CHAPTER - 1

INTRODUCTION
CHAPTER - I

1.0 INTRODUCTION:

In the period of last ten years sports have gained vast popularity all over the globe. The popularity of sports is still increasing at a fast pace and this happy trend is likely to continue in the future also. In the Olympic Games the total number of participating countries, sportsmen and games has also increased steadily. Sports have become an important social and cultural activity of the modern world. The contribution of sports in the all round development of human personality recreation and relaxation of human mind and body, rehabilitation and social adjustment of the injured sick and handicapped persons and understanding a many different people, nations, religions has been widely accepted and recognized by the educationists, physical educationists and people of the world. Sports are classified into several areas e.g., performance sports, physical education, rehabilitation sports, fitness and adventure sports etc. The area of performance sports has gained much more publicity and importance than the other areas. It contributes towards all round development of personality. Sports psychologists have studied the importance of sports and their influence on personality, physical fitness and behaviour patterns at
length, other related variables like physical growth, mental health, emotional stability, social adjustment organic soundness, mental alertness, maturity and posture values which influence sports performance have been studied by physical educationists through application of several scientific tests and measurements and other such procedures. Physical education assumes a place of an un dividable phase of educational process. Therefore, many tests are applied for measurement of various types of physical fitness and anthropometrics measures, through the proper intelligent use of measurements. In individual events, these are well established mathematical procedures of measurements. Therefore, one can measures performance in individual events with more accuracy, and it can be compared with previous records also; and both can be compared with similarly recorded performance in the past or present. Sometimes, they also reflect where an individual stands in relation to other special group of competitors. Wrestling is an individual and combative game played with different combination of techniques and tactics, offensive and defective, with action and reaction etc. which are totally dependent upon the physical and mental characteristics of the individual.
1.1 Wrestling and its importance:

Wrestling is oldest sports of the world. Man by nature and instinct is aggressive and wrestling is one of the best substitutes for its sublimation. Most of the European writers admit this idea that the origin place of the wrestling is India, whereas world renowned Greece, U.S.A., Rome, Egypt, USSR, Germany, Hungry, Turkey and China do not agree with this idea. In the past time the shape of wrestling was not such like the modern wrestling. 220 holds printed upon the walls of Beni Hasan’s village of Egypt, which proves the history of wrestling. Every body is aware of this Greece old saying, “Healthy mind in a healthy body” Milo is known as the top wrestler of the Greece as he became five times Olympic Champion. It is said that wrestling was fought in Mangolia, China, Japan, U.S.A., USSR., and India and may other countries of the world. It is difficult to say with certainty how this sport spread in the world, but in all probability it has its origin in India. In 1938 some archaeologists excavated a stone near the temple of Kanauji in Bagdad, carved with wrestling figures, dating back to approximately 5,000 years. So, we can say that wrestling is oldest and popular game of the world. The first Olympic Games held in 776 B.C. in which wrestling was not added. But in 704 B.C. Olympic Games wrestling held first time in which Hercules and Anatomy fought together. In modern Olympic Games
1896 held at Athens one bout held these in which F. Sutchman of Germany won the gold medal. From 1904 Olympic Games in Saint Luis, wrestling is popular and regular game in Olympic Games. Now a days, there are two types of wrestling - Free Style and Greco Roman Wrestling controlled by the FILA in international and Olympic games.

Wrestling is very popular and the oldest game in India from Mahabharata and Puranas. India produced many wrestlers who challenged many international wrestlers. After independent India has produced many worlds ranking wrestlers like Sh. K.D. Jadav who won Bronze Medal in 1952 Olympics. India has also produced many other wrestlers who won Gold Medal in Asian Games, Common Wealth Games, SAF Games, Asian Championship and other international competitions. Not only male, female also took part in different games in Olympic and other international competitions. FILA has also decided that female also took part in wrestling. So female wrestling has started. Wrestling Federation of India has also started Female Wrestling National Championship from 1997. First time very poor participation was found in this game but now a days it has become very popular. Female participation and their performance are also increasing rapidly in wrestling too. Geetika Jhakhar, Alka Tomer, Kiran Sihag who gained name and
fame at International level. Female Wrestling was introduced in Asian Games in 2002 and in Olympic Games in 2004. Female wrestling also has become a highly competitive and scientific game. Japan, Taipe, China, Mangolia, Germany's female wrestlers gained top level in international competition very fast. But we are lagging far behind in Olympic and Asian Games performance. There are many causes of our failure in international competition. Even today, the players are completely unaware of their draw-backs and other physical components which are truly rudimentary to success in achievements.

1.2 Physical Characteristics:

Physical educationists have long been realized that the performance of sportsmen is greatly influenced by the factors such as age, weight and height. It is also observed that persons of the same age will significantly differ in body size i.e. weight and height. The persons with same height may differ in body weight i.e. muscle, fat etc. For determining the correct fitness, single measure does not serve the purpose. For having the better results, body measurements is decided taking into consideration age, weight and height.
1.3 History of Measurement in Physical Education:

With the rise of civilization and progress in every field including education, the man has become more scientific. He tried to find out new and scientific ways to measure the human body. The history of measuring the body is not very old. Like medicine, physical education has also made its place of prominence and prestige in proportion to the development and refinement of its measuring techniques.

The testing and measuring movement in physical education is only 100 years old. Its history can be divided into periods running from 1860 to the present. These periods tend to overlap and run together and there can be no clear cut demarcation of time. These periods are merely times when the specific measurement types came into prominence and were used mostly. The first three periods reflect an emphasis on physical capacity and development whereas the remaining ones are more indicative of the changing emphasis towards efficiency and ability along with emphasis on the whole person:

1. Anthropometrics measurements 1860 – 1890
2. Strength tests 1880 – 1910
3. Cardiovascular tests 1900 – 1925
4. Athletic Ability Tests 1900 – 1930
1.4 Anthropometric Measurements – A Historical Background:

The measurement of man dates back to ancient civilization and is the oldest form of measurements. For measuring the measurements of man, a French Mathematician used the term 'Anthropometrical' or 'Anthropometrics'. In Egypt, a study was undertaken to find out whether one part or component of the body that would predict or become a common measurement of all body parts. In Egypt, for example, the length of the middle finger was considered a common measure of all body proportions. For instance, five fingers length to the knee, 10 to the public each and 8 to the length of the arm reach.

The Greeks were experts in body measurements. Hippocrates was one of the first known test and measurement expert. He introduced a method of anthropometrics by dividing the subject into two body types. His dichotomy, perhaps the forerunner of Sheldon's Somatotypes, included the phthisis dominated by the vertical dimension and Apoplectic dominated by horizontal
dimension. This body typing was no doubt a prototype of other's to follow. While Hippocrates studied physical types for medical purposes, Greek artists did so, for aesthetic reasons.

The Greek sculptors particularly were concerned with the ideal of physical perfection. However, they changed their idea regarding body perfection over the centuries from the heavy broad body type with emphasis on strength to the more a while skilled type with emphasis on symmetry and grace. The Greek athlete alone rivaled the Gods as subjects for sculpturing. It was a custom in Greece for Olympic victors to have statues of marble carved in their honour. The Romans tended to follow the Greek canons in this regard. Over the centuries other artists and sculptors carried on a similar type of anthropometrics as Vinci, Michel angles and Joshua Reynolds were classic examples. In the early 19th Century, Rotan, a Frenchman presented three physical types: Digest, Muscular airs and cerebral. These were definitely forerunners of Sheldon’s Somatotypes. However, the purposes were different. Earlier measurement stressed body proportions for the sake of art. Whereas more modern methods stressed social, emotional and intellectual factors of the unity 'mosaic'.

The testing movement in America began with the work of Edward Hitchcock at Amherst in the science of anthropometrics.
Artists and sculptors for aesthetic reasons historically had studied body symmetry and proportion, but emphasis now shifted to educators for scientific reasons. In the beginning most of Hitchcock's measurements centered around such factors as height, weight, age, reach, girth, vital capacity and same strength items. These measurements were repeated on the students at Amherst so that progress and gain could be shown. No doubt these first results were more of a concern for health as revealed through anatomic and physiologic aspects since Hitchcock was a medical doctor and responsible for the health of his students.

The fact is that many pioneer physical educators were physicians and had an impact on the advancement of the cause of measurement. It is thought by some that Hitchcock was probably influenced in these early years by the work of Archibald Macarena of England who, in addition to developing programmed in curriculum and methodology, also developed scientific techniques of measurements, including anthropometrics. The ultimate purpose of Hitchcock's measurement was to define the ideal physical proportions of man and with the results of a quarter century of measurement he was able to identify averages of the typical 'college man. In the famous 1885 meeting of pioneer physical educators, measurement was one of the chief topics of discussion.
To the work of Hitchcock was added the efforts of Dudley Allen Sergeant. Macarena and William T. Brigham, an anthropologist, no doubt influenced sergeant in his measurement work not only by Hitchcock, but also as he developed the body measurement idea even further. Starting in 1880 Sergeant devised more than 40 different measurements of the anthropometrics types and used them with his students at Hardware. From these measurement results, he attempted to present a type of norm of the typical or the ideal man and woman. In addition, through the use of these measurements he attempted to prescribe a programme of exercise for each student. His efforts to promote wider interest included the publication of a manual on measurement and testing. He also wrote articles for publication in journals. His system was adopted for use in both the public schools and colleges. These measurements emphasized symmetry and size and norms were established for each group with charts to show now each individual compared with the norm. The American Association for the advancement of physical education adopted his measurement system for use in schools and colleges and the YMCA adopted it to its uses.

Around 1880, emphasis of measurements shifted away from size and symmetry to strength. Even before the wane of interest in
anthropometries measurement, strength testing was being done. Hitchcock had included such testing as a part of his early programme at Amherst. However, Sergeant was the real pioneer in strength testing and was the first to perceive beyond the tape measure and weighing scales to recognize that capacity for performance was a more important quality than size and symmetry. Along with Brigham, Sergeant experimented with the dynamometer a device invented in the 1880's and devised a strength test composed of strength measure of the legs, back, hand grip and arms, clownish a measure of vital capacity item seems to have remained vestigial a part of the strength testing field to this day, although vital capacity no longer is locked upon with the same, confidence in regard to its relationship with actual strength.

Just as measurement evolved from size to strength, so it evolved to another level where body efficiency with respect to movement becomes the center of attention, rather than strength. However, strength-testing dial retuned to a place of prominence in the 1920's. It was revived and new tests were developed. The best known of these was desired by Frederick rangers. His scheme of testing was based on other strength test studies but he differed from them in the manner of test construction. His test was devised in a scientific manner and was shown to have a high relationship with
general athletic ability. Roger's ingenious use of the strength index and the physical fitness index makes this test of the true classics in the field. It has been used among other ways for purpose of classification.

1.5 Anthropometric and Physical Fitness Component Tests:

Not only for wrestling but for all games also men and women must be physically fit. Physically unfit is not able to stand in the arena for wrestling fight as having danger of injury, fracture or dislocation. Wrestling is very tough and hard game. Physical educationists accept strength is a primary component of physical fitness while freedom from disease organics soundness and proper nutrition are essential elements for physical fitness. The positive qualities of muscular strength and circulatory are also needed. It is these elements that the physical educator is trained to understand, interpret and use in developing physical fitness of the boys and girls, men and women.

Although strength does not measure all aspects of physical fitness yet the physical educators view the problems which deal with some basic elements of individual general physical status like height, weight, age and fat etc. The first basic and essential requirement for a wrestler or any other sportsman is to possess a strong and healthy body with a good posture. The idea of using strength as a measure
of physical condition is not new. The test involve following muscular groups for arms, upper arms, shoulder girdles back and legs. Therefore, the physical educationists have devised various tests to measure the static and dynamic strength. For example, grip test is applied for measuring the static strength and standing board jump for dynamic strength.

1.6 Physical Education for Women:

The great Greece Philosopher Aristotle suggested complete education for women. There must be difference in aims and objections of education for men and women. But due to globalization and modernization, great changes have taken place in every sphere of life. In the area of education, we are observing great changes also. Similar is the case with physical education. Women are trying to lead in every aspect of life and this trend is still increasing. Educational and physiological needs of women are converging with those of men. It is being stressed that the aims and objectives of education and physical education must be the same for men and women. More emphasis is being given for covering the gap between the men and women. Jane Show in a study of reasons for participating in YWCA physical education programme as expressed by school girls and women found that they come to gymnasium because they were not satisfied with their lives. They
felt that something was lacking in their life. They gave the following reasons for their participation:

1. To reduce or gain weight.
2. To learn correct postures.
3. To learn to relax and take things easily after working in the office.
4. To learn play skills like Tennis, swimming etc. so that they are able to play them on vocations or in spare time.
5. To learn social dancing so that they would become more popular.
6. To participate in the recreation programmes.
7. To have good company.

After interviews and analysis of the felt needs of girls and women, the following objectives were proposed:

1. Physical Fitness, organic vigor and efficiency. Knowledge of requirements or healthy living, nutrition, exercise and rest, relaxation, correction of physical defects and preparation for motherhood.
2. Personal appearance and beauty i.e. development of a beautiful and graceful body, development of a good posture and physical poise; elimination of physical defects effecting appearance, knowledge, color of hair,
complexion, nails, appropriate healthful clothing and so forth.

1.7 Application of Anthropometric Measurements:

The measurements of various dimensions of human body have long been used by different researchers all over the world for different purposes. In their simplest form these measurements are used to describe the human body and to the proper evaluation of increase in the size of the human body during various stages of post-natal development, i.e., from birth to old age, and also to study the changes during pre-natal period of growth, i.e., from conception to birth. The researchers in the field of human growth and development, Axiological Anthropometry as it is referred at present, use these anthropometric measurements to precisely study the age specific changes in the main body segments and the components of these segments. Through these changes the amount and rate of growth can be assessed for a specific child or a group of individuals at community or national level to formulate the respective health standards to assess the growth of children at both the levels.

J.J. Sue in 1755 used stature, trunk length, upper extremely length and lower extremely length, and provided first clear documentation of two main facts regarding body preparations during growth. She stated that the length of the trunk exceeds that of the
lower extremity until about 14 years, where after both lengths are equal and that the length of upper extremity exceeds that of the lower until about birth, where after the lower extremity is generally longer than the upper one. These facts about body proportions were used by various artists for correct depiction of human body proportions.

Alphonse Bertillon in 1879 used anthropometric measurements for distinguishing one individual from another. He considered head length, head breadth, length of left middle finger, length of right foot and length of left forearm as the primary set of measurements. Subsequently, he developed a secondary set of measurements incorporating sitting height, length of right ear, breadth of face and length of right middle finger in combination with eye colour for this purpose. For nearly two decades this system of body measurements was considered as the most accurate method of personal identification, where after it was eventually replaced by fingerprints in early 1900s.

The Pediatricians use some of these anthropometric measurements to detect the growth disorders manifested in children or the other clinical anomalies in growth of children. The most commonly used measurements are the body weight, height (stature) and the circumference of the head, chest and abdomen.
As all the body dimensions express an increasing trend with increase in age under normal circumstances, the deviations exhibited by a child from the normal path of development are indicative of retardation in growth of a child at that particular age. The human body continues to increase in all dimensions during the post natal period, i.e. after birth, approximately up to the age of twenty four years. This is the time when almost all the bones of the human body have undergone complete ossification at various centers of ossification. Thus, around this period we do not observe any apparent increase in the linearity or transversality of the body. The changes that occur in the different body dimensions after this age are mainly due to circumferential increase in various body proportions due to the accumulation of fat and formation of muscles. Besides certain specific measurements used for designing clothes, equipment, furniture, etc., most of them are used by the researchers engaged in the studies of human growth and development or axiology.

Various anthropometric measurements have their importance in the understanding of general body description and sexual dimorphism. For example, measurements like body weight, stature, height acromion, waist height, elbow height, wrist height, sitting height, sitting eye height, biacromial breadth, bideltoid breadth, hip
breadth, chest depth, chest breadth, neck circumference, shoulder circumference, chest circumference buttock circumference, wrist circumference, buttock circumference, thigh circumference, calf circumference, head length, head breadth, head circumference, hand length, hand breadth, foot length, foot breadth, bizygomatic breadth, bigonal breadth etc., are often used to study the generally body description.

In addition to axiological and general body description studies, the anthropometric measurements play a vital role in sizing of clothing and manufacture of personal protective equipments, for example, stature, body weight, waist height, crotch height, calf height, ankle height, elbow height, wrist height, mid shoulder sitting height, biacromial breadth, bideltoid breadth, hip breadth, chest breadth, chest depth, circumferences of the head, neck, shoulder, chest, waist, buttock, thigh, calf, upper arm, forearm and wrist, sleeve length, waist front, waist back, shoulder length, head length, head breadth, foot length, foot breadth. All measurements on fingers and hand, bizygomatic breadth, bigonal breadth and the various are measurements of the head and face, along with many other measurements are employed for the sizing of clothing and manufacture of personal protective equipments for head and face, hand, feet, and trunk etc.
Designers and agronomists have a constant need for up-to-date anthropometric data to design equipments, working situations and clothing, etc. for day-to-day use. Static and dynamic anthropometric data will provide the designers with wealth of body dimensions to generate new ideas. Generally, the wholesale manufacturers of clothing require static anthropometric data while dynamic anthropometric data is required for designing household furniture and fittings in different forms of transportation and in a wide range of industrial engineering, educational and medical establishments over and above their exclusive use in specific protective or insulated clothing.

Equipment designing is one of the most important aspects where majority of anthropometric measurements have their application in some or the other way in the production of automobiles and air craft etc. On the basis of the standardized measurements various household and office furniture items are designed for our day-to-day use. Body weight helps in constructing structural support for seats, platform couches and body restraint systems and harness rigging. Stature for example, is used in assessing the vertical clearance of work space and living quarters as well as supine clearance of beds and litters. Similarly from waist height one may get the height of the work space for standing
operation, while the sitting height provides an estimate of minimum vertical clearance from sitting surface for the seated operators (Figure-1).

Figure - 1 : Various positions of Arm in Standing position
The sitting eye height, provides an appropriate judgment of the vertical distance from the sitting surface to operator's eye for optimum vision of the work space. The mid-shoulder sitting height is of importance to know the placement of upper torso restrains for seated operator. The elbow rest height together with elbow clearance provides the vertical distance from the surface of the seat to the top of the arm rest for seated operator and sizing of arm rest in the chairs.

The shoulder-elbow length in combination with standing and sitting acromial (shoulder) height is of importance in establishing the vertical placement of work surface and controls in any industrial set up. The forearm-hand length, on the other hand, provides an estimate of minimum distance for work space layout with upper arm restrained. The buttock-popliteal length together with popliteal height and knee cap height provides an estimate of horizontal distance from rear to front edge of the seat pan and vertical distance from floor to seat pan edge for the seated operator. Thigh clearance provides the vertical clearance from the seat surface to the under like bideltoid breadth and maximum body breadth provide the minimum dimension of crawlways, breadth of cockpits and other allied work spaces. The chest breadth, waist front and waist back
are useful for sizing the torso worn personal protective equipments like body armor, respiratory pack and back packs etc. The vertical trunk circumference is used in preparation of straps and webbing for restraint systems and rigging, while shoulder length helps in providing the standardized values for width of straps and webbing of restraints systems and suspension of packs and harnesses. Head length, head breadth, head circumference, facial breadths and lengths and the various arc measurements pertaining to head and face are used in the production of protective head gear and equipment suspension systems and facial masks etc. The hand breadth provides the width of the hand grasping surface for the production of handles and other hand holds. The menton-to-nasal root distance together with nasal breadth and mouth breadth provides the length of the respiratory face pieces and oral-nasal gas masks. The bizygomatic breadth and the facial arc measurements are used for the production of face shields and 'respiratory face pieces'. Anterior neck length, posterior neck length and neck circumference together provide the dimensions for the production of collars worn around the neck. Anterior arm reach, arm reach from the wall and functional arm reach provides the estimates for the minimum work space requirement for the operators in standing position. The length and breadth of the ear is useful in sizing of ear
phones and allied equipments. The maximum over head reach and the arm reach upward are useful in understanding of the maximum vertical space requirements for standing and seated operators in industrial set up. The maximum span provides an idea about the maximum horizontal dimension of work space. Nipple-to-nipple distance over cervical, strap length and bust circumference are used in the production for female protective wear.

Sitting is a means of changing posture and bringing rest to the body by reducing fatigue. Sitting can be a painful process on a poorly designed seat. A good seat should have adequate space for easement to support the best sitting posture for a longer duration. A seat needs to give rigid support but not rigid confinement. It should be designed in such a way to support the thorax and pelvis and help to maintain the angle of the spine between for which the design of back rest is important. Besides these, other measurements like, seat breadth, seat circumference, elbow rest, seat height, seat length, maximum seat width below the hips etc. are required for proper production of chairs for day-to-day use and other seating mechanisms for seated operators in automobiles, air and space crafts and other industrial organizations (Figure-ll). It is necessary to have adjustable seating for industrial and health care works because adjustable head, back, arm and foot rests can lend support to a
more effective use of body when seated. Apart from that individuals with variable size and form can function from the same adjustable Seat.

Figure – 2: Various positions of Arm in Sitting position
The various dimensions of the human foot, for example, the length, breadth, circumference, height etc., are primarily required in the production of foot wear of any kind. Similarly the numerous measurements of hand have their application in the manufacture of the hand worn objects and sizing of various hand holds, knobs, finger and hand grips, switches and handles etc.

In order to study body linkage and construction of models, the anthropometric measurements play an important role. Certain specific measurements pertaining to the head, face, trunk and extremities like shoulder height, trochanteric height, height tibiale, wrist height, sitting height, sitting eye height, shoulder-elbow length, forearm-hand length, buttock-popliteal length, buttock-knee length, biacromial breadth, bideltoid breadth, head length, head breadth, head circumference, foot length and foot breadth, various facial dimensions, ear length and breadth, stature and body weight are primarily used for the construction of models and to the understanding of body linkage.

Identification of talent in sports is of great importance. The selection criterion used during the past lacked scientific approach, as a consequence the performance of various athletes in different sport
events suffered. Kinanthropometry, which emerged as a scientific discipline, has changed the sports scenario all over the world since 1972 (Ross et al., 1980). As a sports science, the role of Kinanthropometry or Sports anthropometry (as it is commonly known in Europe) is highly apposite in identification of individuals, at a relatively younger age, which could be ideal for a specific sports event, through different body measurements. For example, individuals with tall stature, long legs and shorter trunks are best suited for events like jumping, hurdling and vaulting. Individuals with average stature, short legs and narrow shoulders are most ideal for long distance running, while tall and heavy muscled individuals with long legs and broad shoulders in relation to hip breadth are best suited for 400 meter running. Similarly tall individuals with greater arm reach and longer legs have an added advantage in events like basketball, volleyball, pole vault, long and triple jumps. The high jumpers, on the other hand, are tall individuals with probably the longest legs relative to their trunk, than the other athletes.

Thus incorporating the use of anthropometric measurements like, stature, body weight, trunk height, leg length, arm length, arm reach, calf length, thigh length, biacromial breadth, bicristal (hip) breadth, foot length, foot breadth, chest circumference, abdomen circumference, upper arm circumference, thigh circumference, calf
circumference, hip circumference, bicondylar humerus, bicondylar femur, ankle breadth, wrist breadth and skin fold thickness and various sites, and using certain body indices, like shoulder-hip, skaldic, tibia-femoral, shoulder breadth-stature, lip breadth-stature, chest-stature, leg-stature, arm-stature, shoulder-trunk, hip-trunk, thigh-leg etc., individuals could be identified for training in specific sport events. But to achieve optimum results regular exercise, recommended nutritional intake and proper training by the expert coaches is necessary.

Another important aspect of study pertains to the assessment of nutritional status with the help of body measurements. This aspect is more aptly referred to as nutritional anthropometry.

Nutritional anthropometry deals with the measurement of the physical dimensions and gross composition of the human body, at different age levels during the post natal period of growth, and degree of nutrition. Growth of a human body is primarily influenced sex, intra-uterine environment, order of birth, birth weight in single and multiple pregnancies, parental size and genetic constitution, and environmental factors like season, climate, socio-economic level and nutrition. It has been observed that the environmental factors, especially nutrition plays a major role in influencing growth of a child than the genetic composition or other biological factors. The
physical dimensions of the body are influenced much more by nutrition than other factors during the period of rapid growth i.e. the early childhood period. Certain specified body measurements can provide useful information regarding certain types of malnutrition in which body size and gross body composition are affected.

Anthropometric measurements are only one of the numerous techniques that evaluate nutritional status. Food intake data, direct photon absorptiometry, hematological determinants and serum and urinary vitamin determinations are other techniques that play a part in complete assessment of nutritional status. Anthropometric measurements are considered as one of the initial assessment methods because they are relatively cheap, easy to understand and yield immediate results. The ultimate choice of the measurements will depend upon the situation in which nutritional surveillance is required. Garn (1979) recommended the measurements of the weight, height, leg length, head circumference, upper arm circumference, chest circumference, calf circumference and skin fold thickness at triceps, biceps, sub-scapular, suprailiac and abdominal regions and assessment of skeletal maturity for optimal assessment of nutritional status.

Height and weight are obvious base-line measurements that help in identifying a child in the context of his or her peers both
socially and ethnically. Leg length is important due to the differences observed in relative leg length between different populations. Measurement of head circumference is important to exclude developmentally retarded and neurologically impaired children from the nutritional growth failure when the chest or arm fail to increase relative to head growth as observed in case of protein-calorie malnutrition. Arm circumference may be used in the same way or related directly to standards. Chest circumference is used in relation to head circumference to assess normal development of a child before the age of two years. The skin fold measurements are important indicators of fatness. The use of skeletal maturity in nutritional assessment is to provide some developmental basis for subject comparisons. It is often used when exact age is not available or difficult to determine. Age of an individual can be estimated through different maturity rates.

The nutritional assessment would thus involve height and weight for age, weight in relation to height, head circumference, chest circumference, upper arm circumference and triceps skin fold for age. Besides these, the upper arm circumference may be considered in relation to height and/or weight.

Specific importance of these measurements is detailed below:
1.7.1 **Body Weight:** It is the most useful anthropometric measurement which relates to the body mass as its potential value is not only appreciated by the health personnel, but often by parents for whom it is a useful source of health education. The prevalence of protein–calorie malnutrition is best indicated by weight deficiency in children of all age groups. For proper evaluation of significance of weight on growth it must be studied in combination of other appropriate body measurements and clinical examinations.

**1.7.2. Height or Stature:** Height or stature of an individual is another important anthropometric measurement which sums up the linearity of the body. Height of a person is composed of legs, pelvis, trunk (spine) and the head and the face. These components of the stature are of importance in any study pertaining to the assessment of growth in different body proportions and for other general and specific purposes. But in the field of nutritional anthropometry usually the total height (or length in case of infants) is measured.

1.8 **General Motor Ability Test and Wrestling Players:**

General motor ability has been considered as one’s level of ability in a wide range of activities. It has been thought of as an integrated component of such individual traits e.g. strength, endurance, power, speed agility, flexibility, reaction time and coordination. These traits function in a coordinated manner and
effective sequence to perform an accurate and efficient movement, whether this is a single movement as in gold drive or a sequence of complex and rapidly changing movements as in wrestling. Sports motor tests are the most important tools, which can be used by a coach to assess the level of motor abilities, skill and tactical efficiency tests of motor abilities are the responsibilities of sports training science and the sports both.

1.9 Significance of the Study:

The sports scientists have found out that there are specific anthropometric measurements and physical fitness components pertaining to a particular sport. The muscular strength and grip as well as body composition has positive correlation with performance in sports. Various investigations have been undertaken in various games but the literature relating to women wrestling is very rarely available. The present study will serve as guidelines to the teachers of physical education to fix the norms of anthropometric measurements and physical fitness components of women wrestlers and to further research projects in this field will be helpful in planning out a programme of national women wrestlers on the basis of findings and conclusions. Thus, it would lead to improvement of standard in wrestling for excellence.
1.10 Statement of the Problem:

The present investigation has been taken up to find out scientific methods of assessment of national female wrestlers. The statement of the problem of the present investigation has been defined as under:

"ANALYSIS OF ANTHROPOMETRIC MEASUREMENTS AND PHYSICAL FITNESS COMPONENTS OF WOMEN WRESTLERS"

1.11 Definitions of the Terms:

In the present study, a few terms have been used that have got specific meaning for the present investigation. The definitions of the terms are given as under:

1.11.1. Anthropometric Measurements:

The following measurements of the body were taken for comparing the body measurements of Women Wrestlers and Women Non-Wrestlers:

1.11.1.1: Total Arm Length: Length between acromion to Dactylion was counted as total Arm Length.

1.11.1.2: Trunk Length: For measuring trunk length, the difference between height and leg length was taken.
1.12.0 Physical Fitness

Physical fitness is used in two meanings: general fitness (a state of health and well-being) and specific fitness (a task-oriented definition based on the ability to perform specific aspects of sports or occupations).

Physical fitness in the words of Clarke is considered as “the ability to carry out daily tasks with vigor and alertness without undue fatigue and ample energy to enjoy leisure time pursuits and meet unforeseen emergencies.”

According to Brune Balke, a medical doctor, 'physical fitness depends on the individuals’ biodynamic potential i.e. composed of his function and metabolic potential’. The best test of physical fitness is man’s ability to survive under extra ordinary biological demands.

The concept of physical fitness implies that physical fitness is more than "not being sick" or merely "well being". It is a positive quality extending on a continuum from death to abundant life. Thus living individuals have some degree of physical fitness, which is minimal in the -severely ill, and maximal in the highly trained athlete. It varies considerably in different people and in the same person from time to time.
1.12.1 Strength:

Strength is the ability of the muscle to work against resistance. It is a conditional ability and involves a combination of three components i.e. the contractile forces of the muscle causing the movement, ability to coordinate several muscles involved and the mechanical ratios of the lever (bone) arrangements. It is perhaps the most important ability in the sports as it is the direct product of muscle contraction. In games and sports, all the movements are caused by muscle contractions and thus strength assumes an extraordinary importance in achieving excellent performance.

1.12.2 Flexibility:

Flexibility may be defined as "the functional capacity of the joints to work through a full range of movement". The length of the muscles, ligaments and tendons largely determines the amount of movement possible at each joint. Again it should be stressed that flexibility is not a general component but is specific to each joint. It is, therefore, not possible to measure flexibility by just one test. Each movement that is possible at each joint must be measured if all aspects of flexibility are to be evaluated. There is no one test that can measure a person's overall flexibility.

Anthony has defined flexibility, "as the range of joint motion". It may be further defined as extent flexibility, the ability to extend
joint motion as far as possible or dynamic flexibility, the speed in flexing and extending movement.

1.12.3 Agility:

Agility is the ability to change the body's position and requires a combination of balance, coordination, speed, reflexes and strength. In sports, agility is described in terms of response to an opposing player, moving target, as seen in field sports and racket sports. Sheppard and Young (2006) defined agility as "a rapid whole body movement with change of velocity or direction in response to a stimulus."

Agility is the ability to change body position or direction of the body rapidly. This ability is measured with running tests that require the subject to turn or start and stop. Agility is also influenced by balance, coordination, position of center of gravity, running speed and skill. Agility can be improved by practicing specifically for a sport but also by improving the specific individual elements of speed, balance, power and co-ordination.

1.12.4 Endurance:

Endurance is characterized by the maintenance of working capacity and by the degree of resistance of the organism against fatigue and against the influence of unfavorable environmental conditions. It is also characterized by the pace of recovery after a
tiresome activity. Endurance loads cause numerous changes in the functions and structure of the organism. These changes refer to the performance of heart, circulation, respiration, metabolism, hormonal system and bio-chemical changes in the human cell.

1.13 Physical Fitness Tests:

For measuring physical fitness of Women Wrestlers and Women Non-Wrestlers, the following tests were used:

(i) Grip Dynamometer – for measuring Static Strength.

(ii) Standing Broad Jump – for measuring Dynamic Strength.

(iii) Jumps and Reach – for measuring Power (Legs).


(v) Sit Ups – for measuring Power (Abdomen).

(vi) Toe Touch Bend and Twist – for measuring Flexibility.

(vii) 30' Shuttle Run – for measuring Speed and Agility.


1.14 Experimental Tools Used:

(i) Skin Fold Caliper

(ii) Steel Measuring Tape

(iii) Stediometer (Anthropometer)
1.15 Performance Analysis:

The performance test, which is prescribed by the International Wrestling Federation was applied for the assessment of Women Wrestlers.

1.14 Variables Used in the Study:

1. Independent Variables:
   i) Weight
   ii) Height

2. Dependent Variables:
   i) Total Arm Length
   ii) Trunk Length
   iii) Standing Broad Jumps
   iv) Push Ups
   v) Jump & Reach
   vi) Sit Ups
   vii) 30' Shuttle Run
viii) Toe Touch Bend and Twist
ix) Grip Test Left Hand
x) Grip Test Right Hand
xi) Body Density
xii) Harvard Test

1.15 Objectives:

The main aim of the present study is to act with some transparent measuring devices for purpose of attaining certain objectives, therefore, the investigator embarked upon the study in pursuit of the following objectives:

1. To find out the anthropometric measurement of national women wrestler’s height, weight, percent fat, lean body weight and limb length of extremities.

2. To find out some physical fitness components which correlated for successful performance in wrestling?

3. To analyze performance of the national wrestlers in various skills during wrestling competition and to find out areas of strength and weakness of wrestlers.

4. To compare the fitness level of the national female wrestlers among themselves and with some of the top ranking
international female wrestlers and non-wrestlers (participated in other games except wrestling).

5. To suggest some important measures for improvement of present performance of the national female wrestlers.

1.16 Hypotheses:

1. There is no significant difference between the means of Total Arms Length of women wrestlers and women non-wrestlers of different weight groups.

2. There is no significant difference between the means of Trunk Length of women wrestlers and women non-wrestlers of different weight groups.

3. There is no significant difference between the means of Standing Broad Jump of women wrestlers and women non-wrestlers of different weight groups.

4. There is no significant difference between the means of Push Ups of women wrestlers and women non-wrestlers of different weight groups.

5. There is no significant difference between the means of Jumps and Reach of women wrestlers and women non-wrestlers of different weight groups.
6. There is no significant difference between the means of sit ups of women wrestlers and women non-wrestlers of different weight groups.

7. There is no significant difference between the means of 30' Shuttle Run of women wrestlers and women non-wrestlers of different weight groups.

8. There is no significant difference between the means of Toe Touch Bend and Reach of women wrestlers and women non-wrestlers of different weight groups.

9. There is no significant difference between the means of Grip Test Left Hand of women wrestlers and women non-wrestlers of different weight groups.

10. There is no significant difference between the means of Grip Test Right Hand of women wrestlers and women non-Wrestlers of different weight groups.

11. There is no significant difference between the means of Body Density of women wrestlers and women non-wrestlers of different weight groups.

12. There is no significant difference between the means of Harvard Step Test of women wrestlers and women non-wrestlers of different weight groups.
13. There is no significant difference between the means of Total Arms Length of women wrestlers and women non-wrestlers of different height groups.

14. There is no significant difference between the means of Trunk Length of women wrestlers and women non-wrestlers of different Height Groups.

15. There is no significant difference between the means of Standing Broad Jump of women wrestlers and women non-Wrestlers of different height groups.

16. There is no significant difference between the means of Push Ups of women wrestlers and women non-wrestlers of different height groups.

17. There is no significant difference between the means of Jumps and Reach of women wrestlers and women non-wrestlers of different height groups.

18. There is no significant difference between the means of Sit Ups of women wrestlers and women non-wrestlers of different height groups.

19. There is no significant difference between the means of 30’ Shuttle Run of women wrestlers and women non-wrestlers of different height groups.
20. There is no significant difference between the means of Toe Touch Bend and Twist of women wrestlers and women non-wrestlers of different height groups.

21. There is no significant difference between the means of Grip Test Left Hand of women wrestlers and women non-wrestlers of different height groups.

22. There is no significant difference between the means of Grip Test Right Hand of women wrestlers and women non-wrestlers of different height groups.

23. There is no significant difference between the means of Body Density of women wrestlers and women non-wrestlers of different height groups.

24. There is no significant difference between the means of Harvard Step Test of women wrestlers and women non-wrestlers of different height groups.

1.17 Delimitations:

1. The study was confined to the selected anthropometric measurements and physical fitness components.

2. Only those women wrestlers belonging to different states who competed in the National and International Wrestling Championship were taken as subjects.
3. The present study was delimited to 100 women wrestlers from different states who participated in the National and International Competitions.

4. 100 Women Non-Wrestlers (Boxing) were also included for making it a comparative study.