines and Total white blood cell count.

**Psychological Benefits**: Yoga improves Concentration, Attention, Mood, Depth perception, Mind/Body neuro connection, Memory, Learning efficiency, Balance, Steadiness and Cognitive function. Besides, it decreases Anxiety and Depression. It also increases Self-acceptance, Social skills, Well-being, Somatic and kinesthetic awareness and Self-actualization.

\textsuperscript{26} Andrevan Lyse Beth, *Yoga and You*, (New York: Arya Book Depot, 1976), p. 32
Statement of the Problem

The purpose of the study is to investigate the effect of selected aerobic exercises and yogic practices on physical, physiological and biochemical variables of school girls.

Delimitations

The delimitations of the study:
1. This study was confined to school girls who were studying in St. Joseph of Cluny Hr. Sec. School, Pondicherry.
2. The study was limited to the age group of 14 to 18 years.
3. The subjects were divided into three groups namely Aerobic group, Yogic group and Control group consisting of fifteen subjects each.
4. The physical variables include speed, muscular endurance and cardio-respiratory endurance.
5. The physiological variables comprise resting pulse rate, breath holding time and respiratory rate.
6. The bio-chemical variables such as protein and lactic acid.

Limitations

1. Though the subjects were motivated verbally, no attempt was made to differentiate their motivation level during testing and training.
2. The effect of unidentified and uncontrollable factors like food habits, lifestyle that might have influenced the selected test item is accepted as limitation.
3. Previous training and experience were not taken into consideration.

4. The changes in climate condition such as temperature, atmospheric pressure humidity during the training as well as testing period could not be controlled and their influence on the result of the study was recognized as a limitation.

**Hypothesis**

Any systematic and scientific training will produce desirable effects if administered for a specific period. Therefore

It was hypothesized that effect of yogic practices and aerobic exercises would bring about the significant changes on selected criterion variables.

**Definition and Explanation of the Terms**

**Yoga**: Yoga essentially means the integration of personality at all levels: physical, mental, social, intellectual, emotional and spiritual.\(^{27}\)

Yoga is a method by which one can obtain control of one’s latent powers. It offers the complete means to self realization\(^ {28}\).


Yoga is a timeless pragmatic science evolved over thousands of years dealing with the physical, moral and spiritual well being of a man as a whole.\textsuperscript{29}

**Asana**

Asanas are not movements, but postures to be developed and held, most are relaxing rather than demanding effort, refreshing rather than fatiguing. They are noncompetitive and they require no special equipment or clothing. They can be performed by men and women persons in all age groups.\textsuperscript{30}

Pathanjali has defined asana ‘Sthir Sukha Asanam’ that is ‘Asana means steady and comfortable posture’.\textsuperscript{31}

**Speed**

It may be defined as ‘the capacity of an individual to perform successful movement of the same pattern at a fastest rate’.\textsuperscript{32}

Speed is an ability to execute motor action under given condition in maximum possible time.\textsuperscript{33}


Speed is rapidly with which a movement or successive movement of the same kind may be performed.\textsuperscript{34}

**Muscular Endurance**

Muscular endurance is the ability of a muscle to exert submaximal force repeatedly over a period of time\textsuperscript{35}. The muscular strength is defined as the ability of a muscle to exert maximum force against resistance.

**Cardio Respiratory Endurance**

Cardiovascular endurance has been defined as the ability of the lungs, heart, and blood vessels to deliver adequate amounts of oxygen and nutrients to the cells to meet the demands of prolonged physical activity\textsuperscript{36}.

Endurance can generally be defined as the ability of the body to resists. However in athletic events requiring great endurance, the main limitation is the ability of the circulatory system to supply oxygen to the working muscles and to keep the muscle cells free from waste products. This particular process is depending upon cardiovascular endurance\textsuperscript{37}.

Generally endurance can be divided into two kinds namely muscular endurance and cardio respiratory endurance is characterized by contraction of large muscle groups for relatively

\textsuperscript{34} Clarke and Clarke, *Application of Measurements to Physical Education*, 154.
\textsuperscript{35} Werner W.K Hoeger, Sharon A. Hoeger, *Fitness and Wellness*, (Morton Publishing company, 1990), p.16.
long periods of time during which maximum adjustment of cardio respiratory system are necessary as sustained in running, swimming, climbing and bicycling.\textsuperscript{38}

The ability of the heart, lungs and blood vessels to supply oxygen and nutrients to the muscles for sustained exercise.\textsuperscript{39}

**Resting Pulse Rate**

The number of times heart contracts in each minute while the body is at rest.\textsuperscript{40}

The number of beats of a pulse per minute or the number of the beats of the heart and entries per minute.\textsuperscript{41} The number of beats felt in exactly in one minute is known as pulse rate.

**Breath-holding Time**

It is the duration of time through which one can hold his breath without inhaling or exhaling after a deep inhalation.\textsuperscript{42}

**Respiratory Rate**

It is a number of breaths take in a minute or number of inspiration and expiration in a minute.\textsuperscript{43}

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Protein

Serum proteins are complex composition, consisting mostly of simple proteins, mixed with small amount of conjugated proteins such as lipoproteins and glycoproteins. The main components of serum proteins are albumin and globulin.\textsuperscript{44}

Serum proteins represent a complex mixture containing a number of components which differ in properties and functions. The major components of proteins of serum include fibrinogen, the various globulins and albumins.\textsuperscript{45}

Lactic Acid

Lactate is a fatigue metabolite and the end product when glucose is catabolished anaerobically.\textsuperscript{46} Lactic acid is a waste product which results from anaerobic glycolysis.

Lactic acid is the end product of glycolysis and would accumulate unless removed from the cell or oxidized. In the animal both process operate, lactic acid is removed by the blood and carried from muscle to other organs, where it can be oxidized. It can also be oxidized in muscle by reverting to pyruvate and entering into the citrate cycle during periods when muscle has an ample supply of oxygen.\textsuperscript{47}

\textsuperscript{44} S. Ambika, \textit{Fundamentals of Biochemistry for Medical Students}, (Madras: Published by Author, 1986),p. 268.
Aims and Objectives

1. To investigate the effect of selected aerobic exercises on physical, physiological and biochemical variables of school girls.
2. To evaluate the effect of selected yogic practices on physical, physiological and biochemical variables of school girls.

Significance of the Study

The findings of the study will reveal the effect of selected aerobic exercises, yogic practices on physical, physiological and biochemical variables of school girls.

1. Learning the importance of physical activity at young is essential to the development of life long healthy life-style as well as the prevention of long term diseases. Hence, this study will promote awareness of physical activity and yoga among students.

2. This study would provide scientific base and guidance to the physical educationist, coaches and players to understand the effect of select Aerobic exercises and Yogic practices on physical, physiological biochemical, variables of female students.

3. The present study may give some more basic knowledge to the sports scientists to conduct further research in the similar field.

4. The result of the study would add to the quantum of knowledge in the areas of sports training, exercise physiology and biochemistry related to Aerobic exercise and yogic practices.