UNIT 3 KINANTHROPOMETRY

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Learning Objectives
Once you have read this unit you will be able understand:
➢ the meaning of kinanthropometry;
➢ how the knowledge of kinanthropometry can be used;
➢ the relation between kinanthropometry and anthropometry; and
➢ its relevance in different fields.

3.1 INTRODUCTION

The early 1970s witnessed emergence of a new scientific discipline called Kinanthropometry. Kinanthropometry comprises of three Greek words kinein (to move), anthropos (man) and metrein (to measure) referring to the dynamic relationship and quantitative interface between human structure and function. It is defined as the study of human size, shape, proportion, composition, maturation, gross function and cardiorespiratory function, which enables to understand growth, exercise, performance, and nutrition. Ever since that time kinanthropometry has grown to be an all-encompassing scientific interest; with the application in research related to auxology, physical anthropology, human biology, physical education, sports science and medical science. Dynamic anthropometry, sports anthropometry, physiological anthropometry all these terms used by different scientists can be contained in the sphere of kinanthropometry. The predominant focus is on obtaining detailed measurements of the body composition of individuals for application in varied fields.

Kinanthropometry is a medium for individuals to contribute to basic research and applications and is closely associated to physical education, sports science and medicine, human biology, science of growth, physical anthropology, gerontology, ergonometry, and other several disciplines. It is a scientific specialisation dealing with body measurements in a variety of morphological perspectives, its application to movement and those factors which influence movement, including: components of body build, composition, proportions, shape and maturation; cardio - respiratory capacities and motor abilities; physical activities including recreational activity as well as highly specialised sports performance.
3.2 APPLICATIONS OF KINANTHROPOMETRY

The application of kinanthropometry holds significant position in various fields. Kinanthropometry is adjudged as the specialisation of science concerned with the measurement of human body composition and is considered as the cross point between anatomy and movement. In its application it involves a series of human body measurements and the data thus gathered directly or calculated are used to produce various indices to describe physique. Keeping in view the changing lifestyle, nutrition, activity levels and ethnic composition of populations, changes in the distribution of body dimensions are forever occurring. This is where kinanthropometry plays a significant role by using human body measurement and determining its capability for function and movement in a range of setting.

Kinanthropometry is analogous to mechanistic approach to human motion i.e. anthropometry. However, the studies in kinanthropometry are confined to width, length and girth measurements instead of alterations that arise in the human physique out of physical training.

The contribution of kinanthropometry lies in solving problems related to growth, nutrition, exercise and performance. It is concerned with the application of measurement to assess human size, shape, proportion, composition, maturation and function. It puts an athlete into objective focus and gives a clear evaluation of the individual structural status or provides for quantification of differential growth and training influences. Without understanding growth of individuals and their structural evolution, selection of talent and monitoring of training would not be productive. Kinanthropometry provides the indispensable structural basis for the consideration of athletic performance.

Kinanthropometry has been widely used in predicting the increasing secular trend in body size of people and among different populations world-wide. The criteria developed for this research can be used as standards for recruitment in disciplined forces, as well as for streamlining and improving the basic measurement scale for the manufacture of uniforms and equipments.

The human body has been studied for thousands of years, but the introduction of the concept of body compartments study and a progression from the study of corpses led to the increasingly accurate quantification of the living human physique. As a result of increasingly precise evaluation of human body there has been development of numerous theories, advanced approaches and techniques, and inventions of sophisticated instruments. There are various concepts that lead to further understanding of the human physique. Kinanthropometry along with anthropometry, somatotyping, human anatomy and physiology is one such method. Somatotyping is one of the most useful methods of evaluating human physique. It is a physique classification system of quantified expression description and describes the physical characteristics of the body and allows a definition of body type through the analysis of its components. Somatotype is the description of body type based on three components of endomorphy, mesomorphy and ectomorphy. Endomorphy is the relative fatness; mesomorphy is the relative musculo-skeletal robustness, while ectomorphy is the relative linearity or slenderness of a physique. A somatotype is usually given as a composite of three numbers, in which each number demonstrates the strength of
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the respective component parts. The Heath-Carter method defines somatotype as a quantitative description of the present shape and composition of human body. The most widely used somatotyping method is that of Heath and Carter which is the classical method of anthropometric somatotype. The technique of somatotyping is used to evaluate body shape and composition. Therefore, somatotyping together with application of kinanthropometry could benefit other fields like the clothing industry by improving the traditional sizing systems by means of reference to the structure and function of the human body.

In the current scenario, the growth of sports and physical education of any country is much dependent on the development of sport sciences which have contributed significantly in the developed countries. Kinanthropometry is one such science in this context. Combining the integral approach using both applied and basic sciences the standard of sports and competitive performance can be developed.

The field of kinanthropometry in recent years holds a very significant role. The importance of morphological characteristics in the performance of sports events has certainly been recognised. It becomes imperative to study the morphology of sportspersons in order to make an assessment of how close their physique and morphology is with respect to the champions at various levels. The physique of the Olympic players can be considered to be ideal in their respective events. Nevertheless, just about every time the new records are being set up, there comes up reports on humans getting bigger, larger and maturing faster during more than ten decades. This implies that the most desirable physique of today may not exactly be so in future, however, with no compromise on muscularity.

The investigations through kinanthropometry are of fundamental significance in creating the pre-requisite as well as trainable characteristics of sportspersons and athletes. Stature, leg length, arm length etc do not seem to change under normal circumstances. Therefore, athletes in a particular sport need to have such distinctive characteristics which would benefit him/her during the game. It has been documented that the accomplishment of these characteristics will aid an athlete to perform better during competition. The information provided can be used as a norm for assessing the performance status.

The performance in any event of sports is a result of multifaceted and complicated range of variables, which include variety of factors including physiological, biomechanical and skill traits within different sports. The anthropometric dimensions of an athlete specifying body shape, proportionality and composition, are factors that contribute to play vital role in shaping the probability for success in a chosen sport among elite athletes. Hence, it can be said with conviction that athletes with ideal body type for a particular sport will remain competitive. The characteristic body shape which we observe within sports today are a consequence of both natural selection of thriving body type over consecutive generations, and an adaptation to the training demands within the present generations. It is here that kinanthropometry which is concerned with the study of body composition, somatotype and proportionality play a pivotal role for athletic training and selection of talented persons. In unison these three characteristics explain an individual’s morphological profile, which provides as a foundation for planning and monitoring athletic training. Despite the fact that sports performance are reliant on several factors, and winning an event requires much more than an individual player’s build and physical fitness, yet the anthropometric
characteristics of the most successful athletes may serve as a guide in selection of talented probable.

Body composition refers to the categorisation of body weight in terms of absolute and relative amounts of fat mass and fat-free mass. Estimation and evaluation of these characteristics constitute a very important facet of health, nutritional status and physical fitness assessment. As mentioned earlier, somatotype is a classification of the human body comprising to the three essential elements: endomorphy, or relative adiposity; mesomorphy or relative musculoskeletal development; and ectomorphy or relative human linearity. The relationship between different body dimensions and stature are described by human proportionality. This is an extremely vital concern for any person who wishes to practice sports. This holds significance given that this relationship is linked with a person’s physical ability to meet the biomechanical demands of a particular sport or even playing position within a given sport. It is established that athletic skill and feat, as well as propensity for a particular sport, depend greatly on proportionality.

3.3 KINANTHROPOMETRY AND ANTHROPOMETRY

Since athletic performance for a particular sport, depend greatly on proportionality, the role of anthropometry is vital as it is where we can attain an account of the physical dimensions of athletes through it and then evaluate the relative meaning of these body dimensions by comparing two aspects. Using for example the mean of the anthropometric variable for the athletes and comparing this to other reference populations. These investigations assist us to enumerate the value of characteristic body structures and to recommend functional advantage for athletes in particular sports. The bright side of such results would show, more the mean of the sport resemble the mean of the population, more are the chances of potential pool of athlete from which to select.

The commonly used measures for anthropometric profile for athletes giving high-performance are stature, sitting height to stature ratio, upper limb length to stature ratio, brachial index (ratio of length of the forearm to length of upper arm) and level of body fatness assessed using the sum of skinfold, wasit hip ratio, waist height ratio and body mass. Let us understand each of these.

Stature plays an important role in the success of any sport event. An excellent example showing the magnitude of the interaction of height and other physiological performance can be best understood in running events. Have you ever noticed that as one moves from the shorter distance races to the marathon; that is at both the extremes; in terms of height of the athletes, most of them are short? What could be the reason for it? The shorter distances have a comparatively longer acceleration segment and consequently slightly low mean speed which support shorter athlete with relatively short legs whereas in longer distance, excess muscle mass is hindrance, necessitating substantial energy to be exhausted for its transportation and yet has relatively low power production. This, demands the athletes to be typically small lean and have low body mass index. Short stature is predominantly favourable in acceleration and changing direction. It permits decrease in moments of inertia which owing to conservation of angular
momentum throughout angular motion make easy increased angular velocity. Thus, smaller athlete can spin faster achieving more turn than tall athletes and are beneficial for events such as gymnasts, skating ballet and diving. Nevertheless, some pressure is manoeuvred towards selection of bigger athletes as they are competent requiring a relatively lower energy cost per distance travelled. It is known that maximum force produced by body is proportional to cross-sectional area of each muscle and since muscle and bone of smaller athletes are stronger in proportion to body weight, it gives them more agility and are less likely to get injured from high velocities activities and hard landing resulting from sports such as rock climbing, ski jumping etc.

It is not that tall stature does not have any importance in sports. Sports such as volley ball, basket ball, rowing etc. are favourable to tall statured athletes. Tall players’ requirement is to take jump lower relative to percentage of their stature; this facilitates them to reach above net height for the ball.

Sitting height to stature ratio gives a suggestion of the relative length of the legs to stature. The extremes in the ratio are found for athletes in sports requiring upper body segments such as wrestling and weightlifters. Sports such as volley ball, basketball etc which has the component of jumping need relatively short trunks. Successful rowers have proportionally longer limbs and shorter sitting height which provide a mechanical advantage during competition by allowing longer stroke length. Additionally shorter sitting height lessens front surface area, a source of resistance to moment.

Upper limb to stature ratio is negatively correlated with sitting height to stature ratio. This means that individuals who have relatively long trunks will have relatively short arms. Longer arms are beneficial as they mechanically present longer stroke length useful in swimming and rowing. In throwing events it also gives the athlete a longer lever to accelerate an object. Long arms exploit the release velocity of the object, giving the largest distance for amount of muscle mass. Athletes such as shot putters, javelin or discus throwers who need a single and large push also benefit by this sort of relationship. As per the understanding of many researchers greater shoulder width and arm length could be an advantage in throwing tasks. In case of swimming strokes it is the shoulder joint that provides the majority of propulsive force.

Brachial index is represented as length of forearm relative to the upper arm. A high brachial index, in general, is beneficial for sports in which longer propulsive drive of the forearm is desirable. A high brachial index facilitates for longer stroke length, since the forearm is a longer lever resulting in increasing the velocity of the hand at the end of the stroke. It contributes as an important factor in throwing sports as javelin and discus where the athlete wants to have the thrown object at the highest possible velocity the moment it leaves the hand; on the other hand, a lower than average brachial index present better strength and stability, whereas an athlete who has a low brachial index tends to have short force arms which benefit in athletics such as shot put in which an immensely strong push is needed. This arises since the muscle mass is more concentrated in the arm.

Body mass and body fatness too play a vital role in certain sports events. Take the case of rowing. It is purely the forward motion of the shell or boat which is
the absolute power that the oarsperson generates. In the throwing events, body mass is one of the factors responsible for performance, along with the acceleration of the implement prior to its release. But the work capacity decrease with the increase in body fat as the increased body fat acts as dead weight. In sports which essentially require speed or explosive power e.g. sprinting or jumping, excess fat will increase the body mass and decrease acceleration. In view of the fact that heat generated in the course of increased metabolism of the working muscle ought to be lost via evaporation, convection and radiation, the body surface area to body mass ratio is of great meaning in the efficiency of heat dissipation. As observed in leaner counterparts, the heat loss is more effective when the ratio is higher. The amount of heat energy necessary to raise the temperature of a given mass of adipose tissue is lower than that of fat free mass due to the fact that there is difference in water content. A given heat load consequently increase the temperature more in over fat than their leaner counterparts.

Nonetheless, in swimming, body fat provides greater bouncy to swimmers and adds to enhance efficiency by decreasing hydrodynamic drag. This is due to the fact that fat layer acts as thermal insulator to conserve body heat in the water, in spite of high rate of heat production during competition. Not considering the type of sport discipline, on an average, athletes are less fat and more muscular than non-athletes.

It is realised that body weight does not convey the total picture regarding the fitness of sportspersons. In most of the sports there is lesser requirement of extra fat providing greater mass of muscles and bones. It has been observed that those athletes have been found to be superior in performance in sports like football, shot-put and weight lifting. Athletes who possess considerable amount of adipose tissue have increased energy demands due to inert weight of fat, consequently, rendering the work more difficult to carry out in endurance activities where the body has to move longer with greater weight. This could perhaps be reason for long distance runners to be less fatter than other runners in lower level competition. It thus becomes evident that body fat plays an important role in sportspersons which needs to be determined.

Lean tissue and subcutaneous tissue have vital function to play in physical performance. These two components are known to influence physical performance and vice versa which means that the participation of an individual in demanding physical activity increases or decreases the amount of lean and subcutaneous tissue. Generally it is observed that in players subcutaneous tissue is less and lean tissue is more. Also, due to the nature of activity in the field it is observed that the two components may differ even among the players of the same game. Let us take hockey as an example. Among hockey players lean tissues play significant role in forward halves because more muscular upper extremity facilitates the players to hit the ball with force and similarly more muscular calf allows the player to run fast and it is also recognised that a lot of running around is required. The less amount of subcutaneous tissue also aids the player while running as the players will have to carry less weight.

### 3.4 RELEVANCE OF KINANTHROPOMETRY

Kinanthropometry is an emerging scientific specialisation encompassing the application of measurement to evaluate human size, shape, proportion,
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composition, maturation and its gross function. It is a crucial discipline for problem-solving in matters related to growth, exercise, performance and nutrition.

The application of kinanthropometry has been extensively used in envisaging the secular trend in increased body size of and among different ethnic groups worldwide. The criterion developed using research in kinanthropometry can be used as standards for physical recruitment in the armed forces as well as streamlining and improving the fundamental measurement scale for manufacturing uniforms and designing of furniture.

Body measurements of an individual hold significant position in the performance of sports and as such these represent a critical element in the selection of the athlete. We are familiar with the fact that a shot putter cannot give good performance in the sprinting event and vice-versa. There has been number of studies which have been conducted on physique and body composition of athletes and sportsperson which reflect that the physique and body composition are explicit in athletes and sportspersons of different physical activity.

Dental age is one such method which can be used in assessing the degree of physiological maturity of a growing child. The emergence of dentition at a particular age especially from six months to two years for deciduous dentition and five to thirteen years for permanent dentition present decisive factor of developmental age or it may be used as an index of physiological maturity.

There is a strong relation between adult stature of an individual and his stature at childhood. It is a well recognised reality that stature is a key morphological feature in majority of physical activity. The major task ahead of sports counselors/coaches is to direct the sports probable in opting for an athletic activity ideally suited to their adult stature well before their adult age. This would facilitate them to undertake explicit training in particular athletic events. There is lot of significance attached to the adequate calculation of adult stature and if feasible of other physical dimensions in childhood. This would be a significant yardstick to sports counselors for facilitating the sport probable in making a choice of a particular sportive activity best suited to their prospective adult physique and body characteristics. It goes beyond saying that such a counseling may go a long way in steering clear of frustration caused after years of dedicated training by those probables whose probability to attain the requisite physical status as an adult are only slim. The distribution of height varies notably in different sportive activities. It holds lot of significance that a good number of physical activities are initiated by some of the sportsmen at the preadolescence age. Consequently the sports counselor or coaches may possibly suggest the most suitable physical activities to the sports probable say aged 9-11 years, keeping in view their adult stature. Additionally, another responsibility of the sport counselor could be to redirect the young children interests to some other appropriate physical activity if they are following some incorrect physical activity due to change in different requirement of adult stature than that anticipated to be accomplished by them at childhood. Such corrective steps are likely only if suitable prediction standards are available to sports counselors/coaches.

Physique and body composition play an important role in influencing the physical performance of an individual. It has been noted that there is variation in growth status during the adolescence period within the children of the same age groups.
Regular physical activities during childhood are responsible for a positive influence on the performance of an individual throughout growth. This pattern of transformation according to age in physical activity events brings out the meaning of training as one of the essential factor in the progress. The attainment of distinctive physical characteristics is of basic significance for sportsmen of many sportive activities. Being short of such a characteristics is expected to limit their performance during competition, particularly when such characters cannot be altered by training e.g. under normal conditions.

Kinanthropometry’s significant goal is to study variations in various body measurements not only among different individuals but also among different populations. This facilitates in understanding the growth process and maturation in individuals, subsequently its bearing upon physical performance and work capacity of the individual.

Kinanthropometry aids in recognising and discovering the mystique of various dynamic processes and phenomenon of life. Let us appreciate it from the viewpoint of a human biologist. He may be interested in understanding the dynamic pattern of height growth of an individual. What could be the reason of size change with age of a person? He would measure a child’s height at different ages and realise that it does not increase uniformly with age and there is variation. He would then look for answers at different levels: tissue, cellular and molecular.

A large fraction of kinanthropometric work deal with physical performance. A person can be trained for physical stamina on the basis of kinanthropometric studies. There are specific training programs available for developing strength, local endurance and cardiorespiratory endurance to their maximum. A training program can be designed to match the specific energy source needed for an athlete specific event or contest. The effect of training depend upon the type of exercise involved in the training program, the individual’s previous level of training, and how dedicated and motivated the individual is. There are some specific principles and guidelines underlying the development of muscular strength and endurance as well as aerobic and anaerobic fitness of an individual. The type of exercise performed plays an important role in influencing the increase in blood pressure. For example isometric type work generally causes a greater increase in blood pressure than isotonic exercise. Prolonged physical work in untrained subject leads to much quicker fall in systolic blood pressure (which indicate nearing fatigue) than for the trained person. Endurance training also improves blood pressure recovery process after exercise. In other words, the blood pressure of the trained person returns to the pre-exercise level sooner than it does for the untrained person. Other factors which affect blood pressure and heart rate of a person are: age, sex, posture, and emotion.

The uniform manufacturers can make use of the information provided by kinanthropometry and somatotyping of the body configurations to fine-tune their patterns and sizing system. The application of kinanthropometry also involves phenotype as well as the morphological change of the discipline personnel before and after physical training. By making use of the kinanthropometry the relationship between genetic, physical exercises and body shape of these disciplined force personnel can be determined.
Kinanthropometry is a distinct study of human size, shape, proportion, composition, maturation, and gross function, facilitating in understanding growth, exercise, performance, and nutrition. Kinanthropometry serves as a quantitative interface between anatomy and physiology. It focuses on individual athletes into objective focus and provides a clear assessment of his or her structural status at any given time, or, more notably, provides for quantification of differential growth and training influences. Without being appreciative of the growth of children and youth and their structural evolution, selection of talent and monitoring of training is largely a matter of lack of imagination and false impression; kinanthropometry offers the fundamental structural basis for the reflection of athletic performance. Kinanthropometry furnishes us with techniques of different body measurements which can be used to study the gross size of an individual. It would not only give an idea about his shape, size and proportion but would also give an insight into his looks from different directions with respect to his various body parts. It also equips us to understand relationships of different body measurements.

Suggested Reading


Sample Questions
1) Define kinanthropometry.
2) Discuss the important applications of kinanthropometry.
3) Elucidate the relationship of kinanthropometry and sport science.