CHAPTER I

INTRODUCTION

Sport plays a very prominent role in the modern society. It is important to individuals, a group, a nation and indeed the world. Throughout the world, sport has a popular appeal among people of all ages and both sexes.

"Much of the attraction of sport comes from the wide variety of experience and feeling that result from participation such as success, failure, exhaustion pain, relief and feeling of belonging. Sport can bring money, glory, status and goodwill. However, sport can also bring tragedy, grief and even death". (Coakley, Jay J., 1998).

The preparation of an athlete today for achievement is a complex dynamic matter, characterized by a high level of physical and physiological efficiency and the degree of perfection of necessary skills, knowledge and proper teaching and tactics. An athlete arrives at this state only as a result of corresponding training sports activity directed at steadily enhancing the preparation of an athlete and grooming him for a higher-level achievement.

"Sport is an important ingredient of physical education and is a worldwide phenomenon today. The unprecedented popularity and better organization of sports activities and competitions would have been impossible without the recognition of the importance of sports competitions in the world. The world has realized the importance of sports for the modern civilizations". (Coakley, Jay J., 1998)

Fitness is a state which often characterizes the degree to which a 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 total fitness. While fitness is the maximal, economical and efficient functioning of the body, health is referred to as optimal homeostatic functioning of the body.

"Sports is the way which we are, our physical capacities play". (Bruce Jenner et.al., 1984).

Competitive sports are now main in all nations of the world. Competitive sports have brought into sharp focus the training process as a means of improvement of sports performance.

Sports performance is the result and expression of the total personality of the sportsman. The development of the sportsman to achieve high level of performance is usually concentrated in four areas namely physical power, social adjustment, psychological development and physiological efficiency. Different activity makes different demands upon the organism with respect to circulatory, respiratory, metabolic, neurological and temperature regulatory function. In sports environment, the physical work done by an individual depends upon the nature, the duration and purpose of the activity.

Sports achievements depends mostly on the training designed for a particular sport. If our nation wants to win laurels it must take the challenge seriously in terms of well-developed physical training. From the past experience, we can learn that Indian sports persons are physically as well as physiologically weak compared to the international sports persons. Indian sports persons perform very poor in various field as compared to Russia, U.S.A., Germany who invariably reach the peak performance

due to physical and physiological factors and due to inadequate training and conditioning.

1.1 SPORTS TRAINING

"Sports training is the process of sports protection based on scientific and pedagogical principles for higher performance". (Hardayal Singh, 1991).

"The Basic training procedures will serve better when utilized with modification suited to individuals or a group dealt with. The training programme should look into improving the performance of the athletes and at the same time should prevent injury from taking place" (Fox, et al. 1988).

Training means a systematic scientific programme of conditioning exercise and physical activities designed to improve the physical fitness and skills of the players or athletics participated. Training involves periodic assessment of the athlete's status and progress.

1.2 HANDBALL - AN OVERVIEW

"Handball, a popular game throughout the world, was introduced in Germany by a gymnastics teacher, Max Heiser, in 1917. The game was primarily devised for girls and played 11-a-side on a football field. There are, however, authentic reports of a similar game, "Handbold" being played in Denmark as early as 1904". (Ashok R. Lohar, 1998).

In 1919, another Berlin sports teacher, Carl Schelenz, modified the existing rules. He advocated the use of a smaller ball, the players were allowed to fight for the ball, the three-step rule was introduced and the 16-metre penalty area of the football

field provided an ideal throwing zone. Soon other countries accepted these rules and handball was on its way to becoming an international sport.

In 1923, the first inter-city match between Berlin and Dresden took place, while the first international handball match was played between Germany and Austria on 13 September 1925.

During the Olympic Games of 1928 in Amsterdam, 11 countries got together to found the International Handball Federation (IHF). Along with the increase in members, another innovation took place in the Scandinavian countries, where due to the climatic conditions, handball was taken indoors. The rules were modified and adapted to indoor conditions and finally evolved to the format prevailing today.

“A great boost to the sport was provided when m 1972, handball was introduced as an Olympic discipline at Munich”. (Ashok R. Lohar, 1998).

1.3 FUNDAMENTAL SKILLS OF HANDBALL

1.3.1 Catching Skills

1.3.1.1 Catching a High Ball

Use the same position of the body and hands while catching a high ball over head. Keep the body more or less in a straight line, legs straight and arms above the head together. Jump up if necessary to receive the ball. When the ball is caught, bring it into the body quickly so as to protect it from a sudden attack of the opponents for it possession.

1.3.1.2 Catching a Low Ball

Depending upon the situation around, take either a squatting or a straight stance with body weight balanced on the feet shoulder-width apart so as to move away quickly. Lean forward slightly and keep the arms stretched in front. The hands are turned down with fingers pointing towards the ground. Let the ball settle on the palms. Quickly close the fingers and withdraw the arms chest-ward, thereby protecting the ball from the opposition-attack.

1.3.2 Passing skills

1.3.2.1 Over-Arm Pass

From attacker's basic position, swing the ball with the throwing arm up above the shoulder, thus forming a throwing position. The throwing motion starts with a twist of the hip, followed by the whipping motion of the shoulder, elbow and finally the wrist.

1.3.2.2 Under-Arm Pass

Assuming basic position, bring the ball with the throwing arm to hip level next to, and a little behind the body. Keep the right arm slightly flexed with the palm behind the ball, the wrist holding it with the fingers and then forward making a well-sequenced throwing motion.

1.3.2.3 Chest Pass

The chest pass is a simple and accurate technique that makes it possible for to pass the ball safely at a short distance. Assume a slightly transversal straddle and hold the ball tightly in both hand with fingers outstretched, at chest level. Keep the elbows

bent but a bit away so that the ball is close to the body. From here, push the arms forwards straight and release the ball speedily with a wrist snap and finger-flick. In follow-through, keep hands extended and fingers outstretched, pointed in the direction of the flight of the ball.

1.3.3 Goal-Shooting

1.3.3.1 Over-Arm Standing Throw Shot

The entire action-sequence is similar to that of the shoulder pass except that the ball is to be directed downwards to bounce up off the floor.

1.3.3.2 Under-Arm Shot

In the throwing position, the player is in a wide transversal straddle with the front leg firmly placed. Depending on how high the ball is held, both legs are to a slighter or greater degree bent with the body-weight mainly on the back leg. The torso, by curving slightly towards the throwing arm, is turned out with the left shoulder facing the throwing direction and the left arm is in front of the body, ready for action. The throwing arm holds the ball out diagonally behind the body at the throwing height.

1.3.3.3 Jump Shot

From a basic position, start by stepping out with the left leg or while running, catch the ball in such a way that at the first step following, prepare to change the horizontal impetus to vertical. Thus, take a long, diagonal step forward with the right leg while lowering the centre of gravity. The throwing motion is basically the same as in other shots – the most important point, however, being the rhythm. One must be

able to receive a pass cleanly and move smoothly into the permitted steps before taking off into the air after the final step. In this final movement, concentrate on raising oneself as high as possible in order to get the throwing arm over the defensive wall before releasing the ball.

1.3.3.4 Dive Shot

The dive shot combines the characteristics and techniques of both the falling-shot and the long-jump shot. It can be executed to either side of the throwing arm.

1.3.4 Defensive Blocking

1.3.4.1 Individual Blocking

The individual blocking technique is used in one-vs.-one situation when the defender has to somehow neutralize a goal shot being attempted by an attacker.

1.3.4.2 Blocking Over-Am Shot

From the basic position, raise arms diagonally above the head, at the same time take a little step out. At the moment of blocking, keep the palms opened, fingers stretched, and the muscles flexed, permitting the arms to take the whole impact of the ball.

1.3.4.3 Blocking Under-Arm Shot

From the basic position, stretch the arm laterally on the side of the shot with an open palm facing the predicted direction of the on-coming ball. Focus on the advancing player timing one’s movements in such a way that one check the flight of the ball halfway.

1.3.5 Goalkeeping

1.3.5.1 Basic Stance

In basic position, the legs are kept shoulder-width apart, feet pointing out a little and knee and ankle joints are slightly bent. Body weight is evenly distributed on the outer-edge of the feet, the torso is straight or a little bent forward with the centre of gravity in the naval area. The head is held high with peripheral vision following the path of the ball. The arms are raised to the sides of the body, bent at the elbow palms above shoulder-height facing the ball.

1.3.5.2 Saving Long Range Shots

Assuming basic stance, the balls coming at or above shoulder level may be handled with one or both hands. Sometime to put both hands in the path of the ball is quite logical. To save long –range shots the goalkeeper must lift up his arms in the direction of the oncoming ball and simultaneously push off on both feet sideways. At the movement of touching, he should keep his hands together behind the ball to take the impact of the stop and make save safer.

1.3.5.3 One-Handed Saving

The one-handed saving is resorted to in case of unaccepted shots when the goalkeeper does not have enough time to put both hands together.

1.3.5.4 Saving Medium-High Positioned Balls

From the basic position the goalkeeper swings the closets arm and leg simultaneously into the path of the ball in such a way that they cover as much surface as possible so as to allow the ball go through.

1.4 CIRCUIT TRAINING

Circuit training is very special form of training which concentrates on different parts of the body and general endurance. Circuit training is a method of physical conditioning that employs both resistance training and callisthenic training exercises. The method was originally introduced by Morgan and Adamson in the late 1950s at the university of Leads, England. The intensity and vigor of circuit training are indeed challenging and enjoyable to the performer. This system produces positive changes in future in motor performance. General fitness, muscular power, endurance and speed have shown decided improvement as well.

Circuit training is based on the premise that the athlete must do the same amount of work within the limits of an assigned training period. Numerous variations of this system are in use, but all employ certain common factors: a circular arrangement of the activities that permits progression from one station to another until all stations have been visited, the total comprising a “circuit” and a limiting time within which the circuit must be concluded.

“Circuit training employs a series of exercises stations that consists of weight training, flexibility, calisthenics, and brief aerobic exercises. In circuit training the subjects can move rapidly from one station to the next and perform whatever exercise is to be done at that station within a specified time period. A circuit would consist of 8 to 12 stations and the entire would be repeated within three of four times, concentrating on the legs, abdomen, back, arms, shoulders and trunk. These exercises should be organized so that the subject moves from one muscle group to another. This method allows working hard on a muscle group and then resting it, while the other groups have their own work out”. (Tancred, 1987) .

Circuit Training is an ideal workout on one training day during peak season which envelopes aerobics, anaerobic, strength and jumping agility in a single package. Several trainees can participate in a chain. The circuit work will increase the general work capacity by improving the ability to tolerate increasing levels of muscular fatigue.

The circuit training will have shorter exercise and shorter rest intervals between exercises, thus maintaining elevated heart rates during the circuit workouts and helping to upgrade the cardiorespiratory capacity. Circuit efforts will enhance the overall body strength. The circuit programme will increase the lean muscle mass by a moderate amount and decrease the body- fat levels through high levels of energy expenditure.

1.5 INTERVAL TRAINING

In 1956 Olympic games at Melbourne, four athletes created a new Olympic record in 800 M and nine athletes in 1500 M race. This record-breaking effort in middle distance and many other events has been the recent trend in Olympics and World championships. The scientific training method which was then and is now being adopted as “interval training” specific to each sport.

In interval training aims the athlete to run a particular distance, five, ten or 15 times at the same speed and time. The interval in between each run should also be almost the same and the athlete must learn to judge the speed of run.

Interval training develops the ability of the athlete to run at a particular pace. This type of training by adjusting the time, number and distance of the run can be

adopted to suit the needs of any middle-distance runner. This flexibility is an advantage of training system.

Interval training is a series of repeated bouts of exercise alternated with period of lighter work or rest.

The rest interval incorporated into the interval training allows initially and then reduces accumulation of fatigue products associated with increased energy utilization and cardiac workload.

"The training schedule for one year can be divided into three major components - pre competition season, competition season and off season. In off season and pre-competition seasons the coach should concentrate more on the aerobic endurance and so the repetition of exercise will be more and the time interval will be lesser. In competition season the repetition of exercise will be very less and the interval will be maximum with 90% training intensity. The relief interval training usually is expressed in relation to the work interval. It is a work relief ratio and is expressed at 1: ½, 1:1, 1:2 and 1:3. Thus 1: ½ implies that the relief interval is half the time of the work; 1:1 indicates the relief and work intervals are the same and so on". (Fox, et.al. 1988).

1.6 STAIR CASE TRAINING

"Training programme which have been used to improve sprinting speed include weight training, wind sprint and stairs sprinting. Such programmes are designed to develop leg strength, leg speed, speed endurance and explosive power". (Donna Mac Miller, 1974).

Staircase training is a suitable exercise to burn fat and improve the condition of heart and lungs. Staircase training is a creative, fine and very challenging patterns of movement, that is, on and off stair case can challenge the legs, footsteps and arms also.

Correct staircase or stepping technique also prevent injuries and improves performance. Robinson (1971) has provided guidelines for staircase training as stated below.

1. Always place the entire foot on the platform no part of the foot should hand over the edge.

2. Step close to the platform allowing the heels to contract the floor. Note only the ball of the foot not the heel should touch the floor during lunges or other rapidly repeated movements.

3. Step quickly – pounding can unduly stress ankles and knees. Keep an eye on the platform at all times. Don't use hard weights. They greatly increase the risk of injury and provide no benefit.

4. Initially, the athlete finds it difficult to follow the staircase training. It is important to focus on learning the foot patterns and omit arm movements and arm movements could be added later on. Raising arms above shoulder level makes the heart work harder and can result in breathlessness. Intensity of exercise can be lowered by lowering the arms and to decrease breathlessness. (Clarance F. Raobinson, 1974).

1.7 IMPORTANCE OF PHYSICAL, PHYSIOLOGICAL AND PSYCHOLOGICAL VARIABLES

"The goal of physical fitness programme is to improve the performance in activities of daily living, job demands, sports and recreational activities". (Frank W. Dick, 1992).

"Fitness is composed of many complex factors where complete evaluation cannot be done by testing a single factor. Many variables such as those included in measuring cardio-respiratory balance, flexibility and nutrition reflex each in special way, some aspect of total physical fitness". (Fox, et.al., 1988) .

"For the physiological system of the body to be fit, they must function well enough to support the specific activity in which individual is performing. Moreover, different activities make different demands upon the organism with respect to circulatory, respiratory, metabolic and neurological process which are specific to the activity". (Reben B. Frost., 2001).

Psychology plays a major role in sports and in closely associated with psychological components.

The physical components which are indispensable for handball players such as speed, abdominal strength, flexibility and cardiovascular endurance were selected for the study.

1.7.1 Speed

Speed is also the ability to execute motor actions, under given conditions in minimum possible time. Speed is an important ingredient in many sports. Speed will

mean maximal speed and thus apply to sports events where the highest possible speed its strived for a single short-lasting effort are in a repeated maximal effort together lasting less than about ten seconds.

1.7.2 Abdominal Strength

The abdominal strength is very much important in sports because the abdominal part become the axis of the body the centre of gravity also will fall mainly in the abdomen. The abdominal strength helps to maintain the body posture there by involving in many activities in the field of sports and games.

1.7.3 Flexibility

"Flexibility is the ability to execute a wide range of movement in the joints while for repetition of work done in natural speed. Flexibility is most important. Flexibility helps to move bodily parts easily, takes less time, energy to perform a task. Elasticity in muscle reduces tension and provides maximum length. Thus, yielding passive physical stretch". (Hardayal Singh, 1991) .

1.7.4 Cardiovascular Endurance

Cardiovascular endurance may be defined as the ability of lungs and heart to taken in a transport adequate amount of oxygen to the working muscles.

"Cardiovascular Endurance is the ability of the heart, blood vessels, blood and respiratory system to supply oxygen and fuel to the muscles at a steady rate for a considerable length of time". (Strukic P.J., 1981).

Vital capacity and breath holding time were considered as an important physiological variables for handball performance and they were selected for this study.

1.7.5 Vital Capacity

Vital capacity is the maximum amount of air a person can expel from the lungs after first filling the lungs to their maximum extent and then expiring to the maximum extent. It equals the inspiratory reserve volume plus the tidal volume plus the expiratory reserve volume.

1.7.6 Breath Holding Time

Breath holding time is defined as the duration of time through which one can hold one's breath without inhaling and exhaling after a deep inhalation.

"Endurance type of training will improve the breath holding time. Breath holding time also plays a vital role in the sports performance". (Strukic P.J., 1981).

Achievement motivation, self-confidence and anxiety were considered as an important psychological variables for handball performance and they were selected for this study.

1.7.7 Achievement Motivation

Motivation means move to achieve. In psychology the term motivation or motive refers to activation from within in the organism.

The motivation is termed as the urge to push towards a specific goal. Motivation is a concept invented to describe the psychological state or the organism

as it is affected by various influences. A person is motivated when he desires some goal, a goal that will meet his need or satisfy his interest. Level of achievement motivation is positively related to success.

1.7.8 Self-Confidence

Self-confidence is an attitude which allows individuals to have positive yet realistic views of themselves and their situations. Self-confident people trust their own abilities, have a general sense of control in their lives, and believe that, within reason, they will be able to do what they wish, plan, and expect.

"Self-confidence is not necessarily a general characteristic which pervades all aspects of a person's life. Typically, individuals will have some areas of their lives where they feel quite confident, e.g., academics, athletics, while at the same time they do not feel at all confident in other areas, e.g., personal appearance, social relationships". (Marie Reid, et.al. 2000).

1.7.9 Anxiety

While doing any job when one suspects about the proportion of possibility of success is known as anxiety. Anxiety is psychological factor which differs from arousal. It encompasses some degree of activation and an unpleasant emotional state. This form anxiety is used to describe the combination of intensity of behaviour and directional effect or emotion.

Anxiety plays an important role in the acquisition of motor skills as well as in athletic performance. Anxiety can either enhance or inhabit performance whether its effect is positive or negative depends on how an individual athlete perceives the

situation. People with low trait level has been known to perform better in selected motor skills than those with high or trait levels. There is also positive relationship between participants in athletic competition.

1.8 REASONS FOR SELECTION OF THE STUDY

Sportsmen requires a multitude of athletic abilities, such as explosive acceleration and fast sprinting speed; muscular endurance and strength in the lower body; muscular balance and high levels of neuromuscular co-ordination, body awareness and agility, the ability to know where the body is, and be able to move it; good flexibility to avoid injury and correct balance between the quadriceps and hamstrings, as well as strength imbalances between the left and right leg. Thus, every sportsman is interested to improve their physical, physiological and psychological and performance levels.

If one failed to establish correct training patterns for young athletes, unfortunately, goes way back. Hence the investigator was interested to find out the effects of varied capsules of training, namely, circuit training, interval training and stair case training on selected physical variables such as speed, abdominal strength and flexibility and cardiovascular endurance physiological variables vital capacity and breath holding time and psychological variables such as achievement motivation, self-confidence and anxiety and skill variables such as dribbling, shooting and wing shot shooting among college level men handball players.

1.9 OBJECTIVES OF THE STUDY

1. To find out the influence of varied capsules of fitness training namely circuit training, interval training and stair case training for better performance on selected physical variables among college level men handball players.

2. To evaluate the effect of varied capsules of fitness training namely circuit training, interval training and stair case training for better performance on selected physiological variables among college level men handball players.

3. To determine the impact of varied capsules of fitness training namely circuit training, interval training and stair case training for better performance on selected psychological variables among college level men handball players.

4. To find out the effect of varied capsules of fitness training namely circuit training, interval training and stair case training for better performance on selected skill performance variables among college level men handball players.

1.10 STATEMENT OF THE PROBLEM

The purpose of the study was to find out the effect of varied capsules of fitness training namely circuit training, interval training and stair case training on selected physical, physiological, psychological and skill performance variables among college level men handball players.

1.11 HYPOTHESES

1. It was hypothesised that 12 weeks of varied capsules of fitness training namely circuit training, interval training and stair case training would

significantly improve the selected physical variables namely speed, abdominal strength, flexibility and cardiovascular endurance and physiological variables namely vital capacity and breath holding time and psychological variables namely achievement motivation, self-confidence and anxiety and skill performance variables namely dribbling, shooting and wing shot shooting among college level men handball players.

2. It was hypothesised that 12 weeks of circuit training would significantly improve the selected physical variables namely speed, flexibility and cardiovascular endurance and physiological variables namely vital capacity and breath holding time and psychological variables namely achievement motivation and self-confidence than stair case and interval trainings among college level men handball players.
3. It was hypothesised that 12 weeks of stair case training would significantly improve the selected physical variable namely abdominal strength and psychological variable namely anxiety and skill performance variables namely dribbling, shooting and wing shot shooting than circuit and interval trainings among college level men handball players.
4. It was hypothesised that 12 weeks of interval training and stair case training would significantly improve the selected physical variables namely speed, abdominal strength, flexibility and cardiovascular endurance and physiological variables namely vital capacity and breath holding time and psychological variables namely achievement motivation, self-confidence and anxiety and skill performance variables namely dribbling, shooting and wing shot shooting than control group among college level men handball players.

1.12 SIGNIFICANCE OF THE PROBLEM

1. This study is unique in suggesting varied training schedules for the physical, physiological, psychological and skill variables of college men handball players.
2. The findings of this study would suggest which training schedule is better in improving and developing the specific physical, physiological, psychological and skill variables of handball players.
3. The findings would be helpful for the coaches and administrators to modify their existing training schedules for the preparation of handball probable's.
4. This study may help the coaches and physical educators to train the handball players to improve their selected physical, physiological, psychological and skill variables.
5. This research may help the sports scientists to suggest ways and means to improve better standard in sports through suggesting suitable training methods.
6. This study may provide clear guidelines in better performance to be groomed for higher levels of competition.

1.13 DELIMITATIONS

1. The study was delimited to the college men handball players in the age group of 18 to 24 years from various colleges of the University of Madras.

2. The study was delimited to 80 handball players. Further, they were randomly assigned into four equal groups of 20 subjects each.

3. The period of the training programme was delimited to 12 weeks.

The study was restricted to the following variables.

Dependent Variables

Physical Variables

1. Speed
2. Abdominal Strength
3. Flexibility
4. Cardiovascular Endurance

Physiological variables

1. Vital Capacity
2. Breath holding time

Psychological Variables

1. Achievement Motivation
2. Self-Confidence
3. Anxiety

Skill Variables

5. Dribbling
6. Shooting
7. Wing Shot Shooting

Independent Variables

1. Twelve Weeks of Circuit Training
2. Twelve Weeks of Interval Training
3. Twelve Weeks of Stair Case Training

1.14 LIMITATIONS

1. The influence of certain factors like daily routine, food habits, life style and rest period were not taken into consideration.
2. Hereditary and environmental factors which contribute to both physical and mental efficiency were not taken into consideration.
3. Though the total work load of these three training programme was equated, the intensity of the load which varies from individual to individual was not taken into consideration.
4. The previous knowledge of the subjects and their experience in activities was not taken into consideration.

1.15 DEFINITION OF TERMS

1.15.1 Training

"Training has been explained as programme of exercise designed to improve the skills and increase the capacities as resting heart rate". (Hardayal Singh, 1991).

1.15.2 Circuit Training

"It is the type of training, in which a certain number of exercises are done one after the other in the form of a circuit. This circuit is repeated three or more times.

Circuit training can be used for the improvement of technical and tactical element or for the improvement of conditional activities". (Hardayal Singh, 1991).

1.15.3 Interval Training

Fox and Mathews (1974) defined interval training as a system of conditioning or training consisting of a series of repeated bouts of exercise alternated with periods of relief, light or mild exercise usually constitutes the relief period.

1.15.4 Stair Case Training

Staircase training is a suitable exercise to burn fat and improve the condition of heart and lungs. Staircase training is a creative, fine and very challenging patterns of movement, that is, on and off stair case can challenge the legs, footsteps and arms also.

1.15.5 Speed

"The capacity of moving a limb or part of the body's lower system or the whole body with the greatest possible velocity". (Catherin Soanes, et.al., 2000).

The maximal rate at which an individual is able to move the entire body over a specific distance is considered to be his speed movement.

1.15.6 Abdominal Strength

"Muscular strength is the maximum amount of force that a muscle can exert against some form of resistance in a single effort. The strength exerted by the abdominal muscles is defined as abdominal strength and was measured by sit ups tests". (Thomas Karik Cureton, 1974).

1.15.7 Flexibility

"Flexibility is the range of motion around a joint. Good flexibility in the joints can help prevent injuries through all stages of life". (Thomas Karik Cureton, 1974).

1.15.8 Cardiovascular Endurance

The ability to sustain a series of repetitions of an activity without unduly taking the physiological systems that furnish the fuel and oxygen to the muscles is considered as cardiovascular endurance.

1.15.9 Vital Capacity

The volume of air that can be moved out of the lungs after maximum inspiration is called vital capacity.

The maximal volume of air that can be forcefully exhaled from the lungs following a maximal expiration.

1.15.10 Breath Holding Time

"Breath holding time is the duration of time through which one can hold his breath without the study of all living things". (Morehouse, Laurence E. et.al., 1976).

1.15.11 Achievement Motivation

"Achievement motivation refers to the tendency to strive to achieve and excel in whatever challenge that is presented and sports achievement motivation is defined as the tendency to strive to achieve and excel in particular game or sport". (Kamlesh, M. L., 1990)

1.15.12 Self-Confidence

"Self-confidence is an attitude which allows individuals to have positive yet realistic views of themselves and their situations". (Marie Reid, et.al., 2000).

1.15.13 Anxiety

"A state of restlessness and agitation, often with general indisposition and a distressing sense of oppression at the epigastria". (Marie Reid, et.al., 2000).

CHAPTER II

REVIEW OF RELATED LITERATURE

A Study of relevant literature is an inevitable and essential step to get a clear idea and foundation with regard to the problem under study. The investigator has gone through available literature related to the present study from dissertations, journals, magazines, books and articles relevant to Sports and Physical Education. The review of related literature has been presented under the following headings;

1. Studies on circuit, interval and stair case training
2. Studies on physical, physiological and psychological variables
3. Studies on performance variables

2.1 STUDIES ON CIRCUIT, INTERVAL AND STAIR CASE TRAININGS

Rajan, Kasi G. (2018) examined the effectiveness of intensive and extensive interval trainings on selected physical and physiological variables among Kabaddi players. 36 Kabaddi inter-collegiate level players were chosen as subjects from Thottukudi district, Tamil Nadu, India and they were separated into two experimental gatherings and one control gathering. Experimental gathering I involved in intensive interval training, experimental gathering II involved in extensive interval training and control gathering not involved in any special training except their leisure time pursuit as college students. The treatment period was confined to 12 weeks. Data were recorded prior and later the experimental period on chosen dependent variables. Remarkable improvements on selected criterion variables due the trainings were

statistically analyzed with dependent ‘t’ test, ANCOVA and Scheffe’s post-hoc test. The study confirmed that the intensive interval training had remarkable improvement than extensive interval training on speed and explosive power and the extensive interval training had remarkable improvement than intensive interval training on cardio respiratory endurance, resting heart rate, vital capacity and breath holding time among inter-collegiate kabaddi players.

Periadurai V. (2017) attempted to estimate the effects of intensive interval and fartlek trainings on chosen parameter of football school boys. 45 district level football players were chosen as subjects from Tirunelveli district, Tamilnadu, India. The subjects were randomly separated into three gatherings of 15 subjects in each. Experimental gathering I met with intensive interval training, experimental gathering II met with fartlek training and control gathering refrained from any special training except their leisure time pursuit as school students. The treatment period was confined to 12 weeks. Data were recorded prior and later the experimental period on chosen dependent variables. Dependent ‘t’ test, ANCOVA and Scheffe’s post-hoc test were employed as statistical procedure to estimate the remarkable improvement on selected criterion variables due the trainings among the gatherings. The results of the study revealed that intensive interval training group showed remarkable improvement on speed, speed endurance and muscular endurance than fartlek training and both trainings showed equal improvement on resting heart rate and peak flow rate and no improvement on blood pressure among district level school football players.

Naikoo., Khursheed Ahmad., et. al. (2017) initiated to estimate the effect of circuit and resistance exercise on strength endurance among college men. 30 male college students were randomly chosen from the Government Degree College in

Kulgam and the age was fell between 18 and 22 years. The chosen subjects were detached into three gatherings namely circuit exercise gathering, resistance exercise gathering and control gathering. The experimental gatherings executed to their allotted course for 12 weeks and the control gathering did not expose to any specific course. The strength endurance was recorded by applying of bent knee sit-up test. ANCOVA was employed as statistical procedure to analyse the obtained data. The study affirmed that the circuit and resistance training made remarkable gain ($p \leq 0.05$) in physical fitness of the chosen subjects.

Rai S. K. (2017) compared the selected physiological and hematological variables such as the maximum intake of oxygen, vital capacity, resting pulse rate, arterial pressure mean, hemoglobin range, bilirubin, glucose and urea of blood among the soccer players. A sum of 30 players at the level of district, state and university were selected for the study. ANOVA with 'F' ratio at a significance level of 0.05 was applied to determine the significant difference on the selected variables. The result showed significant difference on VO_2 Max of the district players compared to the state and the university players; however, the latter should more or less similar level of VO_2 Max.

Krishnaleela V., et. al. (2015) examined the impact of various powers of alternative pace run, interval training and detraining on cardio respiratory endurance. Sixty subjects were chosen and they were partitioned into four gatherings namely low intensity interval gathering, medium intensity interval gathering, alternative pace run gathering and control gathering. After the completion of interval training period, the subjects of gathering I, II and III were physically detrained for thirty days. The pre and posttest information on cardio respiratory endurance was measurably examined

by using ANCOVA. Significant improvement on cardio respiratory endurance among alternative pace run and decline during detraining period among all the gatherings was observed.

Ohta M et al. (2015) documented that work ability is partly determined by physical and mental fitness. Bench step exercise can be practiced anywhere at any time. The aim of this study was to determine the effects of a bench step exercise on work ability by examining cardiovascular risk factors and oxidative stress. Thirteen volunteers working in a warehousing industry comprised the bench step exercise group (n = 7) and the control group (n = 6). The participants in the step exercise group were encouraged to practice the step exercise at home for 16 weeks. The step exercise improved glucose metabolism and antioxidative capacity and increased work ability by reducing absences from work and improving the prognosis of work ability. The improvement in work ability was related to a reduction in oxidative stress. These results suggest that a bench step exercise may improve work ability by reducing cardiovascular risk factors and oxidative stress.

Nishida Y et al. (2015) investigated the effects of a 12-week home-based bench step exercise program on inflammatory cytokines and lipid profiles in elderly females. Sixty-two postmenopausal females (65-85 years of age) were randomized to either the bench step exercise group (n=31) or the control group (n=31). The subjects in the bench step exercise group were instructed to perform bench step exercises at the exercise intensity corresponding to lactate threshold (LT), three times per day 10-20min each session, for a goal of ≥140min/week at home for 12 weeks. At baseline and 12 weeks, circulating levels of nine inflammatory cytokines (high-molecular-weight adiponectin, interleukin-4 [IL-4], IL-5, IL-6, IL-8,

IL-15, tumor necrosis factor-α [TNF-α], TNF-β and interferon-γ [IFN-γ]) and serum lipids including high-density lipoprotein cholesterol (HDL-C) were measured. The bench step training at the LT significantly increased HDL-C levels and decreased IFN-γ concentrations in the subjects with lower (< 63mg/dL) baseline HDL-C levels ($p<0.05$). The change in IFN-γ inversely correlated with the change in HDL-C in the exercise group ($\rho=-0.56$, $p<0.01$), whereas this association was not observed in the control group. Additionally, principal component analysis-derived index of what we called "inflammatory status factor" was inversely associated with the changes in HDL-C in the exercise group. The bench step exercise-induced reduction in the IFN-γ levels may partially explain the degree of improvement in the HDL-C levels with the exercise program.

Babu R. C., et. al. (2014) attempted to estimate the impact of interval training on cardio respiratory endurance among football players. Thirty football players with age ranging from 18 to 25 years were randomly chosen from Malapuram, Kerala. They were separated into two gatherings of 15 players each. Pre-tests were taken for all the subjects prior the training. Gathering I involved in interval training for 8 weeks on alternative three days in a week and post-tests were conducted. Gathering II acted as the control gathering. The Cardio respiratory endurance was measured by using Cooper's 12 minutes run and walk test and paired 't'-value determined the contrast between two gatherings. The findings showed the significant influence of eight weeks of interval training on cardio respiratory endurance of the soccers.

Deol N. S. (2013) was attempted to evaluate the effectiveness of continuous and interval training on endurance ability of the soccers. It also showed the comparison between the chosen training methods in terms of effectiveness. All 45

players of JCT Academy at Phagwara, were grouped into 3 with 15 each and were named A B and C respectively. Group A involved in Continuous training, B in interval training, C did usual training (Control Group). The twelve minute's run walk test of Cooper (1968) was utilized for testing the endurance ability of soccers. The pre and post-tests were carried out prior and after the training period of eight weeks. SPSS software helped in the application of ANCOVA and LSD post-hoc test. The adjustment of the F-value to 15.88 in the outcome was found to be at the significant level of 0.05. The result of LSD Post –hoc measure exposed the effect of continuous and interval training in improving the endurance ability of the soccers. It also showed the highest impact of interval training over continuous running in terms of improvement of the endurance ability of the players.

Wong P C., et.al. (2008) conducted a study on the effects of a 12-week twice weekly additional exercise training which comprised a combination of circuit-based resistance training and aerobic exercises, in additional to typical physical education sessions, on aerobic fitness, body composition and serum C-reactive protein (CRP) and lipids were analysed in 13- to 14-year-old obese boys contrasted with a control group. Both the exercise group (EG, n = 12) and control group (CG, n = 12) participated in the typical 2 sessions of 40-minute physical education (PE) per week in schools, but only EG participated in additional 2 sessions per week of 45 to 60 minutes per session of exercise training, which comprised a combination of circuit-based resistance training and aerobic exercises maintained at 65% to 85% maximum heart rate (HRmax = 220 - age). Body composition was measured using dual energy X-ray absorptiometry (DEXA). Fasting serum CRP and blood lipids were analysed pre- and postexercise programme. Aerobic fitness was measured by an objective laboratory submaximal exercise test, PWC170 (Predicted

Work Capacity at HR 170 bpm). Exercise training significantly improved lean muscle mass, body mass index, fitness, resting HR, systolic blood pressure and triglycerides in EG. Serum CRP concentrations were elevated at baseline in both groups, but training did not result in a change in CRP levels. In the CG, body weight increased significantly at the end of the 12-week period. This study supports the value of an additional exercise training programme, beyond the typical twice weekly physical education classes, to produce physiological benefits in the management of obesity in adolescents, including prevention of weight gain.

Westcott W L., et.al. (2007) conducted a study on the effects of a longer and more frequent aerobic exercise protocol with a shorter and less frequent circuit strength-training protocol for improving U.S. Air Force physical fitness test scores of subjects who previously failed to achieve a passing point total. 83 men and women of the U.S. Air Force (M age = 32.7 yr.) participated in either the unsupervised standard conditioning program, which recommended approximately 60 min. of aerobic activity 4 to 5 days per week (n=26), or the supervised circuit strength-training program, which required approximately 25 min. of alternating strength and endurance exercises 3 days per week (n=57). Subjects were assessed on a 2400-m (1.5-mile) run, abdominal circumference, push-ups completed in 1 min., and abdominal crunches completed in 1 min. Dependent t tests with Bonferroni adjustment indicated that significant improvements were attained by the circuit strength-training group only on each of the aforementioned measures. Significantly more participants in the circuit strength-training group (26%) achieved a passing point total than in the standard conditioning group (19%) at Wk. 12 (chi1(2) =3.96, p = .05). Implications for enhancing physical fitness in poorly conditioned adults were discussed.

Nash M S., et.al. (2007) examined the effects of circuit resistance exercise (CRT) training on muscle strength, endurance, anaerobic power, and shoulder pain in middle-aged men with paraplegia. Academic medical center. Seven men (age range, 39-58y) with motor-complete paraplegia from T5 to T12 and confirmed shoulder pain occurring during daily activities. Not applicable. Subjects underwent a 4-month CRT program using alternating resistance maneuvers and high-speed, low-resistance arm exercise. One-repetition maximal force was measured before training and monthly thereafter. Pre training and post raining peak oxygen uptake (VO_2 peak) was measured by graded arm testing. Anaerobic power was measured before and after training using a 30-second Wingate Anaerobic Test. Shoulder pain was self-evaluated by an index validated for people with spinal cord injury (Wheelchair Users Shoulder Pain Index [WUSPI]). Strength increases ranging from 38.6% to 59.7% were observed for all maneuvers (P range, .005-.008). VO_2 peak increased after training by 10.4% (P=.01), and peak and average anaerobic power increased by 6% (P=.001) and 8.6% (P=.005), respectively. WUSPI scores +/- standard deviation were lowered from 31.9+/-24.8 to 5.7+/-5.9 (P=.008), with 3 of 7 subjects reporting complete resolution of shoulder pain. CRT improves muscle strength, endurance, and anaerobic power of middle-aged men with paraplegia while significantly reducing their shoulder pain.

Muller S M., et.al. (2006) examined the effects of exercise on indices of emotional well-being of 584 college students enrolled in either a lecture-only health course or one of six health-fitness courses, each using a different mode of exercise including cross-training, aerobics, yoga, circuit weight training, swimming, and walk/jog. Each participant completed the Self-perception Profile for College Students developed by Neeman and Harter. Analysis yielded significant differences on five

indices of emotional well-being (Global Self-worth, Appearance, Romantic Relationships, Social Acceptance, and Athletic Competence) between pre- and posttest scores of participants enrolled in the health-fitness courses, while no differences were found between pre-and posttest scores of participants enrolled in the lecture-only health course. Of the seven subscales examined, a significant interaction effect was found between sex/time and Romantic Relationships/Athletic Competence, with women reporting greater gains than men.

2.2 STUDIES ON PHYSICAL, PHYSIOLOGICAL AND PSYCHOLOGICAL VARIABLES

Arul S. (2014) examined the impact of sand running on chosen criterion variables. Thirty men whose age ranged from the years of 18-24 were selected randomly as subjects from physical education department of Annamalai University, Annamalai Nagar, Tamil Nadu. The students were grouped into two such as sand running group and control group with 15 each. Group-I was exposed to sand running for a period of 12 weeks. Control group was not exposed to any practice programme other than physical education activities. Everyone in both groups were tested on speed and cardio respiratory endurance by standard tests. The researcher used ANCOVA to test the remarkable dissimilarity where “F” ratio obtained was analyzed at 0.05 confidence level. There was significant difference between the groups on selected parameters.

Sathishkumar S. (2011) attempted to evaluate the effectiveness of sand and offshore training on chosen criterion variables amid inter engineering collegiate football participants. To attain the purpose, 45 engineering college football participants were chosen and they were separated into three gathering. Gathering I

and II were executed sand and seashore exercises respectively and the other gathering executed as gathering of control. Tests were taken earlier to and after conclusion of six weeks of course. ANCOVA was employed as statistical technique to analyze the data. The findings disclosed that sand training showed remarkable gain on chosen dependent variables particularly speed, agility, endurance, resting pulse rate, breath holding time and blood pressure than offshore training amid inter engineering collegiate football players.

Jacob S. (2010) examined the effectiveness of sand and seashore training on chosen physical fitness variables namely speed, endurance, power, flexibility, cardiovascular endurance, agility and performance variables among school volleyball players. To accomplish the purpose, 30 volleyball players were chosen from different schools in Chennai and they were randomly separated into three gatherings. Gathering I and II were executed sand and seashore exercises respectively and the other gathering executed as gathering of control. Tests were taken prior to and after completion of six weeks of course. The obtained data was exposed to ANCOVA statistical procedure to attain the results. It was observed that remarkable gain on speed, endurance, agility and flexibility and no remarkable gain on volleyball playing ability due to six weeks of sand and seashore training. The results of the study revealed that remarkable improvement on speed, endurance, agility and flexibility and no remarkable gain in playing ability among school volleyball players.

Paul, C. Godwin (2010) examined the effectiveness of weight and resistance training on chosen bio motor, physiological and skill variables among state level hockey players of Tamil Nadu. To achieve this purpose, 60 state level men hockey players from different colleges of Tamil Nadu were randomly chosen and their age

was between 18 and 25 years. The subjects were separated into three gathering. Gathering I and II were executed weight and resistance training respectively and the other gathering assigned as control gathering. Pre and Post-tests were conducted prior and after 12 weeks of training for all the subject on chosen dependent variables namely speed, leg strength, shoulder strength, cardiovascular endurance, resting pulse rate, breath holding time, vital capacity, dribbling, passing, hitting and scooping. 'F' test was done using ANCOVA. The findings revealed that both training significantly gained the selected bio motor, physiological, skill variables among state level hockey players.

Bolboli L, et.al. (2008) examined the effect of height in the predicted VO_2max by the Queens Step test among short and tall young girls. A sample of 38 individuals was selected in two stages from a total of 500 individuals and was assigned to two groups of short (n = 20) and tall (n = 18). In order to examine the effect of height in the predicted VO_2max, the Queens step protocol and the incremental treadmill speed test were used. Respiratory exchange was measured continuously throughout the test by an automated open-circuit gas analysis system. The study results showed that tall girls revealed a higher VO_2max on the Queen's step and treadmill tests than short girls (Queen's: 44.09+/-2.66 vs. 38.96+/-1.65; Treadmill: 34.03+/-7.26 vs. 28.15+/-5.09 mL/kg/min). Based on the obtained findings it can be concluded that the higher VO_2max seen in tall girls on the both protocols, may be due to their physiological and physical properties; therefore, it seems that designing of the adjustable steps to the height of subjects for optimizing the estimation of VO_2max is not necessary and other physiological factors may be involved, which require further investigation.

Keogh J W., et.al. (2003) attempted to develop an effective testing battery for female field hockey by using anthropometric, physiological, and skill-related tests to distinguish between regional representative with 35 and local club level with 39 female field hockey players. The regional representative players were significantly leaner and recorded faster times for the 10-m and 40-m sprints as well as the Illinois Agility Run (with and without dribbling a hockey ball). The regional representative players also had greater aerobic and lower body muscular power and were significantly ($p < 0.05$) more accurate in the shooting accuracy test. No significant differences between groups were evident for height, body mass, speed decrement in 6 x 40-m repeated sprints, handgrip strength, or pushing speed. These results indicate that percent body fat, sprinting speed, agility, dribbling control, aerobic and muscular power, and shooting accuracy can distinguish between female field hockey players of varying standards. Therefore, talent identification programs for female field hockey should include assessments of these physical parameters.

2.3 STUDIES ON PERFORMANCE VARIABLES

Anis Chaouachi, et.al. (2009) conducted a study on the anthropometric, physiological, and performance characteristics of an elite international handball team. Twenty-one elite handball players were tested and categorized according to their playing positions such as goalkeepers, backs, pivots, and wings. Testing consisted of anthropometric and physiological measures of height, body mass, percentage body fat and endurance, performance measures of speed (5, 10, and 30 m), strength (bench press and squat), unilateral and bilateral horizontal jumping ability, and a 5-jump horizontal test. Significant differences were found between player positions for some anthropometric characteristics (height and percentage body fat) but not for the

physiological or performance characteristics. Strong correlations were noted between single leg horizontal jumping distances with 5-, 10-, and 30-m sprint times ($r = 0.51$-0.80; $P < 0.01$). The best predictors of sprint times were single leg horizontal jumping with the dominant leg and the distance measured for the 5-jump test, which when combined accounted for 72% of the common variance associated with sprint ability. In conclusion, performance abilities between positions in elite team-handball players appear to be very similar. Single leg horizontal jumping distance could be a specific standardized test for predicting sprinting ability in elite handball players.

Oxyzoglou N., et.al. (2008) documented that high performance in team sports depends to a great extent on the motor abilities of all players according to their position in the team. Assessing the motor abilities of elite athletes according to their playing position in the team was the aim of the study. The sample consisted of 46 handballers aged 18-21 years (M=19.5, SD=.4.5), belonging to national teams from Greece and Serbia. Afterward, the sample was divided into subgroups, representing their unique position in the team. More specifically the subgroups consisted of eight goalkeepers, fourteen extreme players, sixteen peripheral players and eight pivotal players. The motor abilities of power, agility and flexibility were assessed. The Kruskal-Wallis and Mann-Whitney U analysis were used for the comparison among groups. The results revealed that the goalkeepers have a highly developed level of pelvis flexibility and a well-developed level of explosive force. The peripheral players have high vertical jump and a high degree of wrist flexibility. Extreme players have a developed level of explosive force and big width of wrist movement. Finally, pivotal players are less flexible but very agile. Every playing position developed specific motor abilities which contribute to team performance.

Visnapuu, et.al. (2007) reported that in handball and basketball the longer the finger length the better the accuracy of the shot or throw. All shots and throws are finished with the wrist and fingers. It can be proposed that athletes with longer fingers and greater hand surface parameters also probably have greater grip strength. The aim of this study was to investigate the influence of general body and hand-specific anthropometric dimensions on handgrip strength in boys participating in handball and basketball training. In total, 193 boys aged 10-17 years participated in this study. They were divided into 6 groups: 10-, 11-, 12-, 13-, 14-15-, and 16-17-year-olds. The body height and body mass were measured and body mass index was calculated as general anthropometric parameters. The outlines of the hands of the boys were drawn on paper with a thin marker. Three groups of hand anthropometric parameters were measured: 5 finger spans, 5 finger lengths, and 5 perimeters of the hand. Handgrip strength was measured on the dominant hand with a Lafayette dynamometer. As a rule, general anthropometric parameters determined the maximal handgrip strength more accurately than did specific hand anthropometric parameters. From the specific hand anthropometric parameters, finger lengths and perimeters of the hand significantly correlated with the maximal handgrip strength. In summary, fingers are the smallest, lightest parts of the motor apparatus, and, therefore, they represent the parts most easily deflected by force from the ball, but at the same time, finger control is especially important for the accuracy of different shots, both in handball and basketball. Thus, it is especially necessary to measure finger length and perimeters of the hand for practical reasons.

Schorer, et.al. (2007) examined the movement patterns of 5 left-handed handball players (ranging from beginner to national level) who threw a handball to

different sections of a goal as if a goalkeeper were present. The authors used time-continuous, 3-dimensional kinematic data to assess interindividual movement patterns and considered participants' intraindividual differences relative to different targets. Cluster analysis yielded the highest assignment rates for level of expertise; a mean of 92% of trials was correctly assessed. The authors observed an interaction with expertise for the intraindividual movement patterns. Variability in the novice throwers was increased, whereas (a) advanced throwers experienced a period of stability, and (b) the expert thrower's variability was increased. The results indicate that random variability characterizes novice motor performance, whereas active functional variability may exemplify expert motor performance.

Vatromir, et.al. (2006) assessed the basic motor abilities that determine top performance in women's handball, and to identify test panel for primary selection at handball school. The study included 155 female attendants of the Split Handball School, mean age 12.5 years. Differences in the basic motor abilities between the subjects that developed into elite handball players after 7-year training process and those that abandoned handball for being unable to meet the competition criteria were evaluated by use of discriminative analysis. The former was found to have also been superior initially in all variables analyzed, and in arm coordination, overall body coordination, throw and jump explosive strength, arm movement frequency and repetitive trunk strength in particular. Motor superiority based on the abilities of coordination, explosive strength and speed determines performance in women's handball, qualifying these abilities as reliable selection criteria. Based on this study results, a new model of selection in women's handball, with fine arm coordination as the major limiting factor of performance, has been proposed.

2.4 SUMMARY OF REVIEW OF RELATED LITERATURE

The investigator has reviewed related literature on the effect of varied capsules of fitness training namely circuit training, interval training and stair case training on selected physical, physiological, psychological and skill performance variables. It was found that there was scope for further research in finding out the effect of varied capsules of fitness training consisting of circuit, interval and stair case trainings on selected physical, physiological, psychological and skill variables among college level men handball players. Hence, the investigator undertook this research. Based on the experience gained through the review of related literature, the investigator formed suitable methodology to be adopted for this research which is presented in Chapter III.

CHAPTER III

METHODOLOGY

This chapter describes in detail about the selection of subjects, selection of variables, experimental design, pilot study, selection of tests, criterion measures, reliability of data, training programme, test administration, collection of data and statistical techniques involved in this study.

3.1 SELECTION OF SUBJECTS

The purpose of the study was to find out the effects of varied capsules of fitness training such as circuit training, interval training and stair case training on selected physical, physiological, psychological and skill variables among college level men handball players. To achieve the purpose of this study, 80 college men handball players from various colleges of the University of Madras were selected as subjects and they were in 18 to 24 years of age.

3.2 SELECTION OF VARIABLES

The research scholar reviewed the various scientific literature pertaining to the circuit training, interval training and stair case training on selected physical, physiological and psychological variables from books, journals, periodicals, magazines and research papers. Taking into consideration of feasibility criteria, availability of instruments and the relevance of the variables of the present study, the following variables were selected.

3.2.1 Dependent Variables

a. Physical Variables

1. Speed
2. Abdominal Strength
3. Flexibility
4. Cardiovascular Endurance

b. Physiological Variables

1. Vital Capacity
2. Breath Holding time

c. Psychological Variables

1. Achievement Motivation
2. Self-Confidence
3. Anxiety

d. Skill Variables

1. Dribbling
2. Shooting
3. Wing Shot Shooting

3.2.2 Independent Variables

1. Experimental Group I: Twelve weeks of Circuit Training

2. Experimental Group II: Twelve weeks of Interval Training

3. Experimental Group III: Twelve weeks of Stair Case Training

4. Group IV: Control Group

3.3 EXPERIMENTAL DESIGN

The study was formulated as a true random group design, consisting of a pre test and post test. The subjects (n = 80) were randomly assigned into four equal groups of 20 handball players in each group. The groups were assigned as Experimental Groups I, II, III and control group respectively. Experimental group I was assigned as Circuit Training Group (CTG), experimental group II was assigned as Interval Training Group (ITG), experimental group III was assigned as Stair Case Training Group (SCTG) and the Control Group (CG) was strictly under control not involving any special training. Pre tests were conducted for all the subjects on selected physical, physiological and psychological variables. The experimental groups participated in their respective circuit training, interval training and stair case training for a period of twelve weeks. After the experimental period, the post tests were conducted on the above said dependent variables for all the four groups. The difference between the initial and final scores on each variable was considered the effect of respective treatments. The effects of varied package of training on selected variables were tested through ANCOVA. In all cases 0.05 level was fixed to test the hypothesis.

3.4 PILOT STUDY

A pilot study was performed to fix the intensity and duration of training programme in relation with the initial capacity of the subjects. The study was

executed with 15 subjects to identify the suitability, short comings and limitations of the training. Further, this study has helped the scholar to mastery over the procedure of the tests and capable to take accurate measurement of selected variables among college level men handball players.

3.5 CRITERION MEASURES

The following criterion measures were adopted to measure the test.

1. To measure the speed, 50 meters run test was administered by using stop watch and the scores were recorded in seconds.

2. To measure the abdominal strength, sit-up test was administered and the scores were recorded in number.

3. To measure the on flexibility, sit and reach test was administered and the scores were recorded in centimeters.

4. To measure the cardiovascular endurance, Cooper's 12 Minutes run / walk test was conducted and the scores were recorded in meters.

5. To measure the vital capacity, wet spiro meter was used and scores were recorded in milliliters.

6. To measure the breath holding time was measured using nose clip method was administered with stop watch and the scores were recorded in centimeters.

7. Achievement motivation was measured by questionnaire was and the scores were recorded in points.

8. Self-confidence was measured by Basavanna's questionnaire (1971) and the scores were recorded in points.

9. Anxiety was measured through Sinha's Comprehensive Anxiety Test (SCAT) and the scores were recorded in points.

10. Skill variables, dribbling, shooting and wing shot shooting were determined as per standard tests in handball.

3.6 RELIABILITY OF DATA

Before the commencement of experiment, the reliability of the data was established through reliability of instruments, reliability of tester, reliability of subjects by test and retest method

3.7 RELIABILITY OF INSTRUMENTS

The research scholar used the following instruments such as stop watch, measuring tape, starting clapper, meter scale and wet spirometer to find out the reliability of the instruments. Further those instruments have been calibrated in standard units, each of the variables are recorded. All the instruments were in good working condition. Their calibration was tested and found to be accurate enough to serve the purpose of the study.

The questionnaires used in this study to measure the psychological variables were standard ones and being used by researchers in the field. Moreover, the authors of the questionnaires have determined the validity and reliability of the tools and hence, the reliability was accepted for this study.

3.8 TESTER'S RELIABILITY

To determine the reliability of measurements involved in this study, the data were collected from 15 handball players. To ensure that the investigator was well versed in the technique of conducting the tests, the investigator had a number of practice sessions in the testing procedures. The investigator took all the measurements with the assistance of persons well acquainted with the tests and their procedures. Tester's competency and reliability of tests were established by Test, Retest, process. Table I shows the test and re-test correlation coefficient.

Table I

Intra Class Correlation Coefficient of Test - Retest Scores

S.No	Variables	Test	Obtained 'r'
1	Speed	50 M Run	0.89*
2	Abdominal Strength	Sit ups	0.91*
3	Flexibility	Sit and Reach	0.87*
4	Forced Vital Capacity	Spirometer	0.85*
5	Breath Holding Time	Nose and Clip method	0.84*
6	Cardiovascular Endurance	12 Min walk / Run Test	0.82*
7	Achievement Motivation	Sports Achievement Motivation (Kamlesh, 1993)	0.79*
8	Self Confidence	Self Confidence Test Basavanna (1971)	0.78*
9	Anxiety	Sinha's Comprehensive Anxiety Test	0.81*
10	Dribbling	Handball Dribbling Test	0.79*
11	Shooting	Handball Shooting Test	0.78*

3.9 SUBJECT RELIABILITY

The intra class correlation coefficient values received from test-retest scores also confirmed the reliability of subjects as the same tester had conducted test-retest for the same subjects in the same conditions.

3.10 CIRCUIT TRAINING PROGRAMME

While training for experimental group I, the circuit training was given. The circuit was structured to develop the physical fitness, physiological and psychological variables of handball players. The following circuit exercises were selected so that they could develop the physical fitness abilities mentioned against each:

1) Four – count squat Thrusts - Speed
2) Abdominal Sit – Backs - Agility /Abdominal Strength
3) Scissor step – ups - Leg Strength
4) Squats to Presses - Muscular Strength
5) Overhead Barbell Press - Upper-body Strength
6) Push – Ups - Cardiovascular Endurance
7) Free Jump Squats - Core Strength / Endurance
8) Bicycle Kicks - Abdominal Strength / Flexibility

Table II
TWELVE WEEKS OF TRAINING SCHEDULE FOR CIRCUIT TRAINING PROGRAMME

WEEK	EXERCISE		CIRCUITS	
	WORK	REST	REPETITION	REST
1.	30 Sec	30 Sec	2	2 min
2.	30 Sec	30 Sec	2	2 min
3.	30 Sec	30 Sec	2	2 min
4.	30 Sec	30 Sec	2	2 min
5.	35 Sec	35 Sec	3	2 min 30 Sec
6.	35 Sec	35 Sec	3	2 min 30 Sec
7.	35 Sec	35 Sec	3	2 min 30 Sec
8.	35 Sec	35 Sec	3	2 min 30 Sec
9.	40 Sec	40 Sec	4	3 min
10.	40 Sec	40 Sec	4	3 min
11.	45 Sec	45 Sec	5	3 min 30 Sec
12.	45 Sec	45 Sec	5	3 min 30 Sec

3.11 INTERVAL TRAINING PROGRAMME

Experimental II underwent Interval Training as per schedule presented in Table III. Care taken that the training session started with 5 minutes warm up consisting of slow walk and slow jogging and ends up with cool down session with slow jogging and slow walking. The intensity level of 60 – 70% was maintained with maximum heart rate (RPE of 5-6 of the 10 on the 10-point scale) during warm up and cool down and recovery intervals. The interval training was based on progressive loading.

Table III

TWELVE WEEKS OF TRAINING SCHEDULE FOR INTERVAL TRAINING PROGRAMME

Week	Warm up	Work Interval (Max Intensity)	Recovery Interval (60-70% MHR)	Repeat	Cool down	Total Workout Time
1	5 min.	1 min.	4 min.	2 times	5 min.	20 min.
2	5 min.	1 min.	4 min.	3 times	5 min.	25 min.
3	5 min.	1 min.	4 min.	4 times	5 min.	30 min.
4	5 min.	1.5 min.	4 min.	2 times	5 min.	21 min.
5	5 min.	1.5 min.	4 min.	3 times	5 min.	26.5 min.
6	5 min.	1.5 min.	4 min.	3 times	5 min.	26.5 min.
7	5 min.	1.5 min.	4 min.	4 times	5 min.	32 min.
8	5 min.	1.5 min.	4 min.	4 times	5 min.	32 min.
9	5 min.	2 min.	5 min.	3 times	5 min.	31 min.
10	5 min.	2 min.	5 min.	3 times	5 min.	31 min.
11	5 min.	2 min.	5 min.	4 times	5 min.	38 min.
12	5 min.	2 min.	5 min.	4 times	5 min.	38 min.

3.12 STAIR CASE TRAINING PROGRAMME

Training for experimental group III, the stair case training was given. The stair case training was structured to develop the physical fitness and performance of the volleyball players. The following stair case training were selected so that they could develop the physical fitness abilities.

1. Sprinting up and down
2. Zig zag running in the steps (diagonally up and down)
3. Up – up down-down (on the same step)
4. Alternate steps (on the same step)
5. Hopping in one leg
6. Jumping with both legs

TABLE IV

TWELVE WEEKS OF TRAINING SCHEDULE FOR STAIR CASE TRAINING PROGRAMME

EXERCISE	I TO IV WEEKS		V TO VIII WEEKS		IX TO XII WEEKS	
	Time (in min)	Rest (in min)	Time (in min)	Rest (in min)	Time (in min)	Rest (in min)
Sprinting Up and Down	3	2	4	2	5	2
Zig Zag running in the Steps	3	2	4	2	5	2
Up-Up, Down-Down (on the same step)	3	2	4	2	5	2
Alternate Step (on the same step)	3	2	4	2	5	2
Hopping in one Leg	3	2	4	2	5	2
Jumping with both Legs	3	2	4	2	5	2

Prior to the experimental treatments such as circuit training, interval training, and stair case training, the subjects were given 5 minutes warm up and after completion of the training, the session was completed with 5 minutes cool down process. The exercises were structured so that there would be progressive work load on the training.

3.13 TEST ADMINISTRATION

3.13.1 Speed

50 Mts. Run

Purpose

The purpose of the test was to measure the speed of the subject.

Equipment

An area on a track, football field or playground with a starting line a 50 mts. run, and a finish line and two stop watches.

Procedure

After a short warm-up period the subject took a position behind the starting line. Best results are obtained when 2 subjects run at a time for competition. The starter uses the command, “ready” and “Go”. The later was accompanied by a downward sweep of the arm as a signal to the timer to start the stop watch. The subject ran across the finish line. One trial was permitted.

Scoring

The score was the clasped time to the nearest tenth of a second from the starting signal to the instant the subject a crossed the finish line.

13.3.2 Abdominal Strength

Sit-Ups

Purpose

The purpose of the test was to measure the abdominal strength of the subjects.

Equipment

Mats

Procedure

The starting position of the test was a back lying position with knees flexed, feet on floor and heels between one foot from the buttocks. The hands are positioned behind the neck and fingers are clasped. A partner held the examinee's feet to keep him in contact with the testing surface. The examinee curled to a sitting position, touching the elbows to the opposite knee. The examinee curled back down to the floor until the mid-back contacted the testing surface another sit-up was then attempted.

Scoring

One point was scored for each correct sit-up. The score was the maximum of sit-ups completed in 60 seconds.

3.13.3 Flexibility

Sit and Reach Test

Purpose

The objective of this test is to test the flexibility of the subjects.

Equipment

A 'sit and reach table with a ruler and Score Sheets.

Procedure

The subject was asked to sit on the floor with shoes removed, feet flat against the table and legs straight. The subject was asked to reach forward and push the fingers along the table as far as possible. The distance from the finger tips to the edge of the table represents the score of that subject.

Scoring

The distance from the finger tips to the edge of the table represented the score of the subject recorded in centimeters. Subject was allowed to three trials and the best one was taken as the score of the subject in flexibility.

3.13.4 Cardiovascular Endurance

Cooper's 12 Minutes Run/ Walk

Purpose

To measure cardiovascular endurance of the subjects

Equipment

A 400 meters track was marked and placed with cones with each 10 meters distance to quickly determine the exact distance covered in 12 minutes. A stopwatch, whistle, score sheets, chest numbers and distance markers were used for testing.

Procedure

Each subject was assigned to a spotter. The subjects were asked to start behind a line and upon the starting signal, run /walk as many laps as possible around the course within the 12 minutes. The spotters maintain a count of each lap, and when the signal to stop was given, they immediately run to the spots at which their runners were at the instant the whistle or command to stop was given.

Scoring

Score in meters was determined by multiplying the number of laps completed plus the number of cones passed plus the distance in meters off the last cone he passed.

3.13.5 Vital Capacity

Purpose

The purpose of this test was to find out the maximum quantity of air that can be expired after a full inspiration.

Equipment

Spiro meter, mouth pieces and nose clips.

Procedure

Vital capacity was measured by wet spirometer in liters. The wet spiro meter was equipped with a good length of rubber hose. The wet spiro meter placed at a height where by all the subject can stand erect at the beginning of the test. The mouth piece was disinfected by an antiseptic solution after use by each subject. The subjects were asked to take a deep breath for test: There after the fullest possible inhalation, the subject exhaled slowly and steadily bending forward over the hose till the air within his control was expelled. Care was taken to prevent air from escaping either through nose or around the edges of mouth piece and was also ensured that a second breath was not taken by the subject during the test. In case of doubt the test was repeated. Care was taken to lower the drum without spilling the water, each time after use.

Scoring

The score was taken from the dial of the Spiro meter which was recorded in milliliters.

3.13.6 Breath Holding Time

Purpose

The purpose of this test was to measure the breath holding time.

Equipment

For recording the breath holding time, a stop watch ($1/10^{th}$ of second) and nose clip were used.

Procedure

The subject was instructed to stand at ease and to inhale deeply after which he holds his breath for a length of time possible by him. A nose clip was placed on nose to avoid letting the air through nostrils. The duration from the time of holding his breath until the movement he let air out was clocked by using the stop watch to the nearest one tenth of a second as breath holding time. The co-operation of the subject to let out the air by opening the mouth was sought to clock the exact breath holding time.

Scoring

The time is recorded in seconds and the beset of two trials were recorded (Mathew, 1988).

3.13.7 Achievement Motivation

Sports Achievement Motivation Questionnaire (SAMQ) developed by Dr. M.L. Kamlesh (1993) was administered to assess the achievement motivation of the subjects.

The questionnaire consists of twenty statements with response from the subject ‘Yes’ or ‘No’. Based on the response of the subject, their achievement motivation was measured using the key of the score of the author.

Scoring

Each right response was awarded two Total score was the number of correct responses multiplied by two, of the subject and it was the achievement motivation of the subject.

3.13.8 Self-Confidence

Standard questionnaire consisting of one hundred statements were administered for evaluating self-confidence of the subjects. The test consists of hundred questions with True / or False response. The respondents were made to '√" the appropriate number which suited their attitude.

Scoring

This scoring range of this questionnaire was 100 to 0. The higher score indicates the high level of self-confidence.

Negative Questions

Of the one hundred questions with serial numbers 1 to 100, the following statements with serial numbers are negative statements. If the subject scored the negative statement as 'True' the score would be '0'.

1, 5, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 22, 23, 25, 26, 28, 33, 34, 35, 36, 37, 38, 43, 44, 45, 49, 51, 52, 53, 54, 55, 47, 58, 59, 60, 61, 63, 63, 66, 69, 70, 71, 72, 73, 74, 75, 76, 77, 80, 82, 83, 84, 85, 89, 90, 94, 97, 98, and 99.

Positive Questions

Of the one hundred questions with serial numbers 1 to 100, the following statements with serial numbers are positive statements. If the subject scored the positive statement as 'True' the score would be '1'.

2, 3, 4, 6, 13, 21, 24, 27, 29, 30, 31, 32, 39, 40, 41, 42, 46, 47, 48, 50, 56, 64, 65, 67, 68, 78, 79, 81, 86, 87, 88, 91, 92, 93, 96, and 100

3.13.9 Anxiety

Anxiety was measured through the anxiety questionnaire. The anxiety questionnaire was designed to measure the degree of anxiety experience prior to the competition.

It was developed by A.K.P. Sinha and L.N.K. Sinha (2002), and the questionnaire is popularly known as 'Sinha's Comprehensive Anxiety Test (SCAT). Anxiety questionnaire was given to all subjects. The complete questionnaire is scores as follows:

Description of the Questionnaire

The anxiety questionnaire (SCAT) consists of ninety statements. The subject had to answer all the ninety statements which are asked in Yes or No answer pattern.

For all 'Yes' answers to the statement, one point and for all the 'No' responses got '0' point.

Scoring

Score is the number of points scored by the subject out of ninety.

3.13.10 Dribbling

Purpose

To determine the dribbling ability of the subjects.

Equipment

Stop watches, measuring tape, standard hand ball, 4 dumbbells, chalk pieces and whistle

Court marking

Horizontal line of 6 feet long was marked as a shooting and finishing line. From starting line to the fourth dumbbell the marked distance was 30 feet long. The distance between the starting line to the first dumbbell was 12 feet and the reaming 3 dumb bells were placed at every 6 feet in between them.

Procedure

The subject starts at the shooting line, which was 6 feet long. She dribbles through the prescribed area, rotate as rapidly as possible for thirty seconds.

Scoring

The player score is the number of dumbbells which he passes in thirty seconds. Three trials were given and the best one was considered.

3.13.11 Shooting

Purpose

To determine the shooting ability of the subjects

Equipment

Stop watches, measuring tape, standard hand ball, two chairs, chalk pieces, rope, wooden stand and whistle

Court Marking

The rope was tied in the goal post in a design such as in the corners and the center. The students were asked to shoot the ball from penalty line which was seven meters from goal line. If she shoots the ball towards the corner then 5 points were awarded. If she shoots the ball at the center then 3 points were awarded. The scores were allotted according to the following marking

GOAL POST

5	3	6
3	2	3
5	1	5

Procedure

The subject stood behind the free throw line, within the 3 steps. She takes jump shot without touching 6 M line and travel towards the penalty line in the air bend her body and jump for selecting right angle and shoots into the particular marking point of goal. The player stands out of the 6 meters line and in any position as he desires.

Scoring

Three chances were given. The average of three trials were taken as score. Points were given for each throw according to particular marking area on the net.

3.13.12 Wing Shot Shooting

Purpose

To assess the wing shot shooting performance of the subjects.

Court Marking

The handball goal post was divided into nine targets by using ropes. Thus, the top and bottom right corner boxes were 75 cm x 50 cm, top and bottom left corner boxes were 75 cm x 50 cm; The top and bottom middle boxes were 150 cm x 50 cm. Left and right middle boxes measures 75 cm x 100 cm, while the middle box was 150 cm x 100 cm. The respective boxes were assigned scores from 1 to 3.

Procedure

On signal the subject came to the position marked for wing shooting and shoots into the goal post. The ball pierce into any one of the boxes and the scorer would award mark. The scoring was awarded to the respective boxes on the assumption that at the time of wing shooting from the right, the 'defender goal keeper' would guard the goal at the extreme left side of the goal post to block the ball. When the shooter shoots the ball from the left the goal keeper came to the right side of the goal post.

Scoring

Each subject would be given 5 trials from right wing and 5 trials from left wing. The total of the 10 trials would be the score of the subject, that is, his wing shooting performance.

3.14 COLLECTION OF DATA

Circuit training, interval training and stair case training were given as per the training schedule of 12 weeks. The pre and post test data on the selected dependent variables were collected by administering the tests as per the standardised procedures before and after the 12 weeks of the training programme.

3.15 STATISTICAL TECHNIQUES

The following statistical techniques were used to find out the effects of varied capsules of fitness training such as circuit training, interval training and stair case training on selected physical, physiological, psychological and skill variables among college level men handball players.

Analysis of covariance (ANCOVA) statistical technique was used to test the adjusted post test mean differences among the experimental groups. If the adjusted post test result was significant, the Scheffe's post-hoc test was used to determine the significance of the paired mean differences (Thirumalaisamy R., 1997).

CHAPTER IV

RESULTS AND DISCUSSIONS

4.1 OVER VIEW

This chapter deals with analysis of data, discussion on findings and discussion on hypotheses. The subjects for this study were selected at random but the groups were not equated in relation to the factors have been examined. Hence, the differences among the means of the four groups in pre test had to be taken into account during the analysis of the post test differences among the means. This was achieved by the application of Analysis of Covariance, where the final means were adjusted for differences in the initial means and the adjusted means were tested for significance. When the post test means were significant, Scheffe's Post-hoc test was used to find out the paired mean significant differences.

4.2 TEST OF SIGNIFICANCE

This is the crucial portion of the dissertation in arriving at the conclusion by examining the hypotheses. The procedure of testing the hypothesis in accordance with the results obtained in relation to the level of confidence which was fixed at 0.05 level was considered necessary for this study.

These tests are usually called the tests of significance to determine whether the difference between the pre test and post test scores of the samples are significant or not. In the present study, if the obtained F-ratio was greater than the table F-ratio at 0.05 level, the hypothesis was accepted to the effect that there existed significant difference between the means of groups compare and if the obtained F-ratio was

lesser than the table F-ratio at 0.05 level, the hypothesis was rejected to the effect that there existed no significant difference between the means of groups compared on this study.

4.2.1 Level of Significance

The probability level below which we reject the hypothesis is termed as the level of significance. The F-ratio obtained by analysis of variance and analysis of covariance needed for significant at 0.05 level. In addition to that the significant difference between the paired adjusted means were tested by computing the confidence interval value, utilizing the Scheffe's Post-hoc test, in which the obtained mean difference value needed to be greater than the Scheffe's confidence interval value for significance.

4.3 COMPUTATION OF ANALYSIS OF COVARIANCE AND POST HOC TEST

The following tables illustrated the statistical results of the effect varied capsules of fitness training namely circuit, interval and stair case training on selected physical, physiological, psychological and skill variables among college level handball players and the ordered adjusted means and the differences between means of the groups under study.

To facilitate the statistical analysis, the following short forms were used.

CTG - Circuit Training Group ITG - Interval Training Group

SCTG - Stair Case Training Group CG - Control Group

Table V

COMPUTATION OF ANALYSIS OF COVARIANCE OF SPEED

	CTG	ITG	SCTG	CG	Sources of Variance	Sum of Squares	df	Mean squares	Obtained F-ratio
Pre – test Mean	7.26	7.21	7.19	7.31	Between Within	0.16 7.69	3 76	0.05 0.10	0.53
Post – test Mean	7.05	7.06	7.04	7.34	Between Within	1.24 4.99	3 76	0.41 0.07	6.30*
Adjusted post – test Mean	7.03	7.09	7.08	7.29	Between Within	0.77 0.80	3 75	0.26 0.01	24.31*

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73,
3 and 76(df) =2.72.
*Significant

The obtained F value on the scores of pre-test means of 0.53 was lesser than the required table F value of 2.72, the obtained F value on the scores of post-test means of 6.30 was greater than the required table F value of 2.72 and the obtained F value of adjusted post-test means of 24.31 was greater than the required table F value of 2.73. Hence, there was no significant difference between pre-test means and there were significant differences between post-test and adjusted post-test means at 0.05 level.

Since significant improvements were recorded, Scheffe's Post-hoc Test was used to find the paired mean differences.

Table V.a

COMPUTATION OF ANALYSIS OF SCHEFFE'S POST-HOC TEST OF SPEED

CTG	ITG	SCTG	CG	Mean Difference (MD)	C.I. Value
7.03	7.09			0.06	0.09
7.03		7.08		0.05	
7.03			7.29	0.26*	
	7.09	7.08		0.01	
	7.09		7.29	0.20*	
		7.08	7.29	0.21*	

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73.
*Significant at 0.05 level.

The adjusted post-test mean differences of 0.26, 0.20, and 0.21 were greater than the required confidence interval value of 0.09 and these comparisons were significant at 0.05 level. Circuit training had remarkable improvement on speed among college handball players than other groups.

The pre-test, post-test and adjusted post-test means of speed are presented through a bar diagram for better understanding of the results of this study in figure 1.

Figure 1

Bar Diagram on Pre-test, Post-test and Adjusted Post-test Means of Speed

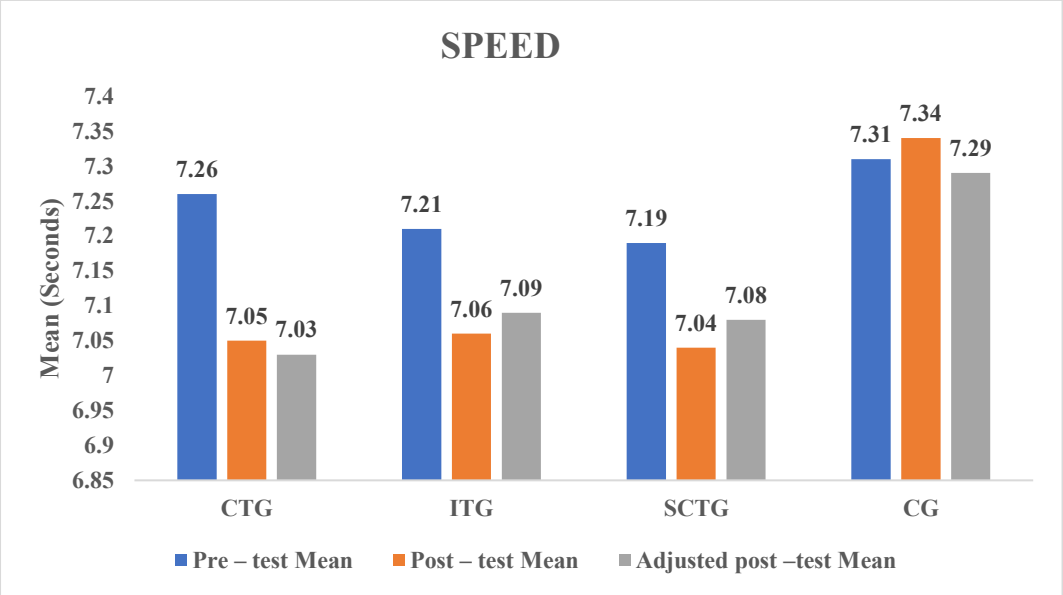


Table VI

COMPUTATION OF ANALYSIS OF COVARIANCE OF ABDOMINAL STRENGTH

	CTG	ITG	SCTG	CG	Sources of Variance	Sum of Squares	df	Mean squares	Obtained F-ratio
Pre – test Mean	34.90	35.15	36.30	38.50	Between Within	161.84 3083.55	3 76	53.95 40.57	1.33
Post – test Mean	37.25	37.50	40.35	38.55	Between Within	119.14 2216.25	3 76	39.71 29.16	2.91*
Adjusted post – test Mean	38.35	38.39	40.28	36.63	Between Within	131.48 38.45	3 75	43.83 0.51	85.49*

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73, 3 and 76(df) =2.72.

*Significant

The obtained F value on the scores of pre-test means of 1.33 was lesser than the required table F value of 2.72, the obtained F value on the scores of post-test means of 2.91 was greater than the required table F value of 2.72 and the obtained F value of adjusted post-test means of 85.49 was greater than the required table F value of 2.73. Hence, there was no significant difference between pre-test means and there were significant differences between post-test and adjusted post-test means at 0.05 level.

Since significant improvements were recorded, Scheffe's Post-hoc Test was used to find the paired mean differences.

Table VI.a

COMPUTATION OF ANALYSIS OF SCHEFFE'S POST-HOC TEST OF ABDOMINAL STRENGTH

CTG	ITG	SCTG	CG	Mean Difference (MD)	C.I. Value
38.35	38.39			0.04	0.65
38.35		40.28		1.92*	
38.35			36.63	1.73*	
	38.39	40.28		1.88*	
	38.39		36.63	1.77*	
		40.28	36.63	3.65*	

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73.
*Significant at 0.05 level.

The adjusted post-test mean differences of 1.92, 1.73,1.88, 1.77 and 3.65 were greater than the required confidence interval value of 0.65 and these comparisons were significant at 0.05 level. Stair case training had remarkable improvement on abdominal strength among college handball players than other groups.

The pre-test, post-test and adjusted post-test means of abdominal strength are presented through a bar diagram for better understanding of the results of this study in figure 2.

Figure 2

Bar Diagram on Pre-Test, Post-Means and Adjusted Post-Means of Abdominal Strength

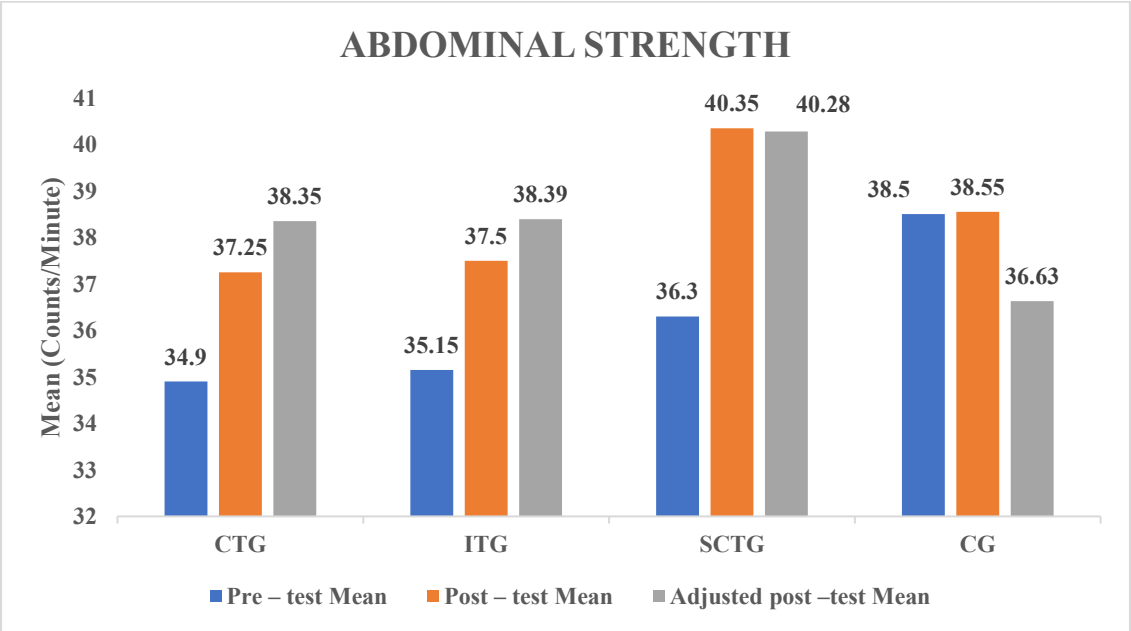


Table VII

COMPUTATION OF ANALYSIS OF COVARIANCE OF FLEXIBILITY

	CTG	ITG	SCTG	CG	Sources of Variance	Sum of Squares	df	Mean squares	Obtained F-ratio
Pre – test Mean	12.65	13.00	13.40	13.10	Between Within	5.74 343.15	3 76	1.91 4.52	0.42
Post – test Mean	14.80	14.65	15.20	13.65	Between Within	26.05 301.50	3 76	8.68 3.97	2.19
Adjusted post – test Mean	15.13	14.68	14.89	13.60	Between Within	27.45 56.92	3 75	9.15 0.76	12.06*

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73, 3 and 76(df) =2.72.
*Significant

The obtained F value on the scores of pre-test means of 0.42 was lesser than the required table F value of 2.72, the obtained F value on the scores of post-test means of 2.19 was greater than the required table F value of 2.72 and the obtained F value of adjusted post-test means of 12.06 was greater than the required table F value of 2.73. Hence, there was no significant difference between pre-test means and there were significant differences between post-test and adjusted post-test means at 0.05 level.

Since significant improvements were recorded, Scheffe's Post-hoc Test was used to find the paired mean differences.

Table VII.a

COMPUTATION OF ANALYSIS OF SCHEFFE'S POST-HOC TEST OF FLEXIBILITY

CTG	ITG	SCTG	CG	Mean Difference (MD)	C.I. Value
15.13	14.68			0.45	0.79
15.13		14.89		0.23	
15.13			13.60	1.53*	
	14.68	14.89		0.21	
	14.68		13.60	1.08*	
		14.89	13.60	1.30*	

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73.
*Significant at 0.05 level.

The adjusted post-test mean differences of 1.53, 1.08, and 1.30 were greater than the required confidence interval value of 0.79 and these comparisons were significant at 0.05 level. Circuit training had remarkable improvement on flexibility among college handball players than other groups.

The pre-test, post-test and adjusted post-test means of flexibility are presented through a bar diagram for better understanding of the results of this study in figure 3.

Figure 3

Bar Diagram on Pre-test, Post-test and Adjusted Post-test Means of Flexibility

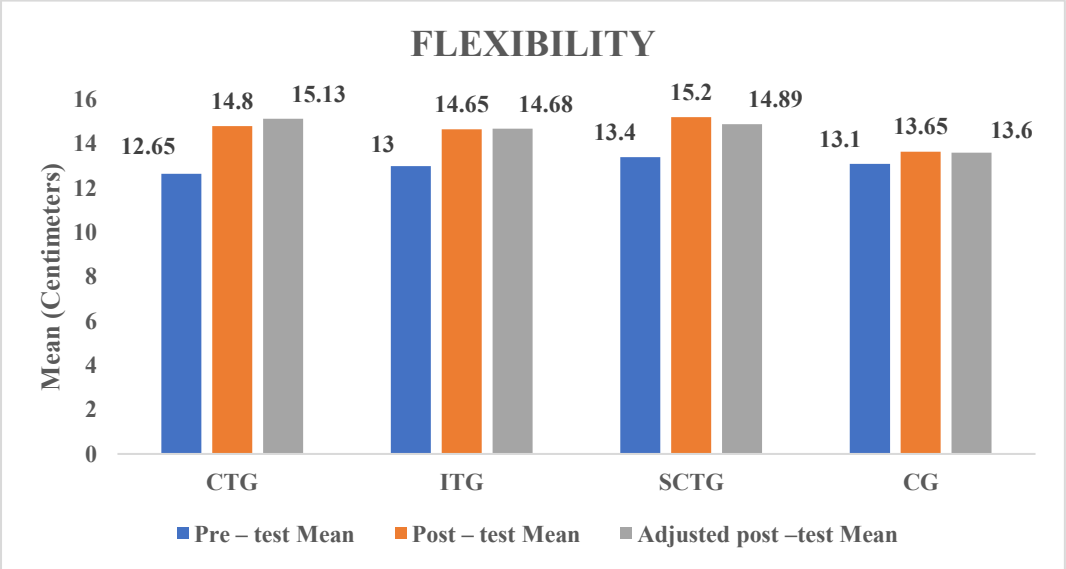


Table VIII

COMPUTATION OF ANALYSIS OF COVARIANCE OF CARDIOVASCULAR ENDURANCE

	CTG	ITG	SCTG	CG	Sources of Variance	Sum of Squares	df	Mean squares	Obtained F-ratio
Pre – test Mean	3240.00	3264.50	3259.50	3304.00	Between Within	43210.00 1127220.00	3 76	14403.33 14831.84	0.97
Post – test Mean	3468.50	3380.00	3437.00	3325.00	Between Within	241173.75 1971175.00	3 76	80391.25 25936.51	3.10*
Adjusted post – test Mean	3493.32	3382.30	3443.89	3290.99	Between Within	440108.79 1018700.53	3 75	146702.93 13582.67	10.80*

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73, 3 and 76(df) =2.72.

*Significant

The obtained F value on the scores of pre-test means of 0.97 was lesser than the required table F value of 2.72, the obtained F value on the scores of post-test means of 3.10 was greater than the required table F value of 2.72 and the obtained F value of adjusted post-test means of 10.80 was greater than the required table F value of 2.73. Hence, there was no significant difference between pre-test means and there were significant differences between post-test and adjusted post-test means at 0.05 level.

Since significant improvements were recorded, Scheffe's Post-hoc Test was used to find the paired mean differences.

Table VIII.a

COMPUTATION OF ANALYSIS OF SCHEFFE'S POST-HOC TEST OF CARDIOVASCULAR ENDURANCE

CTG	ITG	SCTG	CG	Mean Difference (MD)	C.I. Value
3493.32	3382.30			111.02*	
3493.32		3443.89		49.42	
3493.32			3290.99	202.33*	105.28
	3382.30	3443.89		61.60	
	3382.30		3290.99	91.31	
		3443.89	3290.99	152.91*	

The adjusted post-test mean differences of 111.02, 202.33, and 152.91 were greater than the required confidence interval value of 105.28 and these comparisons were significant at 0.05 level. Circuit training had remarkable improvement on cardiovascular endurance among college handball players than other groups.

The pre-test, post-test and adjusted post-test means of cardiovascular endurance are presented through a bar diagram for better understanding of the results of this study in figure 4.

Figure 4

Bar Diagram on Pre-test, Post-test and Adjusted Post-test Means of Cardiovascular Endurance

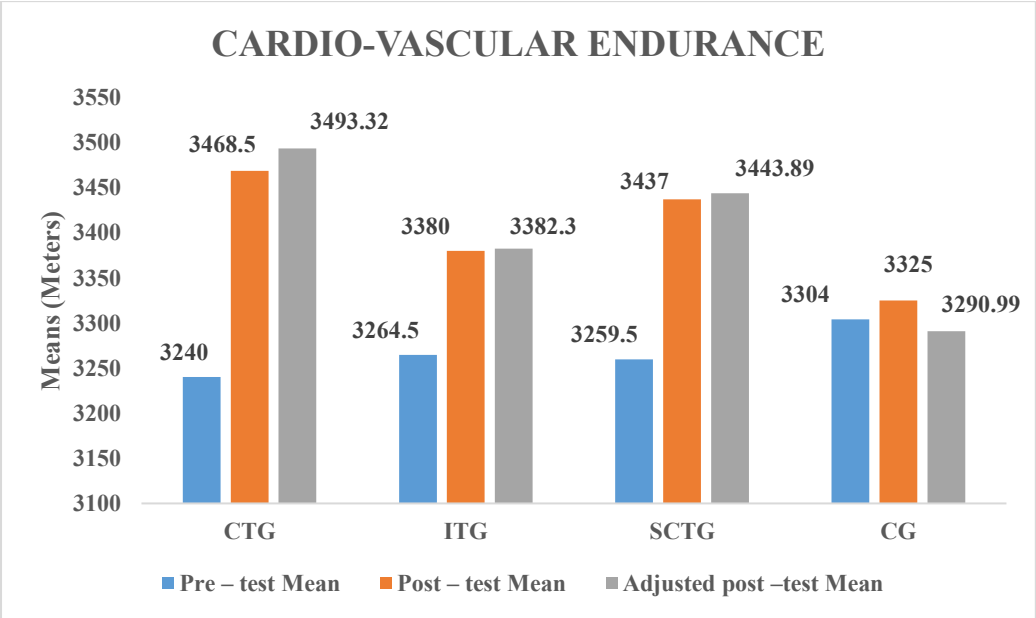


Table IX

COMPUTATION OF ANALYSIS OF COVARIANCE OF VITAL CAPACITY

	CTG	ITG	SCTG	CG	Sources of Variance	Sum of Squares	df	Mean squares	Obtained F-ratio
Pre – test Mean	3497.50	3555.00	3750.00	3612.50	Between Within	702625.00 18711250.00	3 76	234208.33 246200.66	0.95
Post – test Mean	3697.50	3707.50	3837.50	3660.00	Between Within	358843.75 16167375.00	3 76	119614.58 212728.62	3.56*
Adjusted post – test Mean	3792.25	3750.97	3707.08	3652.20	Between Within	213519.26 1288532.65	3 75	71173.09 17180.44	4.14*

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73,
3 and 76(df) =2.72.
*Significant

The obtained F value on the scores of pre-test means of 0.95 was lesser than the required table F value of 2.72, the obtained F value on the scores of post-test means of 3.56 was greater than the required table F value of 2.72 and the obtained F value of adjusted post-test means of 4.14 was greater than the required table F value of 2.73. Hence, there was no significant difference between pre-test means and there were significant differences between post-test and adjusted post-test means at 0.05 level.

Since significant improvements were recorded, Scheffe's Post-hoc Test was used to find the paired mean differences.

Table IX. a

COMPUTATION OF ANALYSIS OF SCHEFFE'S POST-HOC TEST OF VITAL CAPACITY

CTG	ITG	SCTG	CG	Mean Difference (MD)	C.I. Value
3792.25	3750.97			41.27	118.40
3792.25		3707.08		85.16	
3792.25			3652.20	140.05*	
	3750.97	3707.08		43.89	
	3750.97		3652.20	98.77	
		3707.08	3652.20	54.89	

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73.
*Significant at 0.05 level.

The adjusted post-test mean difference of 140.05 was greater than the required confidence interval value of 118.40 and this comparison was significant at 0.05 level. Circuit training had remarkable improvement on vital capacity among college handball players than other groups.

The pre-test, post-test and adjusted post-test means of vital capacity are presented through a bar diagram for better understanding of the results of this study in figure 5.

Figure 5

Bar Diagram on Pre-test, Post-test and Adjusted Post-test Means of Vital Capacity

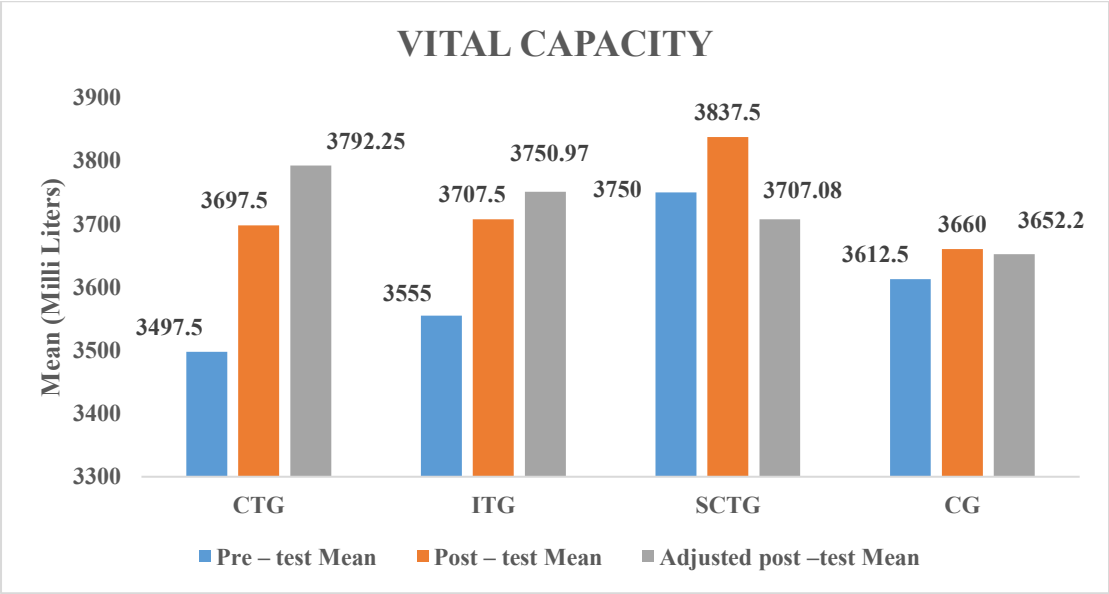


Table X

COMPUTATION OF ANALYSIS OF COVARIANCE OF BREATH HOLDING TIME

	CTG	ITG	SCTG	CG	Sources of Variance	Sum of Squares	df	Mean squares	Obtained F-ratio
Pre – test Mean	41.25	40.60	40.95	42.15	Between Within	26.44 4324.05	3 76	8.81 56.90	0.15
Post – test Mean	49.55	48.80	49.45	41.20	Between Within	982.70 3958.30	3 76	327.57 52.08	6.29*
Adjusted post – test Mean	49.54	49.37	49.71	40.38	Between Within	1253.28 468.67	3 75	417.76 6.25	66.85*

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73,

3 and 76(df) =2.72.

*Significant

The obtained F value on the scores of pre-test means of 0.15 was lesser than the required table F value of 2.72, the obtained F value on the scores of post-test means of 6.29 was greater than the required table F value of 2.72 and the obtained F value of adjusted post-test means of 66.85 was greater than the required table F value of 2.73. Hence, there was no significant difference between pre-test means and there were significant differences between post-test and adjusted post-test means at 0.05 level.

Since significant improvements were recorded, Scheffe's Post-hoc Test was used to find the paired mean differences.

Table X.a

COMPUTATION OF ANALYSIS OF SCHEFFE'S POST-HOC TEST OF BREATH HOLDING TIME

CTG	ITG	SCTG	CG	Mean Difference (MD)	C.I. Value
49.54	49.37			0.17	2.26
49.54		49.71		-0.17	
49.54			40.38	9.16*	
	49.37	49.71		-0.34	
	49.37		40.38	8.99*	
		49.71	40.38	9.33*	

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73.

*Significant at 0.05 level.

The adjusted post-test mean differences of 9.16, 8.99, and 9.33 were greater than the required confidence interval value of 2.26 and these comparisons were significant at 0.05 level. Stair case training had remarkable improvement on breath holding time among college handball players than other groups.

The pre-test, post-test and adjusted post-test means of breath holding time are presented through a bar diagram for better understanding of the results of this study in figure 6.

Figure 6

Bar Diagram on Pre-test, Post-test and Adjusted Post-test Means of Breath Holding Time

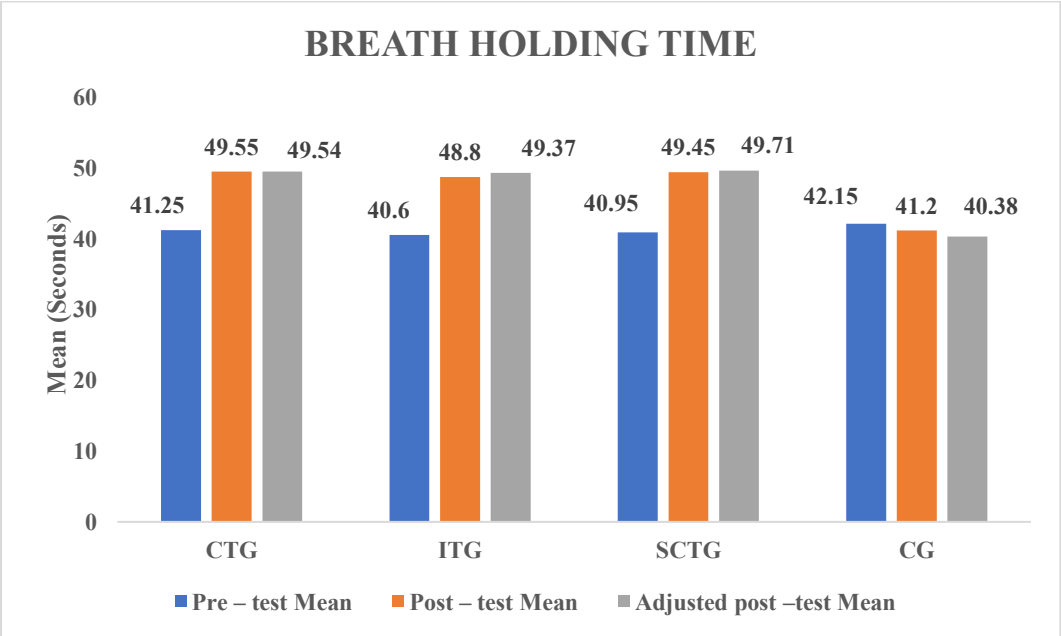


Table XI

COMPUTATION OF ANALYSIS OF COVARIANCE OF ACHIEVEMENT MOTIVATION

	CTG	ITG	SCTG	CG	Sources of Variance	Sum of Squares	df	Mean squares	Obtained F-ratio
Pre – test Mean	23.50	24.40	22.70	23.30	Between Within	29.75 1968.20	3 76	9.92 25.90	0.38
Post – test Mean	27	27.20	25.10	23.60	Between Within	169.20 1799.60	3 76	56.40 23.68	2.99*
Adjusted post – test Mean	26.88	26.33	25.83	23.76	Between Within	110.87 74.96	3 75	36.96 1.00	36.98*

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73, 3 and 76(df) =2.72.
*Significant

The obtained F value on the scores of pre-test means of 0.38 was lesser than the required table F value of 2.72, the obtained F value on the scores of post-test means of 2.99 was greater than the required table F value of 2.72 and the obtained F value of adjusted post-test means of 36.98 was greater than the required table F value of 2.73. Hence, there was no significant difference between pre-test means and there were significant differences between post-test and adjusted post-test means at 0.05 level.

Since significant improvements were recorded, Scheffe's Post-hoc Test was used to find the paired mean differences.

Table XI.a

COMPUTATION OF ANALYSIS OF SCHEFFE'S POST-HOC TEST OF ACHIEVEMENT MOTIVATION

CTG	ITG	SCTG	CG	Mean Difference (MD)	C.I. Value
26.88	26.33			0.54	0.90
26.88		25.83		1.05*	
26.88			23.76	3.11*	
	26.33	25.83		0.51	
	26.33		23.76	2.57*	
		25.83	23.76	2.06*	

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73.
*Significant at 0.05 level.

The adjusted post-test mean differences of 1.05, 3.11, 2.57 and 2.06 were greater than the required confidence interval value of 0.90 and these comparisons were significant at 0.05 level. Circuit training had remarkable improvement on achievement motivation among college handball players than other groups.

The pre-test, post-test and adjusted post-test means of achievement motivation are presented through a bar diagram for better understanding of the results of this study in figure 7.

Figure 7

Bar Diagram on Pre-test, Post-test and Adjusted Post-test Means of Achievement Motivation

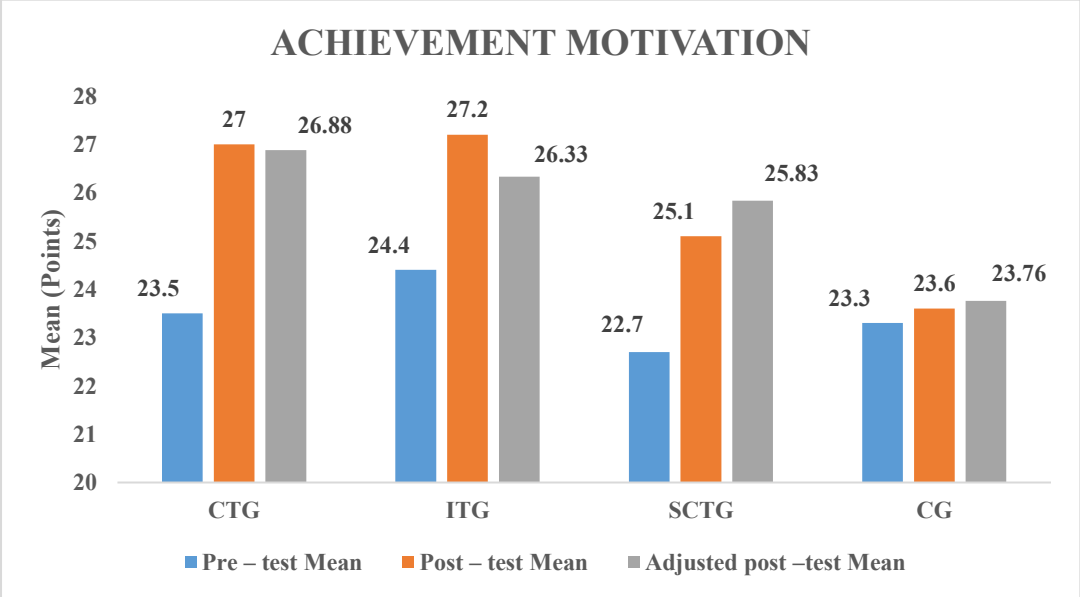


Table XII

COMPUTATION OF ANALYSIS OF COVARIANCE OF SELF-CONFIDENCE

	CTG	ITG	SCTG	CG	Sources of Variance	Sum of Squares	df	Mean squares	Obtained F-ratio
Pre – test Mean	45.00	44.40	44.35	46.25	Between Within	46.90 3923.10	3 76	15.63 51.62	0.30
Post – test Mean	54.10	53.00	54.80	45.50	Between Within	1108.20 3294.00	3 76	369.40 43.34	8.52*
Adjusted post – test Mean	54.10	53.51	55.36	44.43	Between Within	1488.60 407.88	3 75	496.20 5.44	91.24*

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73, 3 and 76(df) =2.72.

*Significant

The obtained F value on the scores of pre-test means of 0.30 was lesser than the required table F value of 2.72, the obtained F value on the scores of post-test means of 8.52 was greater than the required table F value of 2.72 and the obtained F value of adjusted post-test means of 91.24 was greater than the required table F value of 2.73. Hence, there was no significant difference between pre-test means and there were significant differences between post-test and adjusted post-test means at 0.05 level.

Since significant improvements were recorded, Scheffe's Post-hoc Test was used to find the paired mean differences.

Table XII.a

COMPUTATION OF ANALYSIS OF SCHEFFE'S POST-HOC TEST OF SELF-CONFIDENCE

CTG	ITG	SCTG	CG	Mean Difference (MD)	C.I. Value
54.10	53.51			0.59	2.11
54.10		55.36		1.26	
54.10			44.43	9.67*	
	53.51	55.36		1.84	
	53.51		44.43	9.09*	
		55.36	44.43	10.93*	

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73.
*Significant at 0.05 level.

The adjusted post-test mean differences of 9.67, 9.09, and 10.93 were greater than the required confidence interval value of 2.11 and these comparisons were

significant at 0.05 level. Stair case training had remarkable improvement on self confidence among college handball players than other groups.

The pre-test, post-test and adjusted post-test means of self-confidence are presented through a bar diagram for better understanding of the results of this study in figure 8.

Figure 8

Bar Diagram on Pre-test, Post-test and Adjusted Post-test Means of Self-Confidence

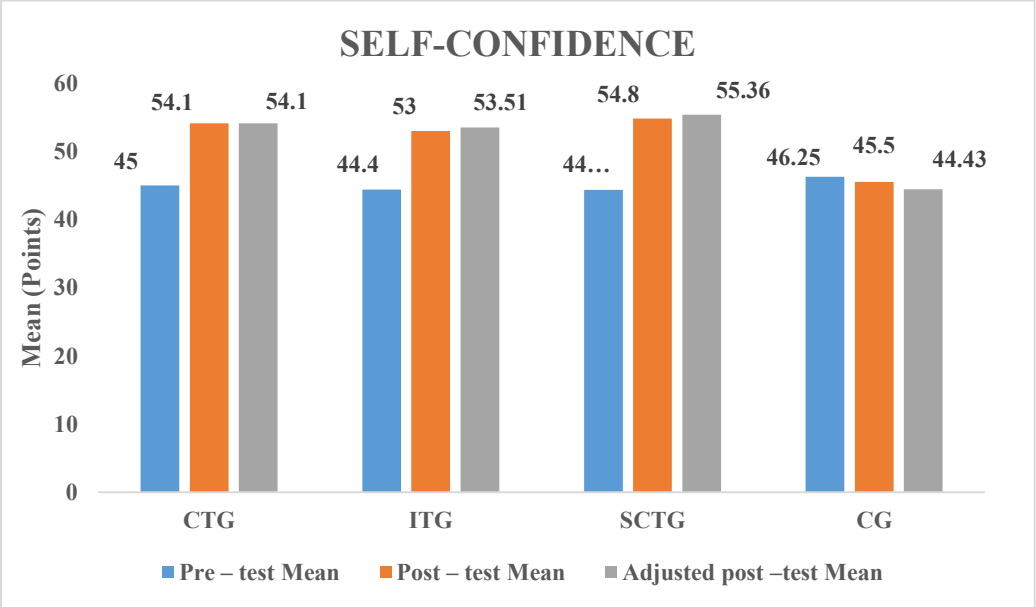


Table XIII

COMPUTATION OF ANALYSIS OF COVARIANCE OF ANXIETY

	CTG	ITG	SCTG	CG	Sources of Variance	Sum of Squares	df	Mean squares	Obtained F-ratio
Pre – test Mean	58.70	61.05	59.70	59.95	Between Within	55.90 1892.30	3 76	18.63 24.90	0.75
Post – test Mean	54.65	53.05	56.30	59.55	Between Within	463.34 1764.65	3 76	154.45 23.22	6.65*
Adjusted post – test Mean	55.58	52.07	56.42	59.47	Between Within	551.62 514.29	3 75	183.87 6.86	26.81*

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73,
3 and 76(df) =2.72.
*Significant

The obtained F value on the scores of pre-test means of 0.75 was lesser than the required table F value of 2.72, the obtained F value on the scores of post-test means of 6.65 was greater than the required table F value of 2.72 and the obtained F value of adjusted post-test means of 26.81 was greater than the required table F value of 2.73. Hence, there was no significant difference between pre-test means and there were significant differences between post-test and adjusted post-test means at 0.05 level.

Since significant improvements were recorded, Scheffe's Post-hoc Test was used to find the paired mean differences.

Table XIII.a

COMPUTATION OF ANALYSIS OF SCHEFFE'S POST-HOC TEST OF ANXIETY

CTG	ITG	SCTG	CG	Mean Difference (MD)	C.I. Value
55.58	52.07			3.51*	2.37
55.58		56.42		0.84	
55.58			59.47	3.88*	
	52.07	56.42		4.35*	
	52.07		59.47	7.39*	
		56.42	59.47	3.05*	

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73.
*Significant at 0.05 level.

The adjusted post-test mean differences of 3.51, 3.88, 4.35, 7.39 and 3.05 were greater than the required confidence interval value of 2.37 and these comparisons were significant at 0.05 level. Interval training had remarkable improvement on anxiety among college handball players than other groups.

The pre-test, post-test and adjusted post-test means of anxiety are presented through a bar diagram for better understanding of the results of this study in figure 9.

Figure 9

Bar Diagram on Pre-test, Post-test and Adjusted Post-test Means of Anxiety

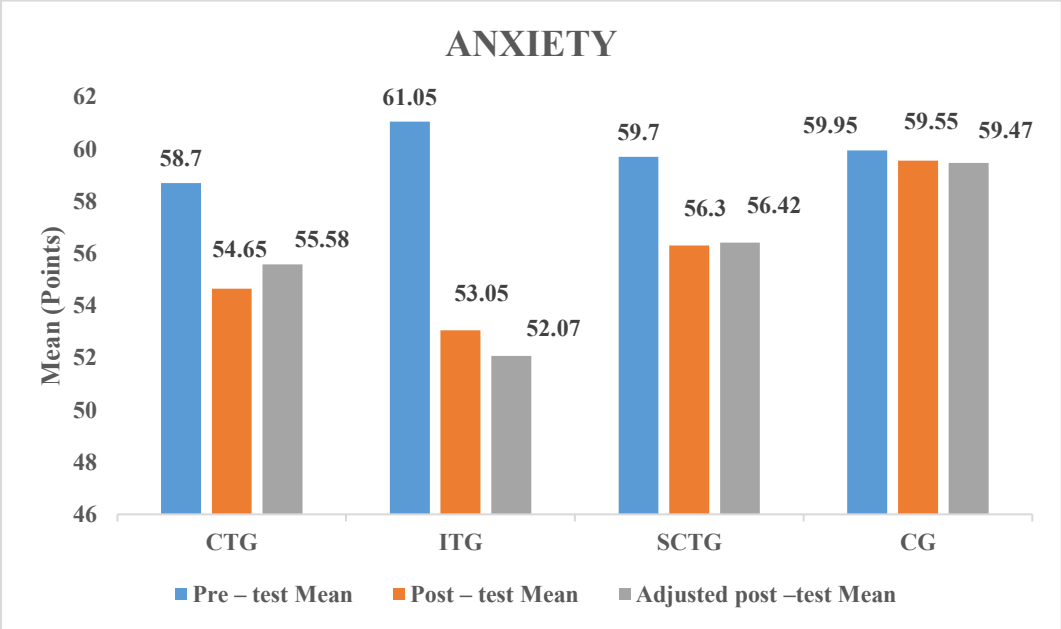


Table XIV

COMPUTATION OF ANALYSIS OF COVARIANCE OF DRIBBLING

	CTG	ITG	SCTG	CG	Sources of Variance	Sum of Squares	df	Mean squares	Obtained F-ratio
Pre – test Mean	9.10	9.40	9.35	9.10	Between Within	1.54 128.95	3 76	0.51 1.70	0.30
Post – test Mean	10.80	11.00	11.45	9.40	Between Within	46.94 140.95	3 76	15.65 1.85	8.44*
Adjusted post – test Mean	10.91	10.87	11.36	9.51	Between Within	37.97 53.07	3 75	12.66 0.71	17.89*

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73,
3 and 76(df) =2.72.
*Significant

The obtained F value on the scores of pre-test means of 0.30 was lesser than the required table F value of 2.72, the obtained F value on the scores of post-test means of 8.44 was greater than the required table F value of 2.72 and the obtained F value of adjusted post-test means of 17.89 was greater than the required table F value of 2.73. Hence, there was no significant difference between pre-test means and there were significant differences between post-test and adjusted post-test means at 0.05 level.

Since significant improvements were recorded, Scheffe's Post-hoc Test was used to find the paired mean differences.

Table XIV.a

COMPUTATION OF ANALYSIS OF SCHEFFE'S POST-HOC TEST OF DRIBBLING

CTG	ITG	SCTG	CG	Mean Difference (MD)	C.I. Value
10.91	10.87			0.05	0.76
10.91		11.36		0.44	
10.91			9.51	1.40*	
	10.87	11.36		0.49	
	10.87		9.51	1.35*	
		11.36	9.51	1.84*	

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73.
*Significant at 0.05 level.

The adjusted post-test mean differences of 1.40, 1.35, and 1.84 were greater than the required confidence interval value of 0.76 and these comparisons were

significant at 0.05 level. Stair case training had remarkable improvement on dribbling among college handball players than other groups.

The pre-test, post-test and adjusted post-test means of dribbling are presented through a bar diagram for better understanding of the results of this study in figure 10.

Figure 10

Bar Diagram on Pre-test, Post-test and Adjusted Post-test Means of Dribbling

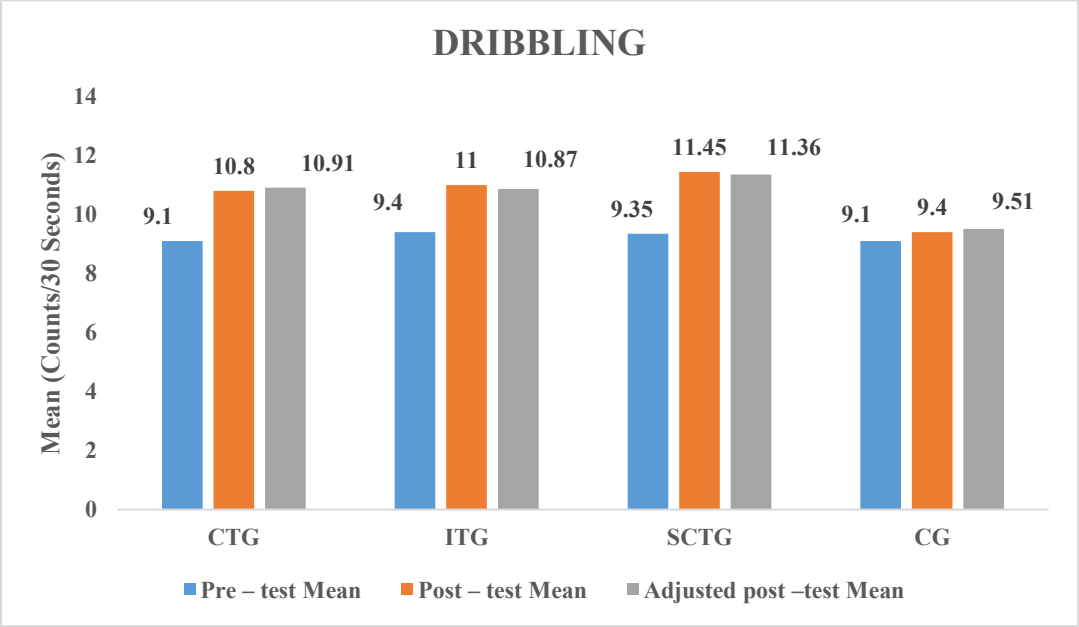


Table XV

COMPUTATION OF ANALYSIS OF COVARIANCE OF SHOOTING (7 METERS THROW)

	CTG	ITG	SCTG	CG	Sources of Variance	Sum of Squares	df	Mean squares	Obtained F-ratio
Pre – test Mean	18.45	17.50	17.85	18.30	Between Within	11.25 960.70	3 76	3.75 12.64	0.30
Post – test Mean	21.45	20.20	20.35	18.65	Between Within	79.64 989.25	3 76	26.55 13.02	2.97*
Adjusted post – test Mean	21.04	20.70	20.52	18.39	Between Within	86.93 100.36	3 75	28.98 1.34	21.66*

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73,
3 and 76(df) =2.72.
*Significant

The obtained F value on the scores of pre-test means of 0.30 was lesser than the required table F value of 2.72, the obtained F value on the scores of post-test means of 2.97 was greater than the required table F value of 2.72 and the obtained F value of adjusted post-test means of 21.66 was greater than the required table F value of 2.73. Hence, there was no significant difference between pre-test means and there were significant differences between post-test and adjusted post-test means at 0.05 level.

Since significant improvements were recorded, Scheffe's Post-hoc Test was used to find the paired mean differences.

Table XV.a

COMPUTATION OF ANALYSIS OF SCHEFFE'S POST-HOC TEST OF SHOOTING (7 METERS THROW)

CTG	ITG	SCTG	CG	Mean Difference (MD)	C.I. Value
21.04	20.70			0.34	1.04
21.04		20.52		0.52	
21.04			18.39	2.66*	
	20.70	20.52		0.19	
	20.70		18.39	2.32*	
		20.52	18.39	2.13*	

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73.
*Significant at 0.05 level.

The adjusted post-test mean differences of 2.66, 2.32, and 2.13 were greater than the required confidence interval value of 1.04 and these comparisons were significant at 1.04 level. Circuit training had remarkable improvement on shooting among college handball players than other groups.

The pre-test, post-test and adjusted post-test means of shooting are presented through a bar diagram for better understanding of the results of this study in figure 11.

Figure 11

Bar Diagram on Pre-test, Post-test and Adjusted Post-test Means of Shooting

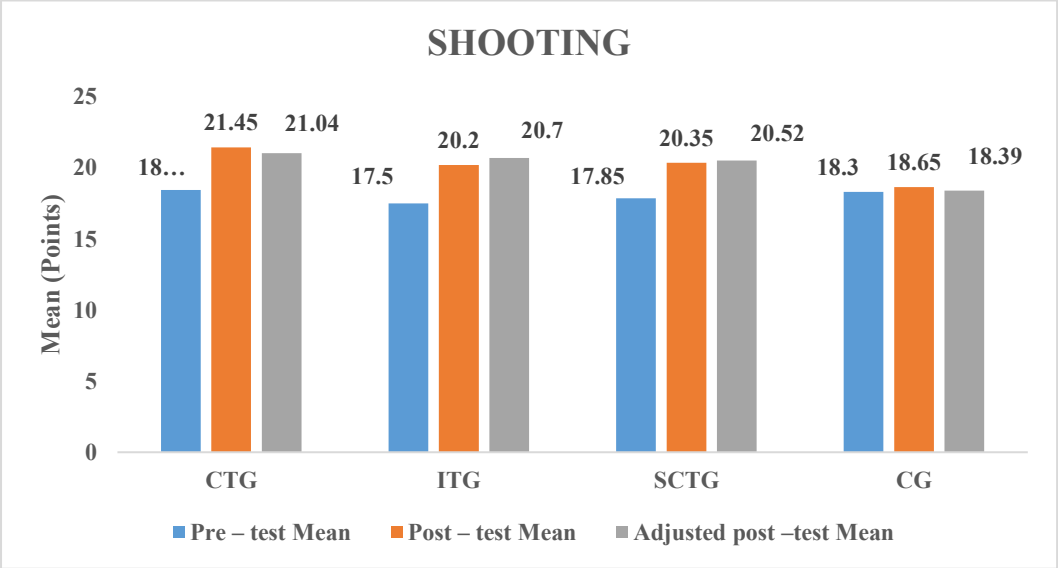


Table XVI

COMPUTATION OF ANALYSIS OF COVARIANCE OF WING SHOT SHOOTING

	CTG	ITG	SCTG	CG	Sources of Variance	Sum of Squares	df	Mean squares	Obtained F-ratio
Pre – test Mean	9.50	10.06	9.91	9.59	Between Within	4.10 135.18	3 76	1.37 1.78	0.77
Post – test Mean	11.18	11.26	11.88	9.90	Between Within	41.77 131.05	3 76	13.92 1.72	8.07*
Adjusted post – test Mean	11.35	11.07	11.78	10.01	Between Within	34.01 70.36	3 75	11.34 0.94	12.09*

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73, 3 and 76(df) =2.72.

*Significant

The obtained F value on the scores of pre-test means of 0.77 was lesser than the required table F value of 2.72, the obtained F value on the scores of post-test means of 8.07 was greater than the required table F value of 2.72 and the obtained F value of adjusted post-test means of 12.09 was greater than the required table F value of 2.73. Hence, there was no significant difference between pre-test means and there were significant differences between post-test and adjusted post-test means at 0.05 level.

Since significant improvements were recorded, Scheffe's Post-hoc Test was used to find the paired mean differences.

Table XVI. a

COMPUTATION OF ANALYSIS OF SCHEFFE'S POST-HOC TEST OF WING SHOT SHOOTING

CTG	ITG	SCTG	CG	Mean Difference (MD)	C.I. Value
11.35	11.07			0.28	0.87
11.35		11.78		0.43	
11.35			10.01	1.34*	
	11.07	11.78		0.72	
	11.07		10.01	1.06*	
		11.78	10.01	1.77*	

Table F ratio at 0.05 level of confidence for 3 and 75 (df) = 2.73.
*Significant at 0.05 level.

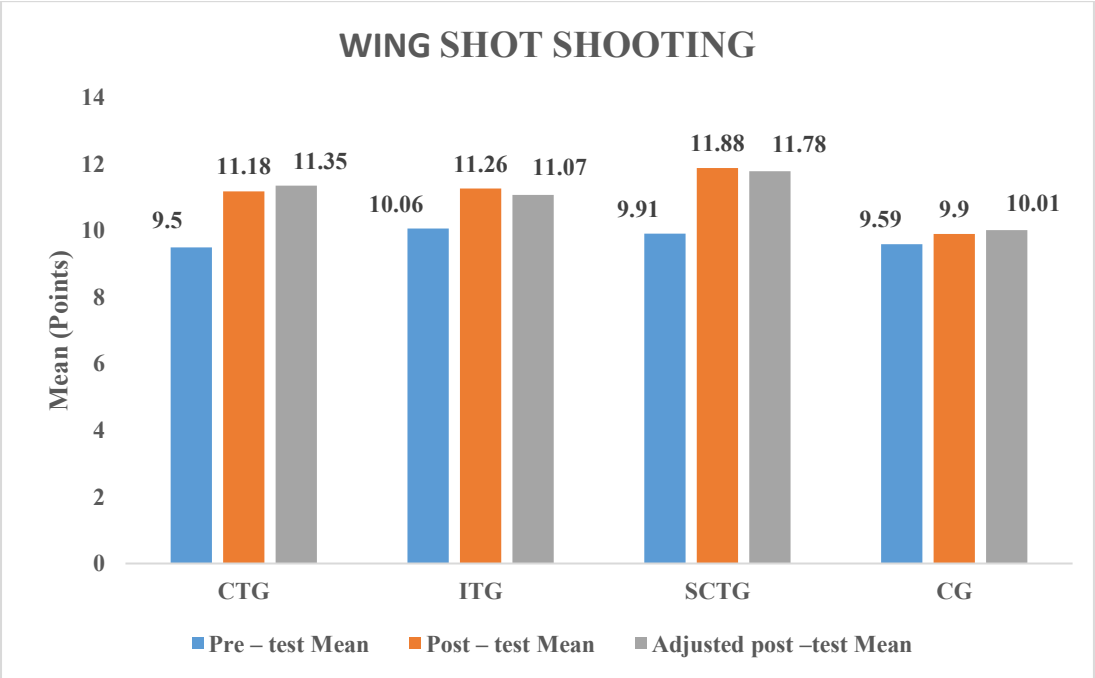
The adjusted post-test mean differences of 1.34, 1.06, and 1.77 were greater than the required confidence interval value of 0.87 and these comparisons were

significant at 0.05 level. Stair case training had remarkable improvement on wing shot shooting among college handball players than other groups.

The pre-test, post-test and adjusted post-test means of wing shot shooting are presented through a bar diagram for better understanding of the results of this study in figure 12.

Figure 12

Bar Diagram on Pre-test, Post-test and Adjusted Post-test Means of Wing Shot Shooting



4.4 DISCUSSION ON HYPOTHESES

1. The first hypothesis was stated that 12 weeks of varied capsules of fitness training namely circuit training, interval training and stair case training would significantly improve the selected physical variables namely speed, abdominal strength, flexibility and cardiovascular endurance and physiological variables namely vital capacity and breath holding time and psychological variables

namely achievement motivation, self-confidence and anxiety and skill performance variables namely dribbling, shooting and wing shot shooting among college level men handball players.

The findings of the study showed that there were significant effects due to the influence of the 12 weeks of circuit training, interval training and stair case training on selected dependent variables such as speed, abdominal strength, flexibility, cardiovascular endurance, vital capacity, breath holding time, achievement motivation, self-confidence, anxiety dribbling, shooting and wing shot shooting. Hence, the first hypothesis was accepted on above said variables.

2. The second hypothesis was stated that 12 weeks of circuit training would significantly improve the selected physical variables namely speed, flexibility and cardiovascular endurance and physiological variables namely vital capacity and breath holding time and psychological variables namely achievement motivation and self-confidence than stair case and interval trainings among college level men handball players.

The findings of the study showed that there were significant effects due to the influence of the 12 weeks of circuit training on selected dependent variables such as speed, flexibility, cardiovascular endurance, vital capacity, breath holding time, achievement motivation and self-confidence. Hence, the second hypothesis was accepted on above said variables.

3. The third hypothesis was stated that 12 weeks of stair case training would significantly improve the selected physical variable namely abdominal strength and psychological variable namely anxiety and skill performance

variables namely dribbling, shooting and wing shot shooting than circuit and interval trainings among college level men handball players.

The findings of the study showed that there were significant effects due to the influence of the 12 weeks of stair case training on selected dependent variables such as abdominal strength, anxiety, dribbling, shooting and wing shot shooting. Hence, the third hypothesis was accepted on above said variables.

4. The fourth hypothesis was stated that 12 weeks of interval training and stair case training would significantly improve the selected physical variables namely speed, abdominal strength, flexibility and cardiovascular endurance and physiological variables namely vital capacity and breath holding time and psychological variables namely achievement motivation, self-confidence and anxiety and skill performance variables namely dribbling, shooting and wing shot shooting than control group among college level men handball players.

The findings of the study showed that there were significant effects due to the influence of the 12 weeks of interval training and stair case training on selected dependent variables such as speed, abdominal strength, flexibility, cardiovascular endurance. vital capacity, breath holding time, achievement motivation, self-confidence, anxiety, dribbling, shooting and wing shot shooting. Hence, the fourth hypothesis was accepted on above said variables.

CHAPTER V

SUMMARY CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY

The purpose of the study was to find out the effect of varied capsules of fitness training namely circuit training, interval training and stair case training on selected physical, physiological, psychological and skill performance variables among college level men handball players. To achieve the purpose of the study, 80 college men handball players were selected as subjects from various colleges of the University of Madras at random and their age was ranged between 18 and 24years. Further, they were divided into four equal groups of 20 subjects each. The groups were assigned as Experimental Group I, II, III and Group IV as control group respectively. Pre tests were conducted for all the 80 subjects on selected physical, physiological, psychological and skill performance variables such as speed, abdominal strength, flexibility, cardiovascular endurance, vital capacity, breath holding time. achievement motivation, self-confidence, anxiety, dribbling, shooting and wing shot shooting. The experimental groups were participated in their respective circuit training, interval training and stair case training for a period of 12 weeks. The control group was not exposed to any special training except their regular game practice. The post tests were conducted on the above said dependent variables after a period of 12 weeks of circuit training, interval training and stair case training. Analysis of Covariance (ANCOVA) statistical technique was used to test to test the adjusted post test mean differences among the experimental groups. If the adjusted post test result was significant, the Scheffe's post-hoc test was used to determine the significance of the paired mean

differences. In all the cases, level of confidence was fixed at 0.05 to test the significance, which was considered as appropriate.

5.2 CONCLUSIONS

Within the limitations of the present study, the following conclusions were drawn.

1 Circuit training, interval training and stair case training significantly improved the selected physical variables such as speed, abdominal strength, flexibility and cardiovascular endurance and physiological variables such as vital capacity and breath holding time and psychological variables such as achievement motivation, self-confidence and anxiety and skill performance variables such as dribbling, shooting and wing shot shooting compared to control group.

2 Circuit training significantly improved the selected physical variables such as speed, flexibility and cardiovascular endurance and physiological variable namely vital capacity and psychological variable namely achievement motivation, self-confidence and anxiety and skill performance variable namely shooting among college level handball players than other trainings.

3 Stair case training significantly improved the selected physical variable namely abdominal strength and physiological variable namely breath holding time and psychological variable namely self-confidence and anxiety and skill performance variables namely dribbling and wing shot shooting compared to other groups.

4 Interval training significantly reduced the selected psychological variable namely anxiety compared to other groups.

5.3 RECOMMENDATIONS

On the basis of the findings and conclusions, the following recommendations were made.

1. The findings of the study confirmed that circuit training, interval training and stair case training significantly improved the selected physical, physiological, psychological and skill performance variables among college level handball players. Hence, professionals in physical education, coaches and trainers in the field of sports can utilize these training programme for better performance of their players.

2. Physical education teachers, coaches and trainers may adopt the circuit training, interval training and stair case training methods to develop the selected physical, physiological and psychological variables.

3. The result of the study would help the handball coaches and players to understand and add the circuit training, interval training and stair case training in their training schedule of fitness and skill development.

5.4 SUGGESTIONS FOR FURTHER RESEARCH

1. There are great scopes for other researchers to carry out similar studies with different physical, physiological, psychological and skill performance variables.

2. Similar studies may be conducted for various games like , hockey, basketball, volleyball, kabaddi and kho-kho.

3. Same training programme may be carried out for more than 12 weeks of training period.

4. Similar studies may be conducted for inter school and state level handball players.

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APPENDIX A

RAW SCORES ON SPEED

S. No.	Circuit Training Group		Interval Training Group		Stair Case Training Group		Control Group	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	7.2	7.2	7.2	7.0	7.5	7.3	7.1	7.1
2	7.7	7.2	7.5	7.3	6.7	6.8	7.3	7.3
3	7.5	7.2	6.9	6.8	6.8	6.7	7.7	7.7
4	6.8	6.9	7.6	7.4	6.9	6.7	7.1	7.2
5	7.2	7.1	6.9	6.7	7.2	7.0	7.5	7.5
6	7.4	6.9	6.8	6.7	7.5	7.3	6.7	6.9
7	6.8	6.8	7.2	7.0	6.7	6.7	7.2	7.2
8	7.6	7.1	7.3	7.1	7.3	7.1	7.7	7.7
9	7.2	7.2	7.2	7.0	7.5	7.3	7.1	7.1
10	7.7	7.2	7.5	7.3	6.7	6.8	7.3	7.3
11	7.5	7.2	6.9	6.8	6.8	6.7	7.7	7.7
12	6.8	6.9	7.6	7.4	6.9	6.7	7.1	7.2
13	7.6	7.1	7.2	7.0	7.5	7.3	7.7	7.7
14	7.2	7.1	7.3	7.1	7.9	7.7	7.1	7.1
15	6.8	6.7	7.7	7.5	7.1	6.9	7.6	7.6
16	7.2	6.8	6.9	6.9	7.2	7.0	7.5	7.6
17	7.4	7.1	6.8	6.8	7.3	7.1	6.7	6.7
18	6.8	6.9	7.3	7.1	7.5	7.3	7.2	7.2
19	7.6	7.3	7.2	7.1	7.3	7.1	7.7	7.8
20	7.2	7.1	7.2	7.1	7.5	7.3	7.1	7.1

APPENDIX B

RAW SCORES ON ABDOMINAL STRENGTH

S. No.	Circuit Training Group		Interval Training Group		Stair Case Training Group		Control Group	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	23	27	36	38	40	44	39	40
2	36	38	35	37	35	39	37	38
3	35	37	40	42	44	46	47	44
4	23	27	40	42	40	44	39	40
5	36	38	46	48	35	39	37	38
6	35	37	23	27	44	46	47	44
7	40	42	36	38	27	33	40	40
8	46	48	35	37	32	37	28	30
9	36	38	40	42	32	37	35	34
10	39	40	46	48	33	38	32	33
11	35	37	36	38	40	43	35	36
12	23	27	39	40	40	44	39	40
13	36	38	35	37	35	39	37	38
14	35	37	23	27	44	46	47	44
15	40	42	36	38	27	33	40	40
16	46	48	23	27	32	37	28	30
17	23	27	36	38	40	44	39	40
18	36	38	35	37	35	39	37	38
19	35	37	40	42	44	46	47	44
20	40	42	23	27	27	33	40	40

APPENDIX C

RAW SCORES ON FLEXIBILITY

S. No.	Circuit Training Group		Interval Training Group		Stair Case Training Group		Control Group	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	11	14	13	15	15	16	13	15
2	9	15	13	14	13	14	19	20
3	15	16	15	16	14	15	13	13
4	15	16	9	12	13	15	7	8
5	13	15	13	14	15	16	13	13
6	11	14	15	16	14	15	15	15
7	12	15	13	15	13	15	13	14
8	13	15	11	12	11	13	15	15
9	13	13	13	15	13	16	9	10
10	15	16	11	13	15	19	13	13
11	11	15	9	11	13	14	19	20
12	15	16	13	14	14	16	13	13
13	15	16	15	16	13	15	7	8
14	13	14	14	16	15	17	13	13
15	11	15	14	15	14	15	15	15
16	12	14	13	15	13	14	13	14
17	13	15	15	17	10	11	15	15
18	13	15	14	16	13	16	9	10
19	11	13	13	15	14	17	15	15
20	12	14	14	16	13	15	13	14

APPENDIX D

RAW SCORES ON CARDIOVASCULAR ENDURANCE

S. No.	Circuit Training Group		Interval Training Group		Stair Case Training Group		Control Group	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	3230	3500	3240	3330	3350	3500	3650	3650
2	3320	3450	3270	3360	3390	3600	3230	3250
3	3240	3550	3250	3460	3210	3420	3320	3320
4	3250	3400	3380	3510	3090	3150	3220	3250
5	3230	3500	3240	3330	3350	3500	3650	3650
6	3320	3450	3270	3360	3390	3600	3230	3250
7	3240	3550	3250	3460	3210	3420	3320	3320
8	3110	3450	3340	3410	3240	3500	3100	3200
9	3165	3450	3260	3510	3220	3400	3110	3110
10	3360	3550	3130	3410	3310	3530	3200	3250
11	3220	3370	3240	3430	3100	3300	3320	3320
12	3250	3400	3270	3510	3090	3150	3220	3250
13	3230	3500	3250	3410	3350	3500	3650	3650
14	3320	3450	3340	3540	3390	3600	3230	3250
15	3240	3550	3130	3310	3210	3420	3320	3320
16	3110	3450	3120	3160	3240	3500	3100	3200
17	3165	3450	3380	3510	3220	3400	3110	3110
18	3250	3400	3420	3610	3090	3150	3220	3250
19	3230	3500	3240	3430	3350	3500	3650	3650
20	3320	3450	3270	2550	3390	3600	3230	3250

APPENDIX E

RAW SCORES ON FORCED VITAL CAPACITY

S. No.	Circuit Training Group		Interval Training Group		Stair Case Training Group		Control Group	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	2850	3050	3450	3650	2850	3050	3850	3750
2	4450	4750	3950	4000	4750	4750	3950	3850
3	3350	3525	2850	3050	3350	3400	3450	3550
4	3150	3350	3350	3525	3850	3950	3350	3350
5	3900	4075	3650	3850	3950	4050	2550	3600
6	3450	3650	3850	4050	4050	4150	3850	3850
7	2950	3125	3950	4150	3750	3800	3950	3950
8	3150	3350	3850	4100	3850	3750	4050	4000
9	3250	3425	3950	4125	3950	4000	3550	3750
10	2850	3050	3450	3650	2850	3050	3850	3750
11	4450	4750	3950	4000	4750	4750	3950	3850
12	3350	3525	2850	3050	3350	3400	3450	3550
13	3650	3850	4750	4750	3450	3550	3150	3150
14	3850	4050	3350	3400	3850	3950	3900	3750
15	3950	4150	3450	3550	4150	4350	3450	3450
16	4050	4225	3850	3950	2850	3150	2950	3050
17	3750	3925	4150	4350	3750	3950	3150	3200
18	3450	3650	3050	3250	4050	4150	3850	3850
19	2950	3125	2750	2950	3750	3800	3950	3950
20	3150	3350	2650	2750	3850	3750	4050	4000

APPENDIX F

RAW SCORES ON BREATH HOLDING TIME

S. No.	Circuit Training Group		Interval Training Group		Stair Case Training Group		Control Group	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	32	39	29	36	51	60	42	43
2	28	42	30	41	39	48	40	39
3	31	39	29	38	43	51	45	44
4	38	46	44	56	42	58	40	42
5	44	53	38	41	39	39	45	45
6	58	60	50	55	38	42	40	39
7	51	55	57	65	31	39	42	39
8	39	48	44	55	40	49	42	41
9	43	51	38	45	41	50	42	41
10	47	58	46	54	42	50	40	41
11	39	50	49	57	38	46	46	43
12	51	58	38	44	44	53	38	39
13	42	48	43	54	58	65	48	42
14	32	39	29	36	51	60	42	43
15	28	42	30	41	39	48	40	39
16	31	39	29	38	43	51	45	44
17	58	65	50	55	28	42	40	39
18	51	60	57	65	31	39	42	39
19	39	48	44	55	40	49	42	41
20	43	51	38	45	41	50	42	41

APPENDIX G

RAW SCORES ON ACHIEVEMENT MOTIVATION

S. No.	Circuit Training Group		Interval Training Group		Stair Case Training Group		Control Group	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	20	22	26	30	26	28	34	34
2	24	28	22	26	20	24	26	26
3	26	30	26	28	24	26	24	24
4	24	26	28	32	16	18	14	16
5	24	28	26	30	20	22	18	18
6	24	28	24	26	26	28	32	32
7	20	22	26	30	26	28	34	34
8	24	28	22	26	20	24	26	26
9	26	30	26	28	24	26	24	24
10	30	34	24	28	24	26	22	22
11	24	26	14	16	20	22	20	20
12	18	22	18	20	36	38	16	16
13	26	28	32	34	26	28	32	32
14	26	30	34	36	20	24	12	16
15	18	22	26	28	26	28	16	16
16	16	20	24	26	22	24	20	20
17	32	32	22	24	20	22	26	26
18	24	28	20	24	20	22	26	26
19	26	30	16	18	20	24	20	20
20	18	24	32	34	18	20	24	24

APPENDIX H

RAW SCORES ON SELF-CONFIDENCE

S. No.	Circuit Training Group		Interval Training Group		Stair Case Training Group		Control Group	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	48	52	44	53	44	55	44	46
2	45	58	39	48	41	52	53	51
3	44	55	38	47	53	61	35	36
4	47	56	52	59	44	55	46	42
5	44	58	53	64	53	62	48	43
6	46	58	47	56	35	46	45	48
7	48	52	44	53	44	55	44	46
8	45	58	39	48	41	52	53	51
9	44	55	38	47	53	61	35	36
10	53	64	34	43	55	62	44	40
11	44	56	45	54	47	58	41	43
12	44	52	56	62	44	55	60	62
13	41	53	42	49	39	50	65	61
14	60	60	32	41	38	49	47	45
15	45	52	41	50	34	45	44	46
16	47	50	42	51	45	56	39	41
17	44	52	47	56	54	66	38	35
18	39	49	51	60	50	61	34	36
19	38	48	56	62	32	43	45	40
20	34	44	48	57	41	52	65	62

APPENDIX I

RAW SCORES ON ANXIETY

S. No.	Circuit Training Group		Interval Training Group		Stair Case Training Group		Control Group	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	57	52	53	51	61	57	55	57
2	66	60	62	53	63	59	62	58
3	59	60	59	50	60	56	59	58
4	51	48	65	59	59	55	61	62
5	68	58	61	54	68	62	63	64
6	50	48	65	56	50	52	60	58
7	52	52	62	53	59	55	59	56
8	59	58	57	48	56	52	68	71
9	57	55	56	47	68	65	58	62
10	57	54	52	43	62	62	59	61
11	58	56	63	54	62	58	56	53
12	50	48	65	56	50	52	60	58
13	52	52	62	53	59	55	59	56
14	59	58	57	48	56	52	68	71
15	59	52	59	50	59	54	59	56
16	61	55	60	51	60	56	54	51
17	68	62	65	56	69	66	53	55
18	63	53	69	60	65	61	59	61
19	62	58	63	62	52	45	60	58
20	66	54	66	57	56	52	67	65

APPENDIX J

RAW SCORES ON DRIBBLING

S. No.	Circuit Training Group		Interval Training Group		Stair Case Training Group		Control Group	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	9	12	9	12	10	13	8	9
2	8	10	11	12	11	12	10	9
3	10	11	10	11	9	11	8	9
4	9	12	11	13	8	11	9	10
5	8	10	9	10	10	13	10	11
6	7	8	8	9	8	11	7	8
7	10	11	10	11	9	12	10	9
8	11	12	8	9	10	11	11	10
9	10	12	9	9	7	9	10	12
10	9	11	10	11	10	12	9	11
11	8	10	7	9	11	13	8	9
12	9	10	10	11	10	12	9	8
13	8	11	11	13	8	11	8	8
14	10	12	10	12	10	11	10	11
15	12	13	9	11	12	14	8	8
16	8	9	8	9	8	10	9	8
17	10	11	9	10	10	12	10	9
18	11	12	8	11	11	12	7	8
19	7	9	10	13	7	9	10	11
20	8	10	11	14	8	10	11	10

APPENDIX K

RAW SCORES ON SHOOTING

S. No.	Circuit Training Group		Interval Training Group		Stair Case Training Group		Control Group	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	15	18	18	21	25	28	18	19
2	16	19	16	18	15	18	14	16
3	18	21	22	24	18	21	14	15
4	19	22	18	26	16	19	18	17
5	21	24	17	19	13	16	16	16
6	22	25	15	17	14	17	22	21
7	26	29	13	15	18	21	24	23
8	16	19	23	25	17	20	17	18
9	18	21	19	26	21	24	15	16
10	14	17	20	22	23	26	13	15
11	12	15	15	17	16	18	23	21
12	18	21	18	20	18	20	21	24
13	16	19	16	18	19	21	25	24
14	22	25	13	15	21	23	15	18
15	24	27	14	16	22	24	15	16
16	17	20	18	20	21	23	16	16
17	15	18	17	19	16	18	18	17
18	13	16	21	23	18	20	19	18
19	23	26	22	26	14	16	21	20
20	24	27	15	17	12	14	22	23

APPENDIX L

RAW SCORES ON WING SHOT SHOOTING

S. No.	Circuit Training Group		Interval Training Group		Stair Case Training Group		Control Group	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	10	12	10	12	11	13	8	9
2	9	10	12	12	12	13	10	10
3	7	11	11	11	10	12	9	10
4	9	12	10	13	9	11	9	10
5	8	10	10	10	11	14	11	12
6	7	8	8	10	9	11	7	8
7	10	11	11	11	10	13	10	10
8	11	12	9	9	10	11	11	11
9	10	12	10	9	8	10	11	11
10	9	11	11	11	10	12	9	12
11	8	10	8	9	12	14	10	10
12	9	10	12	11	11	12	9	9
13	8	11	12	13	9	12	10	9
14	10	12	11	12	11	12	10	11
15	12	13	10	11	12	15	8	9
16	12	9	10	9	9	11	9	9
17	10	11	10	10	11	13	10	10
18	11	12	8	11	12	13	7	8
19	7	9	10	13	8	10	10	11
20	8	10	11	14	9	11	12	11