CHAPTER I

INTRODUCTION
Chapter 1

INTRODUCTION

Sports is a world wide phenomenon today. The field of sports is currently undergoing remarkable scientific changes. Research has revamped the whole concept of sports in terms of highly technological innovations. Contributions from various disciplines like medicine, engineering, human biology, psychology, bio-mechanism, excercise, physiology, etc., have made the sports field, more authentic, glamorous and appealing. Different methods are being tried to spot out the potential talents and train sportmen under ideal environement. Further, efforts are being taken to predict the potentials of sportmen by measuring their physical fitness and anthropometric measurements. Studying, body types of individuals and identifying a suitable game or event is comparatively a recent phenomenon. Thareby, body composition and anthropometry truly play a vital role in sports performance.

In India, there has been a great interest in games and athletics in recent years. Both the Public and the Government extend great encouragement to them. The advancement of scientific knowledge and technique in the field of physical education and sports help players to attain perfection in all possible ways.

A harmoniously developed, well co-ordinated body is an asset to an individual and the nation. A fit nation is an asset and a weak nation is a liability. Physical fitness is a desirable quality to posses. Fitness
is health as well as performance related. Physical fitness is concerned with the development of health and performance which offer protection against diseases frequently associated with physical activity. Performance related physical fitness is associated to better performance in sports and other physical activities. Components of both health and performance related fitness are similar; for example, cardiovascular function, body composition, strength and flexibility. However the degree of development varies with two types of physical fitness.

Most of the games played nowadays not only give enjoyment but also helps to develop physical skills. Games are as old as civilization itself, and the Olympic games ranked among the most famous sports event of ancient times. From the beginning of history, man has paid more attention and care to build up a sound body by means of games and sports.¹

1.1. CONCEPT OF BASKET BALL

Established games such as basket ball, foot ball, volley ball etc., require a group or a team, with co-operation and a vast display of various skills. They also improve one's ability like flexibility, agility, speed, strength and endurance. Basket ball is one such game which needs people with these qualities.

Basket ball is regarded as a "World Wide" game, internationally popular and universally accepted. It is one of the most

strenuous and thrilling games, and it demands physical fitness, speed and endurance.\textsuperscript{2}

The first game was played with a large soccer ball and with peak baskets 10 feet high for goals, hence the name basket ball. The rapid world wide acceptance of basket ball, however is easily explained. Courts were quickly laid out both inside and outside doors. No doubt it may be the only major sport that came into being as the direct result of a request.\textsuperscript{3}

Basket ball is one of the most widely played, popular and fastest games in the world, which enjoys great appeal among people of all ages throughout the world. In 1891, James Naismith who was a Physical Education Instructor at the International Young Men Christian Association, Training School, introduced basket ball. Basket ball as played today has undergone many changes in equipment, rules and style of play over the years. Over these years, it has attained a great reputation in the realm of games. Basket ball is played between two teams throwing the ball into the opponent's basket and preventing the other team from securing the ball or scoring. The ball may be passed, thrown, batted, rolled or dribbled in any direction subject to the restriction laid down in the rules.\textsuperscript{4}

\textsuperscript{2}France Schofsman, \textit{Basket Ball for Women} (Iowa : Wm. C. Brwon Company Publishers, 1968), P.2.

\textsuperscript{3}Carles C. Murphy, \textit{Basket Ball} (New York : Ronald Press Company, 1938), P.2.

1.2. CONCEPT OF VOLLEY BALL

The game volley ball was invented by William Morgan in the year 1885. Nowadays it has become very popular. Volley ball can be played by all ages and by both sexes indoor and outdoor. It is a game where services and passing are the primary skills. These skill may be used in a playing situation (or) in setting the ball up for a spike. It is a game requiring quick sudden movement and fast reaction on many occasions. This game demands a high degree of physical fitness, skill, self-confidence and alertness. The game is a spectacular sport, if only the players demonstrate the physical qualities of strength, speed, control, ability to relax; technical skill; co-ordination; physiological and moral qualities of determination, courage, aggression, selflessness, concentration, team spirit and sportsmanship.  

1.3. CONCEPT OF FOOT BALL

The game football or soccer is one of the most popular games in the world. Soccer, which is popularly known in India as foot ball, where the foot is used much more than any other parts of the body, consists of two teams trying to kick or head a round ball into the opponent’s goal. The object of the game is to score more goals, than the opposing team. To score more goals every player must have mastery over all the skills and thus they can dominate the opponent. It is a game which needs many physical and mental qualities in a player. It needs endurance, speed, agility and motor ability of a player.

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According to Berger, conditioning of the player in the sport of soccer is different from what is needed to optimise performance in cross country running, basketball etc., although the same physiological mechanisms are involved in these activities.

1.4. BODY COMPOSITION

There are numerous factors which are responsible for the performance of sportsmen. Body composition and Body build play an important role in this regard.

It must be remembered that the somatotype is only a general physical capacity and as such it is only one indicator of an athlete’s suitability to perform at a high level. It must be combined with other capacities such as body composition, proportionality, strength and power; flexibility, posture, speed and agility; when one evaluates the physical characteristics of an athlete. However, in the wider performance context the athlete’s level of skill, cardiovascular fitness and physiological profile must also be carefully considered.

1.4.1. Factors Affecting Body Composition

A number of factors affect the size, mass and structure of each of the anatomical components of the human body. These may be broadly classified as follows:

Genetic: - the influence of heredity.

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Hormonal: the variable influence of secretions from the endocrine glands.

Environmental: the additional influences such as exercise, training, nutrition and emotional stress.

1.4.2. Body Composition Assessment

Fat is deposited at a variety of sites in the body. Some of it appears to play an essential role in human function, while the majority is seen as an excess beyond normal requirements. This excess fat may be deposited internally in storage sites such as the greater omentum, within the pericardial sac or as epiploic appendages on the intestine. Superficially, fat is deposited in a subcutaneous layer of varying thickness throughout the body.

In the assessment of body composition, scientists and clinicians are normally interested in estimates of the fat compartment relative to the amount of lean body tissue; however, more recently, estimates of skeletal and muscle compartments have become possible. Regardless of the method used, the total mass of all fat deposition sites must be accounted for. The only truly direct method available to date is that of cadaver dissection. Although limited in sample, the cadaver dissection studies (Clarys et al. 1984) provide valuable criteria against which other indirect methods can be validated. The indirect methodologies may be classified into one of five groups; weight for height indices; densitometry; skinfolds; tissue fractionation models; and other techniques.
1.4.3. Body Composition and Sport Performance

Since 1960s considerable information has become available on the body composition requirements for various sports and events, or positions within those sports. This interest in body composition evinced by coaches and athletes has drawn the inference that success not only demands a particular physique but also as certain ratio of LBM to FM. A lack of standardization of techniques and sampling sites in the past, together the use of a variety of data treatment strategies, has meant that pooling of some the results for profiling and comparative purposes cannot be done with any real accuracy.

In the following section an attempt will be made to relate the current knowledge in the field to athletic performance in a number of different sports. The available data on the sum of skinfolds or body density from hydrostatic weighing will be presented for the various sport categorised. Other sources which report values for per cent body fat or estimates of body density from the anthropometry are disregarded.

1.4.4. Modifying Body Composition

Body composition can be altered by diet, strenuous exercise or a combination of both, which will affect a relative proportions of bone, muscle and fat in the individual. Many athletes are highly conscious of their current body composition status and often undertake dietary regimens to modify this condition. Whether to increase or decrease total body mass, LBM or FM, increased knowledge of the degree of modification which can be safely made will ultimately assist the coach to improve the performance of athletes. In addition, the many strategies
that may be adopted to achieve this modification need to be assessed in terms of their safety and the effects they have on performance and their effectiveness in achieving the desired goal.

However, many individuals will compete successfully in certain sports despite possessing a body composition which varies from the average. The athlete or coach should not attempt to categorically match these values, especially if the modification regimen affects other facets of the athlete's make-up and becomes detrimental to his or her performance.7

Body composition plays an important role in the maintenance of fitness and performance in all types of sports and games. This is proved by the fact that well trained individuals, have better body composition than untrained ones. Body composition can be defined as the relative ratio of fat to fat free body mass. This composition is assessed and presented as body fat percentage.

Assessment of an individual's percent body fat may be through direct body density measurement like water displacement or under water washing method. However, the easier indirect method used is skinfold measurement. This correlates well with direct measurement. Body composition refers mainly three principle tissue components of body ie., muscle, bone and fat.

1.4.5. Importance of body composition

Studies of body composition in certain sports indicated that the athlete who is very lean but heavy because of a well developed musculature is superior in performance in certain competitive sports activities, such as football, weightlifting and shotput. On the other hand, athletes who have substantial amount of adipose tissue have increased energy demands, owing to the insert weight of fat thus making the work more difficult to perform in endurance activities, where the body has to move along with great weight. It may be for this reason that the long distance runners are to be less endomorphic than other runners and their counterparts at a lower level of competition.

However the degree of excess fat may play an advantageous role, if not a vital one in physical performance carried out under damp conditions in cold seasons. It was observed that the middle distance runners and channel swimmers were endowed with a substantial amount of subcutaneous tissue and often were obese. This ability to tolerate cold water for a long period was largely attributed to the insulation provided by the fat and reduction of heatloss.

From these examples, it is evident that physique and body composition have an important role to play in the performance of various physical activities. The selected physical activities reported are athletics, cycling, weight-lifting, wrestling, football, hockey, basketball and volleyball.
In 1942, A.R. Behuke presented evidence proving that a purely anthropometric approach to the study of human physique is unable to yield information on the important factor of body composition. In the two classical communications he has elucidated the relationship of lean body mass of fat.⁸

He tried to identify the individual physique through a series of three numerals, the first referring to endomorphy the second to mesomorphy and third to ectomorphy. Each rated on a seven point scale with zero being, the lowest and the seventh highest, where half point was used for intermediate values in the rating scale. Endomorphy, the first component was defined as relative pre-dominance of adipose tissue. Mesomorphy, the second component has the relative pre-dominance of bone muscle and connective tissue and ectomorphy, the third component has the relative predominance of linearity and fragility⁹.

Young tend to distribute a triangular pattern. The big boned heavy muscled group are in the extreme mesomorphy, the frail, light weight types are in the extreme ectomorphy and the over weight obese individuals fall in the extreme endomorphy¹⁰.

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⁹Ibid., P.52.

¹⁰Ibid.
1.5. SOMATO TYPE

Somato type is description of present morphological conformation. It is expressed in a rating consisting of three sequential numbers always recorded in the same order. Each number represents evaluation of one of the three primary components of the physique, which describe individual variations in human morphology of composition.

1.5.1. Endomorphy

Endomorphy is characterised by roundness and softness of body. The anterior, posterior dimensions as well as catoral tend towards equality in the head and limbs. Also included in the type are predominance of abdomen over thorax. High square shoulders and shortneck. There is a smoothness of contours throughout with no muscle relief. The breasts are always developed usually as a result of fatty deposits. As Shaldom so aptly states, the entire trunk gives the impression of being under moderate pre-matic pressure. The buttocks appear with round fullness and no noticeable dimpling. The skin is soft and smooth and rarely in these massive chest fair.

1.5.2. Mesomorphy

Mesomorphy is characterised by a square body with hard, rugged and prominent musculation. The bones are large and lowered with thick muscle in legs, trunks and arms, usually upright with trapezius and deltoid muscle quite massive.

The abodminal muscle are prominent and thick and characterised by rippling muscles. The buttocks must always exhibit a
muscular dimpling. The skin appears coarse and takes a deep tan readily holding it for a long time.

1.5.3. Ectomorphy

Ectomorphy includes, predominant characteristics with linearity, fragility and delicacy of the body. The bones are small and muscles are thin, shoulder group is a constant in the ectomorphy. The limbs are relatively long, trunk short however, this does not mean that the individual must be tall. The abdomen and lumbar curve are flat, while the thorasic curve is relatively sharp and elevated. The shoulders are mostly narrow and lacking in muscle relief. There is no bulging of muscle at any point on the physique. As the shoulder girdle lacks muscular support and padding, the scapula tend to rising out posteriorly.

1.6. BODY FAT

Nearly one half of the body fat is situated deep inside the body, whilst the rest is between the skin and the muscles. Body fatness of an individual can be determined quite easily by measuring skin folds, thickness of fat under the folds of the skin. The instrument used for measuring the fat is called a skin fold caliper.

Theoritically the body can be divided into serveral components according to definable tissues. A two compartment model is commonly used in which the body is divided into fat and fat free compartments; because the only direct method qualifying these compartments of tissues in human is through postmortem techniques.
Estimates could be made at present by indirect laboratory and field techniques.

1.7. SKINFOLD

It is a fold of skin and subcutaneous adipose tissue lifted by the fingers to separate it from underlying tissues. It consists of a double layer of skin and a variable amount of adipose tissue which depends on the consistency of the adipose tissue and the pressure exerted by the fingers.

1.7.1. Skinfold Thickness

The thickness of the compressed skinfold is measured by a skin fold caliper with standardized characteristics of tension of jaw surface area. It is considered as an acceptable indicator of the level of fatness if a sufficient number of sites are measured by trained anthropometrists. The sum of different numbers of skinfolds are related to the total body fat or density, and a reasonable relationship between external as measured by skinfolds and internal fat assumed

1.7.2. Skinfold Pattern (or) Profile

This is a representation of the simultaneous adipose tissue configuration. Skinfold patterns can be graphically presented by plotting the raw scores of the thickness in a suitable co-ordinate graph in a set sequence of joining the plotted points

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12 *Ibid.*, P.145
1.7.3. Fat

Fat in the body, the soft tissue other than that making up the skeletal muscle mass of viscera.\(^3\)

1.7.4. Lean Body Mass

When the weight of the body fat is subtracted from the total body weight, the remaining weight is referred to as fat free weight or lean body mass.

1.8. ANTHROPOMETRIC MEASUREMENTS AND ITS USES

Recognising the importance of anthropometry in sports performance, it was found worthwhile to analyse the body composition and anthropometry, relating to basket ball, football and volley ball players. Several scientists have proved that enough evidence associating a particular physique to a particular event.

Anthropometry is the science of measuring the size and proportion of the human body.\(^4\)

‘Anthropometry’ means the measurement of man, whether living or not and consists primarily as the measurement of the dimensions of the body. Anthropometry represents the typical and traditional tool of human biology, physical anthropology and aucology. Recently it has


taken a strong bonded relationship with physical education and sports science\textsuperscript{15}.

According to Clarke and Clarke, one of the uses of anthropometry is to determine relationship between body structure and motor performance observations. Of such relationships are wrestlers and gymnasts, the superstructure of great basket ball competitions the solidarity of top-flight foot ball, albetes athletes coirines of champion distance runners and massive builds of great shotputters and discus throwers\textsuperscript{16}.

The study of human physical measurement has wide application as one of the essential parameters constituting the selective diagnostics of any game or sport. The study of 'Body type' has a significant place in the field of sports. Anthropometry indicates have aided evaluating potentiality for athletistic performance.

The physical structure, especially the height and leg length have definite defensive advantage in many a game or sport. Height has the potential placement as a preferable pre-requisite for the performance excellence in many sport or game. Anthropometric measurements have revealed correlation between body structure and physical characteristics and sports capabilities. This knowledge of mathematical correlation


permits sports physicians to evaluate and to predict performance, potentialities or the requirements of the game or sport, the prediction Prognostics\textsuperscript{17}.

Hence the investigator has selected height, leg length as relevant anthropometric variables since they would play a definite role in successful basket ball, foot ball and volley ball performance.

1.9. IMPORTANCE OF ANTHROPOMETRIC VARIABLES

Anthropometric measurements of body structure is the oldest type of body measurement known, dating back to the beginning of recorded history. It was also an early type of test in Physical Education. The theory that exercise should be prescribed to affect muscle size, emphasise upon muscle symmetry and properties. In 1861, Hitchcock and later Sargent, produced profile charts to reveal how individuals compared with their standards. Sargent chart contained forty four anthropometric measurement as well as a number of strength tests. Fifty such tests were recommended by American Association for the Advancement of Physical Education.

Numerous anthropometric measures are available and have been used in various growth studies. One of these measures show a succession of annual means during the growth period.

\textsuperscript{17}G.S. Sundara Rajan, Sport Medicine Lecture (Madras : Rashar Publication, 1979), PP.158-163.
Another use of anthropometry is to determine relationship between structure and motor performance. Observations of such relationship are commonly observed in the well proportional bodies of wrestlers and gymnasts, the super structure of hockey players, basketball competitors, the solidarity of top flight footballers, athletes, the massive builds of great shotputters and discuss throwers.

The anthropometric measurements such as height, weight and arm length were likely to influence skill development and performance in hockey. Further, the influence of anthropometric components were found in basketball, football and volleyball players.

Height has the potential placement as a preferable prerequisite for the performance excellence in many sports and games. Anthropometric measurements have revealed correlation between body structure and physical characteristics and sports capabilities.

The performance in hockey does not depend only on the mastery of technical aspects, but also upon the optimum development of physical, physiological and other metric factors. In basketball, height and arm length have good advantage of greater reach of the ball and covering more space while defending. The height of the subject is measured in centimeters in standing position. It is the measurement from top of the head to the heal in standing position.

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The application of anthropometry is one of the essential parameters constituting the selection and diagnosis for any game or sport. The study of body type has a significant place in the field of sports. The physical structure especially the height and arm length have definite decisive advantage in many games like basket ball, volleyball and sports. Similarly segmental length of individual body parts, specially the leg length and arm length are of considerable advantage in certain games like football, volley ball and basket ball. The anthropometric variables selected for the study are height, weight and arm length. The higher level performance of a basket baller, foot baller and volley baller do not depend only on mastery of the technical and tactical aspects alone, but also upon the anthropometric variables like leg length and arm length.

1.10. KINANTHROPOMETRY

Kinanthropometry is a new science that deals with the structural and functional aspects of athletes and non-athletes. It is of utmost importance to study the body build proportions, compositions, size, maturation and motor abilities of athletes and sportmen. It is recognised that tallness is useful in some sports providing greater reach, helping in shifting the centre of gravity, higher similarly, shortness is useful in some other sports where greater stability is more essential. The degree of development of muscle and bone, as assessed by anthropometric method is also important for scientific training in sports. Further the body fat also needs regular monitoring especially in high performance athletics from time to time. Similar considerations are in different phases of their
physical growth. The science of Kinanthropometry provides a convenient frame work of study of all those aspects\(^9\).

The emergence of relatively new scientific specialisation called Kinanthropometry provides a convenient frame work for the study of the human body. Kinanthropometry provides quantitative interface between human structure and function. It is defined as the study of human size, shape, proportion, composition, maturation and gross function in order to help understand, growth, exercise, performance and nutrition. Kinanthropometry is a scientific specialisation dealing with the measurement of man in a variety of morphological perspectives, its application to movement and those factors which influence movement including components of body build, body measurement proportions, composition shape and maturation, motor abilities and cardiorespiratory capacities, physical activity, including recreational activity as well as highly specialized sports performance. Kinanthropometry is a scientific specialization closely allied to physical education, sports science, anthropology, geronotology and several medical disciplines\(^20\).

According to Carter\(^21\), a relatively new and comparative approach to the assessment of physique is through Kinanthropometry, which evaluates the physical structure of individual in relation to gross motor performance. The term Kinanthropometry is derived from


\(^20\)Ibid., P.2.

\(^21\)Ibid., P.4.
morphometry, which is the measurement of shape and form of man. Kinanthropometry is the quantitative study of size, shape proportion, composition and maturation in relation to gross function.

1.11. PHYSICAL FITNESS

Components of physical fitness are required for basket ball, volley ball and foot ball players. The components of physical fitness are strength, endurance, speed, flexibility, agility, co-ordination and cardiorespiratory endurance. Most of the benefits of physical fitness came from an aerobic programme made up of vigorous non-stop activity that keeps the heart rate around 150 beats per minute.

Physical fitness is the ability to carry out daily tasks with vigour and alertness without undue fatigue and with ample energy to enjoy leisure time pursuits and to meet unforeseen emergencies.

Physical fitness is required for a healthy human body. Only after achieving fitness physically, a man or woman can indulge himself or herself in any kind of activity.

Physical fitness is a positive and dynamic quality extending the entire life span of man. It is related to the ability to meet the demands of the environment; specially to preserve, to withstand stress, to resist fatigue and to possess the energy for a vigorous and well rounded life. Physical fitness minimal indicates illness ill and maximal is an index of a highly conditional person.

Recognising the importance of physical fitness in sports and games, various physical efficiency tests have been evolved and developed in the form of long and short batteries. The tests which have been widely applied to measure the different elements of physical fitness are,

1. The California Physical Performance Test
2. American Association for Health, Physical Education.

The knowledge of the physical differences and similarities among players can lead to an evaluation of the size, range and importance of the differences. In addition to size, it is also helps to understand the relationship between physique and performance. This knowledge helps the players who wish to achieve success in sport at a high level to compare their physique with those of the selected players and consider whether further changes in physique such as lower body fat or increased muscle mass would help or hinder performance.

In the modern days of competition, coaches are also making all efforts to select persons of a particular physique and body composition suitable for various activities.

Hence, the trend in the field of games, sports and physical education is to assess the related components as a part of the total body build and size of each player and also to interpret how these components are helpful for the performance in games and sports under competitive conditions.²¹

1.12. IMPORTANCE OF PHYSICAL FITNESS FOR BASKET BALL, VOLLEY BALL AND FOOT BALL PLAYERS PERFORMANCE

Physical fitness plays an important role in all sports and games. All the living individuals must possess physical fitness. Physical fitness can be divided into two categories, the health related physical fitness and skill related physical fitness. Health related physical fitness components are cardiorespiratory fitness, body composition, abdominal strength, endurance and flexibility. Skill related physical fitness includes components important to play sports well, such as speed, strength, endurance, ability, flexibility, balance, power, co-ordination etc. Both types of physical fitness are important for all the sportsman in order to achieve better performance.

A player in good physical condition is generally thought to have the ability to do sustained work over a long period of time. He or she should have sufficient speed, endurance, power and ability. High level of general fitness with motor abilities like power, speed, agility, cardio vascular, jumping ability, etc., are essential qualities required to be developed by all players. For good performance in any sports or athletic event, achievement of high standard of fitness is a basic requirement. Mere participation in sports activity is not enough to improve fitness because fitness must be gained only through conditioning programme.

Evidence is mounting that physically fit persons lead longer lives, have better performance records that those who are unfit. A totally fit individual has strength, speed, power, agility, endurance to his life. Ability to function depends upon physical, physiological,
Kinanthropometrical components of fitness of which are related to each other and are mutually interdependent.

1.13. PHYSIOLOGICAL VARIABLES AND ITS IMPORTANCE

Resting pulse rate (heart rate), cardio respiratory endurance and anaerobic power are some of the physiological variables to be considered for selecting and training the basketball, football and volleyball players and these physiological variables should be developed to increase the performance of those players. The pulse rate and cardiorespiratory endurance are the two parameters that belong to the blood circulatory and cardio respiratory system of the body. Cardio respiratory endurance is one of the important factor for efficient sports/games performance. It is the ability of the body to take in and distribute adequate amount of oxygen to the working muscles during physical activities.

Any form of physical activity is directly related to an energy supplying system which in turn is the cardio respiratory endurance, especially in work of longer duration. The players have to play seventy minutes up and down and it puts heavy demands on the players.²⁴

1.14. PHYSIOLOGICAL BENEFITS

Physiology of exercise is elastic in its content, methodology and practices, since it involves not only physiology but also nutrition, psychology, bio chemistry and endocrinology. Researchers observe and record data of the body under exercise stress and learn much about the

dynamics of the respiratory, cardio vascular and muscular system. Results of these studies reveal the adaptation of the body of exercise and provide ample data that ascertain the benefits occurring as a result of such training. The hallmark of exercise physiology is what happens to the human biologic system under the stress of exercise and human movements.

1.15. REASONS FOR THE SELECTION OF THE TOPIC AND VARIABLES

In India, unlike the countries of Europe and America, is a vast country inhabited by people of different racial, origins and living under different geographical, economical and socio-cultural conditions. This feature, therefore makes this study more important.

Further the reason for the selection of this topic is to find out whether there is any difference between body composition, anthropometric and physiological factors with the university men Football, Basketball and Volleyball players and further pave way whether it would be helpful to the coaches, trainers and players.

India has produced lot of sports personalities at Asian level; but in recent years due to lack of advanced knowledge in players’ body composition, anthropometry, physiological factors, latest techniques, training methods and coaching, our Indian Football, Basketball and Volleyball players performances are not satisfactory and therefore we have failed to produce top ranking olympian players. It is necessary to analyse deeply the body composition, anthropometry and physiological
requirements. Since there was no specific research work for the comparison of body composition, anthropometric and physiological variables, the investigator has decided to do the research on this.

Performance of Basketball, Football and Volleyball depends on certain body composition, anthropometric variables like height, weight, leg length, arm length and circumference of legs and limbs and physiological variables like resting pulse rate, anerobic power and cardiorespiratory endurance. These variables influence the development of the performance of Football, Basketball and Volleyball games.

On the basis of the knowledge reflected from the available literatures and research findings, the research scholar has undertaken selected anthropometric and physiological variables on university sports men.

1.16. STATEMENT OF THE PROBLEM
The purpose of the study was to compare the selected body composition, anthropometric and physiological variables among university men Basketball, Volleyball and Football players.

1.17. SIGNIFICANCE OF THE STUDY
The study will help the Basketball, Volleyball and Football players to compare their physique and performance of the selected players.
The present study will help the coaches to select the players with appropriate physique for appropriate sports and games and concentrate on coaching and training of those individuals.

This study not only helps to know the existing performance of Football, Basketball and Volleyball according to their body composition, anthropometric and physiological factors but also can suggest to increase the performance of such players. Further the study will help to rectify the selection of players according to the body composition which is related to better performance. The scholar has chosen this study to overcome the difficulties in the selection of players.

The present study will provide the physical education teachers with the basis for determining sound programmes of physical activity and games.

1.18. HYPOTHESIS

It was hypothesised that there would be significant difference in selected body composition, anthropometric and physiological variables among university men Basketball, Volleyball and Football players.

1.19. DELIMITATIONS

1. The study was delimited to ninety elite university men Basketball, Volleyball and Football players who participated in the All India Inter-University Tournaments during the year 1996-97.
2. The age of the subject ranged from eighteen to twenty-five years.

3. The study was delimited to the following body compositions, anthropometric and physiological variables.

A. ANTHROPOMETRIC VARIABLES

1. Age
2. Weight
3. Height
   Sitting Height
4. Length
   Lower Limb length
   Upper Limb length
5. Width
   Humerus
   Femur
6. Circumference
   Chest
   Abdomen
   Relaxed arm
   Flexed arm
   Calf
7. Skinfold
   Biceps
   Triceps
   Subscapular
   Anterior thigh
   Suprailiac
   Medial Calf
   Sum of Six skin folds
8. Indexes
   Pondernal index
   Skelic index

9. Somato type
   Endomorphy
   Mesomorphy
   Ectomorphy

B. BODY COMPOSITIONS
   1. Body fat percentage
   2. Absolute body fat
   3. Lean body weight

C. PHYSIOLOGICAL VARIABLES
   1. Anaerobic power
   2. Resting pulse rate
   3. Cardiorespiratory endurance

1.20. LIMITATIONS

   This investigation was limited in the following respects which will be considered at the time of arriving at conclusions.

   1. The environmental factor such as temperature of the testing place could not be controlled.

   2. The daily diet of the subjects were not taken into consideration.

   3. The subjects for the study were the students from different Universities and they differ from routine habits.

   4. Certain factors like habit, life style, daily routine and other things which might have an effect on the result of the study have not been taken into consideration.
1.21. DEFINITIONS OF THE TERMS

1.21.1. Anthropometry

Anthropometry is the science of measuring the human body and its parts. It is used as an aid to the study of human evaluation and variation.\(^{25}\)

1.21.1.1. Age

Age is a measure of the time the developing person has been interacting with the environment (that is the amount of time spent outside the womb) and is, therefore, inseparably associated with biological growth and experience. Since growth rates vary widely with individuals, children of the same age show marked variations in strength, motor proficiency, etc.

1.21.1.2. Body Weight

Anthropometry, the mass of the human body measured to the nearest tenth of a Kg, when the subject is nude, or with clothing of known mass so that a correction to nude mass can be made.

1.21.1.3. Height

Height is the distance from the bottom of both feet with heels together to the highest point on the head.

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\(^{27}\)Ibid., P.64.

\(^{28}\)Ibid., PP.423-424.
1.21.1.3.1. Sitting Height

A body height measurement taken from the vertex to the base of the sitting surface when the seated subject is instructed to sit tall²⁹.

1.21.1.4. Length

A linear measurement of an object, end to end; it is usually the longest dimension³⁰.

1.21.1.4.1. Lower Limb Length

Region of the body which consists of three functional segments; the thigh, leg and foot³¹.

1.21.1.4.2. Upper Limb Length

Part of the body which includes the arm, fore arm and hand³².

1.21.1.5. Width
1.21.1.5.1. Humerus Width

A distance between the medial and lateral epicondyles of the humerus when the arm is bent at the elbow to form a ninety degree angle³³.

²⁹Ibid., p.403.
³⁰Ibid., p.252.
³¹Ibid., p.260.
³²Ibid., p.469.
³³Ibid., p.209.
1.21.1.5.2. Femur Width
In anthropometry, the distance between the medial and lateral epicondyles of the femur when an individual is seated with the leg bent at the knee to form a ninety degree angle\textsuperscript{34}.

1.21.1.6. Circumferences
1.21.1.6.1. Chest Circumference
The circumference of the thorax, around the mesosternale\textsuperscript{35}.

1.21.1.6.2. Abdominal Circumference
The abdominal circumference is an anthropometric indicator of subcutaneous and deep adipose tissue\textsuperscript{36}.

1.21.1.6.3. Relaxed Arm Circumference
The circumference of the right arm at the midpoint between the acromial and the radial when the subject is standing erect and the relaxed arm is hanging by the side\textsuperscript{37}.

1.21.1.6.4. Flexed Arm Circumference
Maximum circumference of the arm usually the right arm in supination when held at an angle of 45\textdegree{} with the biceps fully tensed\textsuperscript{38}.

\textsuperscript{34}Ibid., p.166.

\textsuperscript{35}Ibid., p.87.


\textsuperscript{37}Ibid., p.372.

\textsuperscript{38}Ibid., p.171.
1.21.1.6.5. Calf Circumference

The maximum circumference of the calf of an individual standing erect with legs slightly apart and weight distributed equally on both feet\(^39\).

1.21.1.7. Skinfold Measurement

In anthropometry, a measurement of skinfold thickness\(^40\) usually the measurement is taken with skinfold calipers of a vertical fold of tissue held by the left thumb and index finger at specific sites on the body.

1.21.1.8. Index
1.21.1.8.1. Ponderal Index

An indicator of body size and shape used in somatotype. The ponderal index is equal to the body height divided by the cube root of body weight\(^41\).

1.21.1.8.2. Skelic Index

The skelic index is equal to the lower limb length divided by sitting height and finally multiplied by hundred.

1.21.1.9. Somato type

Somato type is a description of present morphological conformations.

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\(^{39}\)Ibid., P.73.

\(^{40}\)Ibid., P.405.

\(^{41}\)Ibid., P.340.
1.21.1.9.1. Endomorphy

Endomorphy or first component refers to relative fitness and leanness of the physique.

1.21.1.9.2. Mesomorphy

Mesomorphy or the second component refers to musculoskeletal development relatively to height.

1.21.1.9.3. Ectomorphy

Ectomorphy or the third component refers to relative linearity of the physique.

1.21.2. Body Composition

Body composition indicates the percentage of total body weight that is composed of fat tissue in relation to lean tissue.

1.21.2.1. Percent Fat

The absolute body fat is the total weight of fat in the human body; it is the product of the percentage body fat and body weight.

1.21.2.2. Absolute Body Fat

A measurement of the amount of fat in the human body, usually expressed as percentage of total body weight.

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45Ibid.,
1.21.2.3. Lean Body Weight

The mass of body tissue which does not contain fat; it is the total body mass minus the total body fat.\(^{46}\)

1.21.3. PHYSIOLOGICAL VARIABLES

PHYSIOLOGY

It is the branch of biology which is concerned with the mechanism of human body function.\(^ {47}\)

1.21.3.1. Anaerobic Power

Anaerobic Power is the ability of the individual to mobilize energy stored in the muscles during and ultra short exercise.\(^ {48}\)

1.21.3.2. Resting Pulse Rate

Resting pulse rate is the rate at which the heart beats when a person is at complete rest. The best time to determine resting heart rate is before getting out of bed in the morning.\(^ {49}\)

\(^{46}\)Jbid., P.251.


1.21.3.3. Cardiorespiratory Endurance

The ability of the lungs and heart to take in and transport adequate amount of oxygen to the working muscles and allowing activities that involve large muscle masses (e.g., running, swimming, bicycling, etc.,) to be performed over long periods of time\textsuperscript{50}.

1.21.4. Basketball

Basketball is played between two teams of five players each. The purpose of each team is to throw the ball into the opponent's basket and to prevent the other team from securing the ball or scoring\textsuperscript{51}.

1.21.5. Volleyball

Volleyball is a game requiring quick sudden movement and fast reaction on many occasions. The player will be forced to move very quickly to his sides (or forward) to play a ball. To do this he must be agile. The demands of every day life are such that few individuals reach their optimum level of agility without specific training. The Volleyball player has to be active to his optimum level, if he is to be an effective player\textsuperscript{52}.

\textsuperscript{50}Edward Fox, et.al., \textit{The Physiological Basis for Exercise and Sports} (Kerber Boulevard, Dubuque : Wm.C. Brown Communications, Inc., 1993), P.678.


1.21.6. Football

Football is a game which calls for a strenuous continuous thrilling action and therefore appeal to youth world wide. The skills involved are simple natural and yet highly stimulating and satisfying to any player. The skills are kicking, jumping, throwing, dribbling, dodging and out fetching an opponent\textsuperscript{53}.

1.21.7. Physical Fitness

The ability to carry out daily task with vigour and alertness without fatigue and with ample energy to enjoy leisure time pursuits and to meet unforeseen emergencies\textsuperscript{54}.
