CHAPTER I
INTRODUCTION
CHAPTER - I

INTRODUCTION

Nowadays, the value of physical activities is recognized as an invaluable asset for human life. The reason can be attributed to it as a need for human growth, as a preventive measure of deadly diseases, its rehabilitative characteristics and as a remedy for stress. Thus, the participation in physical activities is the need of the hour. But people’s attitude towards participation in resourceful physical activities is not a significant one. In studying the factors behind this, it was observed that people who are in a state of approach and avoidance, conflict in this regard, as they have a positive approach towards the need for physical activities, whereas, because of the ever changing human needs of this competitive world, they are avoiding participation in physical activities on the grounds of lack of time for participation and social and economic issues. However, no compromise can be made as participation in physical activities is a very basic need for healthy existence. Without possessing health, plentiful wealth would be futile not only to the concerned individual but also to the society. Hence, it is the duty of physical educationists to find the remedy for these crises and to motivate people towards participation in physical activities by identifying the physical activities that are most feasible in terms of easy adaptability, consumption of minimum time, freedom from injury and an activity for both body and mind.

As a result, society can have healthy persons and the nation in turn would be prosperous in all aspects. With this perspective, the investigator has impelled to have the utilities of yogic exercises as the activity alternate to aerobic forms and to adjoin with the resistance exercises in an attempt to identify its effects on health related physical fitness and physiological aspects. Earlier theoretical and empirical aspects have proven that yogic exercise is the two sides of a coin in deriving the benefits where the body and mind are inseparable one. At this juncture, the present
study has been carried out titled, “Effects of varied combination of aerobic exercises, yogic exercises and resistance training on health related physical fitness components, body composition and selected physiological variables of engineering college students.”

1.1. FITNESS

Fitness refers to the capacity of the individual to live and function effectively, purposefully and zestfully, here and now, and to meet confidently the problems and crises which are among life’s expectations. Fitness is a state, which characterizes the degree to which the person is able to function. Ability to function depends upon the physical, mental, emotional, social and spiritual components of fitness, all of which are related to each other and are mutually interdependent. This may be referred to as ‘total fitness’ (Frost, 1971). As a broad term, fitness denotes dynamic qualities that satisfy the needs regarding mental and emotional stability, social consciousness and adaptability. But the term physical fitness denotes that the organic systems of the body are healthy and function efficiently so as to enable the fit person to engage in vigorous tasks and leisure activities without much strain (Bucher, 1985).

1.1.1. Physical Fitness

Physical fitness is the total functional capacity of an individual to perform a given task (Thomas, 1962). The greater the physical fitness, the longer a person can keep going and the more efficient will be his performance and his capacity for recovery from fatigue. It is common knowledge that any organ that is not in optimum use may compel an individual to adhere to some well-established regimen, if he wants to enjoy sound health and physical fitness. It is true that muscles do help in attaining health and fitness by their regular rational employment of physiologically useful work. But it must also be remembered that muscular exercises, which are of local influence on certain parts of the body, will not provide the desired health and fitness. A general requirement of the body is a
well-coordinated rhythmical movement, which is specially designed for organic and functional promotion of the body. It should be borne in mind that the influence of mind over body is perhaps much greater than that of the body over the mind because there is a belief that mental attitude does affect the physical aspects (Hollis, 1987).

Physical fitness is an essential lather for the individual’s capacity to strive and live effectively in his environment. Physical fitness, though not so broad in its meaning as total fitness, would include adequate degree of functioning of vital organs and adequate amount of strength, endurance, co-ordination, flexibility, etc. Scientific evidence has been produced to show that the general health and physical performance of the people make a demand mainly on their physical fitness level (Barrow and McGee, 1979).

1.1.2. Present Trend of Physical Fitness

Earlier, the living conditions of the people necessitated walking. That itself is one of the means of physical activity for maintaining fitness. Nowa days, the major concerns is preferring vehicles as a mode of transport even for covering a short distance. Scientific advancements in all cases such as machines, communication devices, computers and other electronic amenities have greatly diminished the means of health prompting levels of physical activity from our lives. Specifically, to note that the students during the school life and college life are mostly concerned with their academics, ignoring the basic means of physical fitness that are most essential for their future course of action. It drags them to learn sedentary activities which have become commonplace. The average Indian has become terribly sedentary. He lacks the required self motivation to keep himself fit, and by middle age, sadly becomes an unfit citizen. Blaire and Connoly (1996) have expressed concern over the sedentary ways of life among the youth leading to increased risk of chronic diseases, premature mortality and functional limitations as they age. Such a lack of awareness is the direct result of the absence
of proper scientific physical education programme in schools, colleges and universities. Thus, the present trend of fitness during the early ages and middle ages is dismal. To overcome this dismal show, every educational institution should impart minimum required physical education programme to students so as to enable them to practice their respective professions in a healthy manner.

1.1.3. Life Style and Environment

Halkell (1996) recommends a follow-up activity battery for enhancing health and physical performance of children, adolescents and adults as we move towards a new century. In his recommendations, he stresses at least 30 minutes of moderate or high intensity activity on all days preferably. Of this, he prefers 66% to 75% time to be spent performing endurance type activity and 25% to 33% on strength type activity. And to ensure maximum benefits, endurance activity has to be moderate to high intensity (45% to 55% of Vo2 max). Besides, as far as the type of activities are concerned, he specifically mentions that the endurance activity component can consist of aerobic activities like walking, swimming, stationary cycling/rowing, etc. and strength developing activities should be performed at least twice a week or more, depending on the person’s needs or goals.

Jordon (1999), through extensive survey, discovered the existence of a seventh sense in human beings which she named as “Fitness Instinct”. All human beings possess the basic urge to carry out some acceptable task to keep fit. But what prevents them from practicing it is lack of motivation. Modern life is sadly a progressive stage of moving less and less, growing more and more deconditioned and chubby and results in easy going sedentary life style.

1.1.4. Physical Activity

Physical activity or exercise is a cornerstone of a healthy life style. The human body is designed for physical activity and movement. Physical activity makes the individual look and feel better, and is a source to improve health and
extend life. Throughout his life, man has to be physically active. Physicians suggest that patients must use physical activities as a medicine or therapy for deadly diseases such as coronary health diseases, diabetics and respiratory diseases, as physical activities preserve the patients from side effects due to use of medicines. Today, exercise scientists are exploring the limits of exercise as a therapy, as a medicine.

According to Hippocrates (1849), “In a word, all parts of the body which were made for active use, if moderately used and exercised at the labour to which they are habituated, become healthy, increase in bulk and bear their age well, but when not used, and when left without exercise, they become diseased, their growth is arrested and they soon become old”. Medicine’s view of exercise did not progress much in the subsequent two millennia, and exercise was primarily viewed as an activity for healthy people, but not for the chronically ill. The first recorded anecdote of exercise as a treatment for heart disease is thought to be from William Heberden, who wrote of a man with ‘angina pectoris’ in 1772: “I knew of one who set himself the task of sawing wood for half an hour every day, and was nearly cured” (Heberden, 1772).

Physicians of the 1800s were interested in the role of exercise in maintenance of health (McArdle, 2001). But the modern notion of exercise as a medical treatment is thought to have originated with Berryman (1995) who perceived exercise as a technique to rehabilitate people with disabling injuries. William Osler opined that bed rest and baths at spas were the optimal treatment for heart disease (Osler, 1909). Physicians of the 19th and early 20th centuries were confused by enlargement of the heart, having recognized that cardiac hypertrophy paradoxically occurs both in athletes and patients with heart failure. Only after decades of research did physicians become advocates of exercise as a method of rehabilitation for heart disease.
1.1.5. Physical Activities and Health

According to World Health Organization (WHO) health is the state of complete physical, mental and social well being. The stated aim of WHO is the attainment of the highest possible level of health by all people. Health is the product of active life and participation in various physical activities. Participation in physical activities promotes fitness for health and fitness for successfully performing the given task. As far as effects of physical activities on health related aspects such as body composition is concerned, empirical studies so far done in this area have reported only modest changes. It is plausible that activity of higher intensity or longer duration could have resulted in a more dramatic fat loss. Thus, physical activity can improve health, decrease the loss of muscle mass, increase functional strength and greatly improve the likelihood of achieving successful weight maintenance (Baumgartner and Jackson, 1991). Physically active individuals have higher survival rates and live longer (Paffenberger et. al. 1984).

1.2. YOGA

Yoga is one of India’s wonderful gifts to mankind. It refers to the union of body and mind. Yoga is simple and easy to practice, acceptable to the people of all walks of life. One of its valuable qualities is that it builds up a store of physical health through the practice of a system of exercises called asanas which keep the body cleansed and fit. Yoga believes that exercise is essential for speedy removal of toxins and for tuning blood circulation and for enabling all internal processes function smoothly. Yoga has a complete message for humanity. It is a message for the human body, mind and soul (Kuvalayananda, 1977). Today, the world is looking to yoga for solving the various problems men are facing. At no time in the past yoga has attracted so much attention from people in so many corners of the world as it is today. Yoga is an indigenous physical and mental training (Chandrasekaran, 1999).
Yogic exercises are suitable for all people and are recommended for long living and healthy life. The practice of yoga has also been made systematic by the exponents of the system. Yoga guru Patanjali discusses the nature of enlightenment, the means of attaining it, the obstacles and problems of practice and ways of overcoming them. Patanjali lists the eight ‘limbs’ of stages of yoga, an eight – fold path, namely, abstention (Yama), regulations discipline (Niyama), easy posture (Asana), control of breathing (Pranayama), sense of control (Pratyahara), concentration (Dharana), meditation (Dhyana) and super conscious state (Samath). The eight limbs are seen both as progressive stages and as inter-related aspects of yoga practice. Yama and Niyama for the foundation of study, and posture and breath control are mastered before meditation. But the more one progresses, the more one realizes that the development of the limbs cannot be separated (Sophy Hoare, 1984).

1.2.1. Nature of Yoga

Yoga postures are the physical positions that co-ordinate breath with movement and withholding the position to stretch and strengthen different parts of body. Yogic exercises are the ideal complement to other forms of physical exercises such as running, cycling and swimming. Yogic postures systematically work on all the major muscle groups, including the back, neck and shoulders, deep abdominal, hip and ankles, feet, wrists and hands. By their very nature, yogic exercises affect all the muscle groups and organs as they simultaneously impart strength, increase flexibility and bring nourishment to internal organs. Although most poses are not aerobic in nature, they do in fact send oxygen to the cell by way of conscious deep breathing and sustained stretching and contraction of different muscle groups. Yoga can help to check any imbalance in muscular development and will enable both mind and body to function efficiently.

Iyengar (1986) puts forth his view on asanas thus: Asana can be done alone as the limbs of the body provide the necessary weights and counter weights. By
practicing them, one develops agility, balance, endurance and greater vitality. Asanas have been evolved over centuries so as to exercise every muscle, nerve and gland in the body. They secure fine physique, which is strong and elastic without being muscle-bound and they keep the body free from diseases. They reduce fatigue and smoothen the nerves. But their real importance lies in the way they train and discipline the mind.

1.2.2. Yoga and Physical Exercises

Physical exercises lay emphasis on strong movements of muscles whereas yoga opposes violent muscle movements, as they produce large quantity of lactic acid in the muscle fibres. Physical exercise causes fatigue. Rapid movement of the muscle causes tremendous strain on the heart. Muscular development of the body does not necessarily mean the body is healthy. In yoga, all the movements are slow and motionless and gradual with proper breathing.

Yoga exercises and breathing exercises, unlike physical exercises, do not strain the cardio vascular system, and they improve physical fitness and endurance. Physical exercises are repetitive movements, whereas yoga exercises involve very little movement and are only postures which are to be maintained for a specific period of time. Yogic exercises tone up both the body and the mind whereas physical exercise affects mainly the body. Postures involve concentration on certain parts of the body and result is a toning up of both the mind and the body. The caloric requirement in yogic asanas varies from 0.8 to 3 calories per minute while the caloric requirement of a physical exercise varies from 3 to 20 calories per minute.

The main purpose of physical exercise is to increase the circulation of the blood and the intake of oxygen. This can be done by yoga’s simple movement of the spine and various joints of the body with deep breathing but without violent movements of the muscle. On doing yoga exercises of the twist movements and asanas, the various blood vessels are pulled and stretched and blood is equally
distributed to every part of the body. The stretched muscles and ligaments during the yoga practices are immediately relaxed and they carry more energy to the muscle fibre. So, more energy flows into the relaxed muscles.

Yogic exercise aims at both prevention and treatment of various diseases. Breathing exercises like Pranayama, including Kapalabhati, is very effective for keeping the lungs healthy and prevent lung infections. With yoga deep breathing air circulates to every part of lungs, whereas with most other physical exercises there is mainly an increase in respiratory rate. Physical exercise should not be started without a thorough physical examination and making certain the exercise to be undertaken would not do any harm. Yogic postures are generally mild and one is less likely to get into compilation, but physical exercise, especially the type known as jogging, which is most popular in the western world today, should never be undertaken unless the individual is fully evaluated by his physician. The physician should look for signs and symptoms and take an electro cardiogram at rest and after exercise to detect an overt or subclinical heart disease.

1.2.3. Pranayama

Pranayama is a compound term ('prana' and 'yama') meaning the maintenance of prana in a healthy manner throughout one's life. More than a breath-control exercise, Pranayama is all about controlling the life force or prana. Ancient yogis, who understood the essence of prana, studied it and devised methods and practices to master it. These practices are better known as Pranayama. Since breath or prana is basic to life, the practice of Pranayama helps in harnessing the prana in and around us, and by deepening and extending it, Pranayama leads to a state of inner peace. Pranayamas are the practices in the control of respiratory impulses which form one of the main channels of the flow of autonomic nerve currents. They are practiced for bringing control over the autonomic nervous system and thereby diminishing mental fluctuations.
By becoming aware of the nature of the breath and by restraining it, the whole system becomes controlled. When retaining breath, it stop nervous impulses in different parts of the body and harmonizes the brain wave patterns. In Pranayama, it is the duration of the breath retention, which has to be increased. The longer the breath is held, the greater the gap between nervous impulses and their responses in the brain. When retention is held for a prolonged period, mental agitation is curtailed. Through Pranayama, the mind can be brought under control.

1.2.4. Aerobic Fitness

Aerobic fitness is the ability to sustain work for prolonged periods. The term 'aerobic' implies that the oxygen necessary to accomplish the work is taken up by the individual during the activity. A high level of aerobic fitness during the growing years indicates good development of the muscles, bones and cardio respiratory system. It is more important in this respect than body weight. During advanced age, aerobic fitness provides a measure of how fit one is physiologically. According to Payne and Halus (1986), aerobic fitness helps to complete the daily activities with enjoyment and strengthens the heart muscles and makes it more efficient. Maximal oxygen uptake (VO2 max) is the indicator of aerobic fitness. As VO2 max increases, the level of aerobic fitness also increases. In general, males have higher VO2 max than females. The main reason for this is that aerobic fitness is directly related to fat-free body weight, which consists mainly of the weight of muscles in the body.

1.2.5. Aerobic Exercise

The term ‘aerobic’ is a new word but not a new idea (Jackson, 1985). Aerobics is a progressive physical conditioning programme that stimulates cardio respiratory activity for a period sufficiently long to produce beneficial changes in the body. According to Robergs and Roberts (1997), aerobic exercise can be defined as the ability to perform cardiovascular exercise, whether it is
cross-country skiing, spinning, running, aerobic exercise or swimming, for an extended period of time.

Any exercise or activity that elevates the heart rate to one hundred and twenty beats per minute for at least twelve minutes is said to be aerobic (Creggaing, 1984). Aerobic exercise requires the heart rate to reach at least 60% of the maximal heart rate for an extended period of time. It is the activity that can be sustained for an extended period of time without developing an oxygen deficit (Bucker, 1983). It is characterized by one simple requirement, the necessity to sustain repeated muscle contraction. This criterion is fulfilled through two basic functions, the ability to consume enough oxygen and an adequate fuel provision. The capacity for oxygen consumption is reliant upon the physiological parameters of maximal oxygen uptake, lactate threshold and economy of movement in the given activity. Fuel or food is supplied mostly through carbohydrates and fats.

Aerobic exercise is essential to healthy cardiovascular fitness. According to Mitchell and Dale (1980), aerobic exercise produces beneficial changes in the body, especially the action of the lungs, heart and blood circulation. Some of the benefits of aerobic exercises include the ability to utilize more oxygen during strenuous exercise, a lower heart rate at rest, the production of less lactic acid and greater endurance. Also, many exercise physiologists have found that it reduces blood pressure and changes blood chemistry. It also improves the efficiency of the heart.

1.2.6. Adaptations of Aerobic Training

Adaptations of aerobic training include increased stroke volume of the heart, capillary density and mitochondrial density. Stroke volume increase simply means that the heart pumps more blood per beat. Mitochondria are structures within muscle cells that produce energy from fat and carbohydrate oxidation. Think of them as tiny batteries for muscle contractions. Regular endurance training can double these structures. By increasing capillary density one can...
effectively transport more blood to the working muscles. The process of building capillaries occurs gradually. Because high stress training breaks down capillaries, base training is the best for allowing the slow growth of capillaries. As far as effects of aerobic exercises on cardiac system is concerned it facilitates the flow of air in and out of the lungs by strengthening the muscles involved in respiration, strengthening and enlarging the heart muscle, to improve its pumping efficiency and reduce the resting heart rate, toning muscles throughout the body, which can improve overall circulation and reduce blood pressure, increasing the total number of red blood cells in the body, to facilitate transport of oxygen throughout the body, increasing storage of energy molecules such as fats and carbohydrates within the muscles, allowing increased endurance and neovascularization of the muscle sarcomeres to increase blood flow through the muscles.

1.2.7. Cardiovascular Adaptations

Endurance training produces significant dimensional and functional cardiovascular adaptations because of the intimate linkage of the cardiovascular system to aerobic processes.

1.2.8. Heart Size

Aerobic training normally enlarges the heart by increasing left ventricular cavity size and by inducing a slight thickening of its walls. Cardiac enlargement of this type, termed eccentric hypertrophy, improves intensity, myocardial structure returns to control levels. Plasma volume after only four training sessions can increase upto 20%. This adaptation enhances circularly and thermoregulatory dynamics and facilitates oxygen delivery to muscles during exercise. The rapid increase in plasma volume with aerobic training also contributes to training - induced eccentric hypertrophy.
1.2.9. Stroke Volume

The endurance athlete’s heart has a considerably larger stroke volume during rest and exercise than an untrained person of similar age. For trained and untrained individuals, the greatest increase in stroke volume in up light exercise occurs in the transition from rest to moderate exercise. Further increases in exercise intensity increase stroke volume only minimally.

1.2.10. Heart Rate

A proportionate reduction in heart rate during sub-maximal exercise accompanies the large stroke volume of elite endurance athletes and stroke volume increase of sedentary subjects. The larger stroke volumes account for the lower exercise heart rates. The heart pumps a large quantity of blood with each beat and adequate blood (oxygen) delivery to the active muscles requires only a small heart rate increase and vice versa for a heart with a relatively small stroke volume.

1.2.11. Cardiac Output

An increase in maximum cardiac output represents the most significant change in cardiovascular function with aerobic training. Maximum heart rate may decrease slightly with training and so the heart’s increased outflow capacity results directly from improved stroke volume. Oxygen extraction aerobic training increases the maximum quantity of oxygen extracted from arterial blood during exercise. A more effective distribution of cardiac output to working muscles and enhanced capacity of muscle fibres to metabolize oxygen produce the increase in a Vo$_2$ difference.

1.2.12. Blood Pressure

Blood pressure aerobic exercise training decreases systolic and diastolic blood pressures during rest and sub-maximal exercise. Systolic and diastolic blood pressures generally decline approximately from 6 to 10 mm hg with regular aerobic exercise for previously sedentary adult men and women of all ages.
1.3. RESISTANCE TRAINING

Resistance training is also known as Strength Training. It is a form of exercise for the development of strength and size of skeletal muscles for achieving a completely healthy life. According to the American Sports Medicine Institute (ASMI), resistance training is a “specialized method of conditioning designed to increase muscle strength, muscle endurance and muscle power”. Resistance training can be performed in a variety of ways; with resistance machines, free-weights (dumbbells and barbells), rubber tubing or one’s own body weight, as in doing pushups, squats or abdominal crunches. The goal of resistance training, the ASMI says, is to “gradually and progressively overload the musculoskeletal system so that it gets stronger”. In addition to the obvious goal of getting stronger, resistance training programmes may be undertaken to improve long-term health. Studies have shown that strength training, when properly structured with regard to frequency, mode (type of lifting), intensity and duration of programme can provide significant functional benefits and improvement in overall health and well-being.

Regular resistance training will strengthen the bones, building and strengthening of the muscles. Keith Cinea, a certified strength and conditioning specialist and educational programme coordinator for the National Strength and Conditioning Association, says that any fitness programme should include resistance training, along with aerobic exercise and flexibility training. Aerobic workouts, which strengthen the cardiovascular system, focus primarily on the large muscle groups of the lower body, he says. Strength training offers a way of balancing that out by challenging all the major muscle groups, including those in the chest, arms, back and abdomen.

1.3.1. Need of Resistance Training

One of the basic thrusts of resistance training is to improve the functional performance of the neuromuscular system, the system of muscles and nerve pathways that direct and control movement. In addition to this, resistance training
helps to increased strength, superior movement performance and general fitness, including enhanced function of the respiratory, cardiac and metabolic systems. Other improvements include an increase in muscle mass, strengthening of connective tissue and supportive tissue as well as improvements in posture and physique. Resistance training has many psychological benefits as well. It can boost self-confidence, increase motivation, enhance perseverance and produce a strong commitment to fitness. It is common knowledge that all other things being equal, a weight trained muscle is not only able to generate better force, it is also more resilient and less susceptible to injury. But while the effects of different weight training regimes on muscular performance are well understood, few athletes or coaches are aware of the effect of weight training on hormone balance in the body. As John Shepherd explains, these weight training induced hormonal changes have a profound effect on musculature, body weight and subsequent performance of an athlete.

1.3.2. Combined Aerobic and Resistance Training

Resistance training provides numerous and important health benefits through multiple mechanisms that may reduce the risks for diabetes, heart disease, possibly cancer and disabilities. There is much more extensive and long-standing evidence, however, about the benefits of aerobic training on cardiovascular fitness and disease risk reduction, particularly for reducing the risks of heart disease and for premature death from heart disease. A resistance training protocol for hypertrophy would try to increase protein synthesis and also stress the primarily interested in resistance training. The tricky issue is how to incorporate aerobic training into an overall programme without undermining strength development or hypertrophy (gaining muscle mass). Docherty and Sporer (2000) have recently attempted in an extensive review article to advance the science by postulating specific physiological mechanisms affected by different training protocols that can predict when there will and will not be interference between aerobic and resistance
training. They noted that aerobic training increases maximum oxygen consumption and hence the body's ability to transport and use oxygen is dependent upon both a central component involving adaptations in the cardiopulmonary system and a peripheral component involving adaptations in muscle tissues. Central and peripheral adaptations are, in turn, dependent upon different mechanisms. It does appear that higher the intensity of the stimulus used to increase maximum oxygen consumption (e.g., high intensity interval training), the greater the increase in oxygen consumption. However, the location of the adaptation to aerobic training may shift depending upon the intensity of the stimulus. At lower levels of intensity, it appears that most of the adaptations occur centrally.

With higher intensity training, more adaptations occur peripherally. Docherty and Sporer (2000) noted that research suggests that training between 70% and 80% of VO\textsubscript{2}max (70% to 80% of heart rate reserve; about 80% to 85% of maximum heart rate; just slightly below the anaerobic threshold) results in maximal contractile force in the heart and thus maximizes central adaptations important for health benefits. These findings are critical and suggest how concurrent training can be optimized. Aerobic training favourably influences health through central adaptations and there may be no reason to train at levels that will result in more peripheral adaptations. The ability to perform at higher levels does require training at high levels of intensity and specific peripheral adaptations, but such performance levels are not the goal of most people. Aerobic training at very high intensities, through its effects on mechanisms associated with peripheral adaptations, may be the cause of blunting of strength gains and hypertrophy when aerobic training is done along with resistance training.
Docherty and Sporer (2000) discussed the mechanisms that appear involved in increasing strength and hypertrophy. The basic theory holds that high intensity aerobic training such as interval training affects specific mechanisms in peripheral adaptations such as those involved anaerobic energy system.

1.3.3. Effects of Resistance Training

The effect of resistance training on muscle fibre, muscle strength, blood pressure, heart rate and body composition is as follows:-

1.3.4. Muscle Fibre Adaptations to Resistance Training

The increase in size of muscle is referred to as hypertrophy. The 'pump' one feels from a single exercise bout is referred to as transient hypertrophy. Hypertrophy refers to the increase in muscle size associated with long-term resistance training. Increases in the cross-sectional area of muscle fibres range from 20% to 45% in most training studies (Staron et. al. 1991). Muscle fibres hypertrophy has been shown to require more than 16 workouts to produce significant effects (Staron et. al. 1994). In addition, fast-twitch (glycolytic) muscle fibre has the potential to show greater increases in size as compared to slow-twitch (oxidative) muscle fibre (Hather, Tesch, Buchanan and Dudley, 1991).

1.3.5. Strength Adaptations to Resistance Training

The increases in muscular strength during the initial periods of a resistance training programme are not associated with changes in cross-sectional area of the muscle (Sale, 1988). Changes in strength evidenced in the first few weeks of resistance training are more associated with neural adaptations (Moritani and de Vries, 1979), which encompass the development of more efficient neural pathways along the route to the muscle. Long-term changes in strength are more likely attributable to hypertrophy of the muscle fibres or muscle group (Sale, 1988). The range of increase of strength is quite variable to the individual and may range from 7% to 45% (Kraemer, 1994). It should be noted that strength results appear to be
velocity specific. Velocity specificity best characterizes the probability that the
greatest increases in strength occur at or near the velocity of the training exercise
(Behm and Sale, 1993).

1.3.6. Body Composition Adaptations to Resistance Training

Resistance training programmes can increase fat-free mass and decrease the
percentage of body fat. One of the outstanding benefits of resistance exercise,
as it relates to weight loss, is the positive impact of increasing energy expenditure
during the exercise session and somewhat during recovery, and on maintaining or
increasing fat-free body mass while encouraging the loss of fat body weight
(Young and Steinhard, 1995). It is more likely that body composition is affected
and controlled by resistance training programmes using the larger muscle groups
and greater total volume (Stone, Fleck, Triplett and & Kramer, 1991). An
impressive finding to highlight resistance training is that the energy expenditure
following higher total volume workouts appears to be elevated, with an increase in
fat utilization (due to a lower respiratory exchange ratio) during this period
(Melby, Scholl, Edwards and Bullough, 1993). The energy expenditure following
the higher total volume workouts appears to be elevated, compared to other forms
of exercise, and thus, further contributes to weight loss objectives. The evidence
unequivocally supports the combined use of aerobic exercise and resistance
training for optimal changes in body composition to successfully attain weight
management goals.

1.3.7. Heart Rate Adaptations to Resistance Training

Heart rate is acutely elevated immediately following a work out affected by
the amount of resistance, the number of repetitions and the muscle mass involved
in the contraction (small Vs. large mass exercises) (Fleck, 1988). Interestingly, in
terms of chronic adaptations, there appears to be a reduction in heart rate from
resistance training, which is considered beneficial (Stone et. al. 1991). Long term
adaptations observed in the research, from no change up to a 11% decrease in
heart rate, may be explained by the differences in intensity, volume, rest between sets, use of small Vs large muscle mass, duration of study and fitness level of the subjects. Regular participation in aerobic exercise often results in a decrease in resting heart rate by 5 to 25 beats per minute. The lowered resting heart rate from exercise training is proposed to be primarily due to an increase in the parasympathetic nervous activity with a minor decrease in sympathetic nervous discharge (Katona, McLean, Dighton and Guz, 1982; Smith, Hudson, Graitzer and Raven, 1989).

1.3.8. Blood Pressure Adaptations to Resistance Training

More dynamic forms of resistance training, such as circuit training, that involve moderate resistance and high repetitions with short rests are associated with reductions in blood pressure. Studies have shown decreases in diastolic blood pressure (Harris and Holly, 1987), no change in blood pressure (Blumenthal, Siegel and Appelbaum, 1991) and decreases in systolic blood pressure (Hagberg et. al. 1984; Hurley, Hagberg and Goldberg, 1988).

1.3.9. Concurrent Resistance and Aerobic Training

Concurrent resistance and aerobic training programmes produce less muscular strength and power improvement than training for strength only. Concurrent training generally refers to the performance of both aerobic and anaerobic exercise within a fitness or athletic training programme. To that end, strength and endurance training are applied in varying sequences within the same daily or weekly schedule workout. Athletes as well as popular and commercial fitness applications capitalize on these basic themes and supply the consumer with unlimited exercise options. Included within this variety are techniques which combine both resistance and aerobic training at the same moment in time. Such techniques are now very popular and are most commonly utilized in group exercise settings in which individuals utilize barbells or dumbbells with the upper body and some kind of aerobic movement with the lower body at the same
moment in time. For clarity, this type of training will be referred to as simultaneous training.

1.4. PHYSIOLOGICAL VARIABLES

Physiology is the study of the functions of the normal human body. They depend upon the race and geographical and climatic conditions of human beings. It is universally accepted that the physical function and the body improve with use. More specifically, the heart, lungs and muscles become stronger and more durable the more they are used. This physiological system are highly adaptable to exercise. Based on this, to study the effects of aerobic training as compared to yogic exercises in conjunction with resistance training on cardio pulmonary adaptations, the present study specifically focused on factors such as VO₂ max, blood pressure and heart rate. The nature of the factors are briefly as follow as.

1.4.1. Blood Pressure

Blood pressure is the pressure exerted by the blood against the walls of the arteries. This pressure is created by the contractions of the heart and it propels the blood through the blood vessels. During each heartbeat, the heart pumps a volume of blood. The ejection of this additional volume of blood into the arterial system serves to raise the pressure of blood in the arteries during systole and is called systolic pressure. During diastole, the distended arteries recoil due to their elasticity and press on the blood contained in them. This serves to maintain the arterial blood pressure during diastole although no blood is being pumped in the arteries by the heart in diastole and is called diastolic pressure.

1.4.2. VO₂ max

Maximum oxygen uptake (VO₂ max) refers to the highest rate at which oxygen can be taken up and consumed by the body during intense exercises. Traditionally, the magnitude of an individual’s VO₂ max has been viewed as one of the most important predictors of endurance. The ability of the cardio respiratory
system to transport oxygen to the exercising muscles refers to the central component of VO₂ max. The role of the central component is for oxygen to be transported from the atmosphere and delivered to the muscles where it is utilized during mitochondrial respiration to produce ATP. The major limitations in oxygen delivery are pulmonary diffusion, cardiac output, blood volume and flow. In aerobic work, oxygen is obtained from the air and is transferred from the lungs to the blood and then to the muscles via the circulatory system. Maximal oxygen uptake or maximal aerobic power (VO₂ max) is the indicator of aerobic fitness. As VO₂ max increases, the level of aerobic fitness also increases which refers to individual aerobic capacity. An individual who is fit will have a cardio-respiratory system that is capable of meeting the demands of the tissues under conditions of intense exercise.

1.5. OBJECTIVES OF THE STUDY

The objectives of the study are as follows:-

1. To compare the effects of aerobic exercises -cum - resistance training and yoga exercises - cum - resistance training on selected health related physical fitness components and physiological variables of professional college students,

2. To determine the effect of twelve week training period of aerobic exercises - cum - resistance training on selected health related physical fitness components and selected physiological variables of professional college students, and

3. To determine the effect of twelve week training period of yogic exercises - cum - resistance training on selected health related physical fitness components and selected physiological variables of professional college students.
1.6. STATEMENT OF THE PROBLEM

The purpose of the study is as follows:

1. To find out the individualized effects of aerobic - cum - resistance training and yogic exercise - cum - resistance training on health related physical components and selected physiological variables of professional college students, and

2. To compare the aerobic - cum - resistance training and yogic exercise - cum - resistance training on health related physical physiological variables of professional college students.

1.7. HYPOTHESES

The hypotheses formulated in the present study are as follows: -

1. It was hypothesized that the interventions such as aerobic - cum - resistance training and yogic exercise - cum - resistance training would have positive and significant changes from the base line to post treatment on health related physical fitness components and selected physiological variables of professional college students,

2. It was hypothesized that as far as comparative effects are concerned, there is a significant mean difference among the three groups, namely, aerobic exercises - cum - resistance training, yogic exercises and control group on health related physical fitness components and selected physiological variables of professional college students, and

3. It was hypothesized that aerobic exercises - cum - resistance training and combination of yogic exercises and control group have similar effects on selected health related physical fitness components and selected physiological variables of professional college students.
1.8. SIGNIFICANCE OF THE STUDY

The present study is significant in the following aspects:-

1. Basically, the present study is aimed at designing the package of exercises, using yoga, aerobic and resistance. Of these, the aerobic and resistance are absolutely in the calisthenics format. It helps the students to develop their physical fitness within the spatial infrastructure and free from financial constraints in demanding the modern equipments that are needed for physical activities,

2. It is believed that the outcome of the study would motivate the students themselves which results in increased participation among the students community,

3. The present study would provide a scientific base and guidance to the physical educationists, sports scientists, exercise physiologists and fitness leaders to design the combined training programme for the people who are in need of health related physical fitness, and

4. The result of this study would add to the quantum of knowledge in the areas of yoga, fitness and wellness, exercise physiology and exercise science.
1.9. DELIMITATIONS

The delimitations are as follows:

1. In the present study, random method of sampling was used. Hence, to overcome the variations in selection of samples and to endure the homogeneity in selection of samples as criteria, the present study was confined to the performance on health related fitness. Further, it was confined to the student’s performance in the lower quartile, specifically in the range of 30 – 35 to extract as samples,

2. In distribution of samples to experimental group used in the study, the present study was confined to equal number of samples. Thus, each group consisted of 20 students. The age of the samples for the present study was confined to the range of 18 – 22,

3. The present study is confined to the AAPHERD Health Related Physical Components, namely, abdominal muscular strength and endurance, flexibility, cardio vascular endurance and body composition and its test items,

4. As physiological variables, the present study was confined to resting heart rate, systolic blood pressure and diastolic blood pressure and breathe holding time,

5. The duration of the treatment for the present study was confined to 6 days a week with about 12 weeks as total period, and

6. The data were collected prior and after the 12 weeks of training programme.
1.10. LIMITATIONS

The limitations of the present study are as follows:

1. The influence of certain factors like life style, daily routine work, diet and other factors on the results of the study were not taken into consideration,

2. No attempt has been made to control factors like air resistance, intensity of light atmosphere and temperature during training and testing period,

3. The knowledge of the subjects in exercise science and their previous experience in physical activities were not taken into consideration,

4. As the subjects were motivated verbally during testing and training periods no attempt was made to differentiate their level of motivation, and

5. The heredity of the subjects and its influence on the selected criterion variables were not taken into consideration.

1.11. DEFINITION OF THE TERMS

Concurrent Training

Generally refers to the performance of both aerobic and resistance training within a fitness or athletic training programme. To that end strength and endurance training are applied in varying sequences within the same workout, in the weekly schedule.

Strength

Mathews has defined muscular strength as the force that a muscle or groups of muscles can exert against a resistance in one maximum effort.

Endurance Harre (1986) defines endurance as the ability to resist fatigue.

Flexibility

It is the range of movement at joint or joint complexes.
Resting Heart Rate

The resting heartbeat or heart frequency is defined as the frequency of heartbeats in one minute, when a person is in resting condition.

Maximal Oxygen Uptake (VO₂ max)

VO₂ max is defined as the highest rate of oxygen consumption attainable during maximal or exhaustive exercise.

Body Weight

The force with which a quantity of matter is attracted towards earth by normal acceleration of gravity (Traditional unit: Kilogram of Weight).

Cardio-vascular Endurance

Clarke defines the cardio-vascular endurance as the moderate contractions of large muscle group for relatively longer periods of time, during which maximum adjustment of the cardio-respiratory systems are necessary.

Body Composition

Body composition is the component part of the body, or otherwise, it refers to fat and muscle weight.

Percent Body Fat

Fat is the most variable tissue in the body and is distributed throughout the body, primarily under the skin and in the abdominal cavity.

Skin fold thickness gives an estimation of total body fat, in as much as 50% of total body fat lies immediately under the skin.

Lean Body Weight

The total body weight minus the weight of the body fat is called lean body weight.

LBW = Total body weight – weight of fat
1.12. OPERATIONAL DEFINITIONS AND EXPLANATIONS

Health Fitness

Health Fitness is defined as “the ability to carry out the daily task with vigour and alertness, without undue fatigue and with ample energy to enjoy leisure time pursuits and to meet unforeseen emergencies”.

Muscular Strength and Endurance

Muscular Strength and Endurance refers to the ability of a muscle or of muscles to perform repeated contractions against a light load for an extended period of time.

Flexibility

Flexibility is the range of movement about a joint. Individual difference in flexibility depends upon physiological characteristics that influence the extensibility of the muscle and ligaments surrounding a joint.

Cardio Respiratory Endurance

Cardio respiratory endurance is referred to as the ability of the lungs, heart and blood vessels to deliver adequate amount of oxygen and nutrients to the cells to meet the demands of prolonged physical activity.

Lean Body Mass

The lean body weight is defined as total body weight less the weight of subcutaneous fat. Lean body weight was determined by use of the following equation: \[ LBW \ (kg) = \text{Total Body Weight (kg)} - \text{Total Weight of Fat (kg)} \]

Resting Heart Rate

Morehouse and Miller (1976) have defined resting pulse rate as the distension of the arterial walls at the beginning of systolic ejection of blood which is not confined to aorta but travels down the arteries as a wave followed by a wave of recoil. The arteries that lie close to the body such as radial artery of the wrist,
the arrival of the wave of distension and subsequent recoil may be felt as a distinct throw pulse which offers a convenient method of counting the pulse rate.

**Blood Pressure**

Blood pressure is the pressure in blood vessels that the blood exerts against the wall of vessels.

“Blood pressure is the lateral pressure exerted by the blood on the vessel walls flowing through it” (Chatterjee, 1980).

**Systolic Blood Pressure**

Systolic blood pressure is the pressure in the heart and blood vessels during contraction phase of this cardiac cycle (Guyton, 1980).

**Diastolic Blood Pressure**

Diastolic blood pressure is the minimum level of arterial blood pressure in the time between successive heartbeats (Guyton, 1980).