
UNIT 3 APPLIED DIMENSIONS-I

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Learning Objectives



Once you have studied this unit, you will know:

- the meaning of applied physical anthropology;
- how academic knowledge is applied as applications; and
- the application of physical anthropology in designing equipment, forensic anthropology, epidemiology, aging, sports, public health and nutritional anthropology.

3.1 INTRODUCTION

In this unit, we will first discuss the meaning of applied physical anthropology and how it was initiated. Following this, we will read through the anthropological applications in the fields of designing equipment, forensic anthropology, epidemiology, aging, sports, public health and nutritional anthropology.

3.2 MEANING OF APPLIED PHYSICAL ANTHROPOLOGY

Anthropology has achieved the status of being more than just an academic discipline. The recent years reflect an ever increasing awareness of what anthropology has discovered and can discover. The basic of applied anthropology basis lies in making theoretical anthropological knowledge useful. An applied anthropologist can be qualified in any or all the branches of anthropology. Physical Anthropologist exploits their expertise to design clothes and equipments to fit human body and also enjoy significant role in providing forensic support in court. As the perception of evolutionary biology incorporates both the natural and social sciences, it has also influenced such applied areas as medicine, psychotherapy, education and conservation.

The basic objective of all sciences is to apply the results of scientific knowledge in betterment of mankind. The applied physical anthropology is not something new that needs an introduction. The knowledge gained by physical anthropology has been used for getting practical benefits in diverse fields. But then the application of physical anthropological knowledge is far behind the mammoth contributions made by so many people in this field.

Applied anthropology in the United States came into picture when the anthropologists' worked on disadvantaged people in other cultures and realised the need for their improvement. In fact, today anthropologists are involved in understanding and finding solution to the problems in their own society in an endeavor to improve people's lives. Currently, there is demand for applied anthropologists to progressively increase their participation in earlier stages of planning process and in helping in ventures by solving wide range of issues. With the passage of time, our knowledge in the subject has seen phenomenal increase, and this knowledge has culminated in designing many products for applying it for the benefit and welfare of human use such as airplanes and automobiles.

Physical anthropologists have been active in practical applications of their research for several years. Rudolf Virchow, one of the most prominent 19th century German anthropologists regarded as pioneer of social medicine, founded the public health service in Berlin. French anthropologist, Paul Broca's input to medical treatment of brain disorders is unparalleled. Then with the advent of twentieth century, endless applications of physical anthropological research can be boasted of which vary from designing the dimensions of fighter plane cockpits to assisting apprehending criminals to urban planning. Applied physical anthropology is holistic in approach involving evolutionary, cross-cultural, and comparative and population dimensions.

As you all know, anthropology is a population based biological science and is not restricted to an individual. Whatever results are derived, they are based on statistics and its statements are probabilistic as it involves population which is just too diverse. This aspect of anthropological research is of immense importance for physicians or other health professionals to remember while dealing with anthropological data.

Physical anthropology also concerns evolutionary perspectives and the applied aspect of it can facilitate people to bring their living environment into closer similarity with their biological adaptation as human beings. This has foundation in natural selection proceeding through millions of years of evolution; an ideal fit between human adaptive capabilities and the environment as these have also co-evolved. In the following block, we will learn that natural selection plays significant role in the process of evolution. This evolutionary perspective signifies that human beings are the product of a long process of change that has perfected a certain way of solving problems and getting work done.

The demand for applied physical anthropologists is enormously increasing in government agencies, international development agencies, private consulting firms, business, public health organisations, medical schools, law offices, crime investigations, sports, nutrition and designing equipments.

3.3 APPLIED PHYSICAL ANTHROPOLOGY

The thrust of applied physical anthropology aims to construct an explanatory framework for the many physical and behavioural traits of human species within evolutionary and environmental contexts and to seek ways to maximize their function. Here are some examples illustrating the aforementioned.

3.3.1 Designing Equipment

It is not very easy to design any product or equipment especially when magnitude to the extent of diverse human variation is involved. This warrants the participation of the users, anthropologists and the manufacturers in unison with anthropologists playing very crucial role. This all the more gains importance, particularly when the efficiency of equipment is dependent on human variability. Designs that do not take into account human variations result in poor job performance and waste of time. Earlier equipment was designed without taking into account the physical characteristic of the users. Anthropometry concerned with the measurement of human body plays an enviable role in designing equipment as they provide information on the range and variation in body shapes. This holds significance because it affects the utility of equipment, clothing or work space, significantly in designing automobile seating or aeroplane cockpit where reach or field vision is a critical factor.

One of the most momentous applications of anthropometry is designing of defense equipment which dates back to World War II with the contribution of physical anthropologists as the experts of human anatomy. There has been no looking back after that as anthropometric research has played pertinent role in engineering designing of many technologies right from Jet-fighter ejection seats to analysing human posture in zero gravity on Skylab experiences. Anthropometric data with due credit to its accuracy and reliability has been intelligently applied by anthropologists for Air Force by improving the flying efficiency of the pilots thus saving much money on procurement of large number of pilots. Anthropometric techniques have witnessed its wide usage in defence for better results. For example, a gun turret is designed using scientific principle that any extrusion from an aircraft adds air resistance in such a manner that the gunner has all the free movement of his body needed. This not only reduces their discomfort of long occupancy in a cramped enclosure but also increased efficiency of crewmen, and ensured effective means of escape from an aircraft in emergency. A landmark contribution is reflected in improvising the cock-pit size in different types of air craft and designing of various seat configurations for both fighters and bombers which assisted in reducing cockpit fatigue and discomfort by proper body support.

Another noteworthy application is in flight clothing. Anthropologists have contributed in providing sculptor-carved wooden head forms in four statistically derived sizes: extra-large, large, medium and small to the helmet manufacturers as standards to provide correct size-control. Great deal of physical anthropologist's concern also lies in designing of oxygen masks using set of seven statistical sizes and shapes of sculptured face forms for correct fit. These are not restricted to males but body sizes of females are also taken to procure flight clothing and other garments for service women. The ejection seat and car passenger safety modifications have helped crew accommodation in the space capsules as well as

cockpits and seats of advance fighter aircrafts and automobiles thereby reducing the severity of damage during accidents. Talking of jet engines at high altitudes where the jet flies human body, has the tendency to swell up due to reduced atmospheric pressure. Now in such a scenario, clothing for high altitudes has to be designed in a manner that would prevent muscles from expanding. Using the anthropological technique, it was construed that stature and weight generally yield the highest correlations with other body dimensions and were projected to be diagnostic dimensions for complex fitting garments.

In fact after 1942, anthropometric applications were exploited by other fields of human activities to improve work efficiency by reducing discomfort of people. The design requirements include work space design, clothing and personal equipment design. Workplace design includes designing of any space for human occupancy during work, recreation, rest, education, travel, treatment, etc. The intention behind such designing aims to ensure that there is enough operational work space and proper location of controls, displays and devices for the convenience and efficiency of the operator. Designing of automobile interiors, aircraft cockpit, seating apparatus, doors, tunnels, furniture and kitchen are some of the examples where workplace designing is needed for better results. The measurements required in designing workplace include reach limits, body clearance, eye location, etc. The body measurements that are considered for designing clothing and personal equipment are the circumferences, body contours, limb movements etc. Clothing and personal equipment design includes designing of garments, sportswear, press suits, helmets and gloves, knobs, handles, switches, etc., basically to ensure proper fitting and comfortable movement.

3.3.2 Forensic Anthropology

Forensic anthropology is a specialised branch of physical anthropology that is devoted in solving crimes, attracting increasing attention by the public and an increasing number of practitioners. The term Forensic is a Latin word 'Forensis' which means court of law. The term Forensic Anthropology entails the application of anthropological and medical knowledge to queries of law. This science is used in detection of crime. Forensic anthropology is the largest and very popular applied sub discipline of physical anthropology.

The scope of forensic anthropology as an applied discipline in physical anthropology was recognised by C C Show in 1972. By virtue of the fact that Physical anthropologists study osteology, they would be able to contribute considerably in the field of crime. There are two aspects of Forensic Anthropology which hold importance; they are the identification of decomposed or mutilated bodies and the analysis of skeletal and fragmentary remains. Any evidence left at the site even in an unimportant proportion, finger prints, skeletal remains, teeth, saliva, blood or scratches of skin tissues significantly helps the forensic anthropologists to identify the persons involved. Genetics plays a very vital role for Forensic anthropologists in identifying the victim as well as the culprit. Anthropologists are well versed in racial variations, estimation of stature from broken bones and assessment of understanding postmortem skeletal alterations. These features facilitate the crime investigators in positive identification. The accomplishment by forensic anthropologist can be attributed to new developments in its methodological techniques. Due to this, there is an increasing trend of associating anthropologists in evidence discovery and recovery.

3.3.3 Epidemiology

We all know that health and longevity of every individual to a great deal depends on heredity and environment. Diseases reveal the array of triggering factors right from inheritance of genes to the environment of surroundings they live in, which means that disease can occur due to trait running in the family or the environment a person lives in. The last two decades have seen momentum in the contributions that anthropology may be useful to epidemiological study of health and disease. This can be attributed to rise in chronic, non-infectious diseases as important causes of morbidity and mortality during the 20th century. Chronic (long lasting), non-infectious diseases (disease that may be caused by the environment) are influenced by a number of lifestyle variables. These variables are by themselves strongly influenced by social and cultural factors. The past decade witnessed anthropologists and epidemiologists moving together beyond the “harmless neglect” that characterised their prior relationship. Some of the most important collaborations between epidemiology and anthropology concerns impact of culture change and stress, social stratification and spread of various health risks which have increased immensely. Anthropologists have disapproved and have expanded epidemiological notions of risk and vulnerability. Now involving multidisciplinary approaches, anthropologists and epidemiologists have invented measures to increase the validity and reliability of their results. The working together of anthropologists and epidemiologists due to their specialised field area, ensures more nuanced and accurate descriptions of human behaviour and more appropriate and effective interventions. The involvement of epidemiological techniques is exploited for anthropological ends, because disease often spreads along the framework of social structure.

3.3.4 Aging

The field of gerontology is amazingly diverse, warranting massive number of investigations of physical anthropological issues in aging research. It has been experienced that a good number of gerontology topics of actual and/or potential interest are significantly important to physical anthropologists. It has been observed that the physiological changes of aging include a varied mixture of physical decline as would be expected from an evolutionary model. It has been seen that the studies of the prehistoric aging accounts for the estimation of lifespan, which in no way reflects rate of aging. Recent years have witnessed substantial work relating to body composition and aging. These results give an evidence towards the loss of lean tissue with age and relatively constant, though redistribution of fat mass. Though osteoporosis is one of the major concerns in females due to aging, tooth loss in both sexes is also witnessed. Biological age is found to be associated with lifestyle, economic and nutritional status. These factors can be of significance in divulging cause for variation in rates of aging which in turn would be of vital importance. To answer these and many more potential queries physical anthropologists is the best bet.

3.3.5 Sports

Sports, as history shows, has developed to be part of human culture as recreational activity. We cannot deny the role of cultural aspect in sports, but the biological aspect of human is considerably responsible for the performance in any sporting event. The factors like body size, body proportions, physique and nutrition influence the performance in any sporting event. Most of these traits are acquired

through heredity but they are also influenced by environment to a substantial extent. Human psychological factors like motivation, training and nature also play a vital role in moulding the sportive personality to a large extent. It becomes quite obvious that human biological, cultural and psychological aspects are must to understand the environment of sports, thus laying the foundation for anthropological role in the field of sports.

The study of sports is a specialised sub-discipline in physical anthropology christened as Kinanthropometry. This specialisation of physical anthropology assesses the physical structure of individual in relation to gross motor functions or functioning capacity, taking into account maturation, nutrition and body composition. The term Kinanthropometry was coined by Bill Ross in 1972. It was first considered in Olympic Scientific Congress at Quebec in 1976 prior to Montreal Olympic Games in 1978. UNESCO has been instrumental behind most initiatives for development of Kinanthropometry when it founded an International Working Group on Kinanthropometry at Brasilia, working under the International Council of Sports Science and Physical Education.

There are number of factors that are responsible for the performance of an individual in sports. These factors in turn are dependent on both genetic constitution and environment. However, it is undisputable that genetics has a greater role to play in the formation of a phenotype (observable characters arising out of interaction between gene and environment in an individual). Phenotypic variations in size, physique, body composition, metabolic powers, strength, speed and skill, cardio-vascular adaptations are prevailing forces responsible behind a sportsman's feat. Environment to some extent can shape a genotype by way of training and motivation. The goal of Kinanthropometry focuses on selecting the fit genotypes which help individuals attain their fullest potentialities, that means selecting those individuals who possess genetic constitution which is ideal for a particular sport. It is not just muscular strength that is required for coordinating body movements. But the responsibility of physical anthropologist lies in selecting the players who have better potentialities in a particular sport than others; for training and other external influence can change one's morphological status only within the narrow limits set by genotype. Physical anthropologist can also curtail the financial implications by minimizing the expenditure on individuals who because of their unfavorable anthropometric standards are less fit for a particular sport. Physical anthropologist would exercise his discretion to choose an individual ideal for sporting event. It is rather impossible to alter the capacity of the genotype in order to maintain desirable levels of different bio-chemical determinants. Thus, it is imperative to lay more emphasis on the genetically determined morpho-physiological status of the individual to yield good results. We realise that the techniques of Kinanthropometry enabled the anthropologists to classify humans into different somatotype and suggest the right sport for them. The composition of body plays important morphological characteristics essential for sports. Body composition inclusive of muscular, skeletal, fatty tissues are dependent on the environmental influence, sex, socio-economic conditions, occupations, genetic make-up, nutrition and exercise.

Studies on body composition of sportsman hold significance. It has been deduced that athletes with less fat but heavy muscles perform better in certain competitive sports, while those with substantial amount of fat tissues require increased energy due to inert weight, result in endurance in activities like jumping, running, etc.

Moderate quantity of fat aids performance by providing extra buoyancy and reduction of heat loss in water sports. Apart from physique and body composition, somatotype also plays decisive factor for different sports. This in turn is dependent on flexibility of training, motivation factors and psyche. Physical anthropologist plays a constructive role in designing sports equipment using anthropometric techniques suitable for a particular somatotype.

3.3.6 Public Health

Public health refers to the population or community rather than an individual as its focus. This is a rapidly growing field of research and practice within anthropology. Physical anthropology has followed systematic approach to public health by applying the scientific knowledge at a community level in such a way to be an effective practice. Ecology which involves an interaction of population and environment has also an important role to play since it forms bond between biomedicine with biological and cultural anthropology. This provides a significant path of perception to health and disease as dynamic, adaptive, population-based processes. Public health practice unambiguously seeks to contribute to the creation of global health systems that serve the people. The application of anthropological methods to public health problems has been major area of contribution for health and disease amelioration. The wide range of variation in populations can be used to improve the development and measurement of epidemiologic variables.

3.3.7 Nutritional Anthropology

This field is continuously contributing to the field of nutritional sciences especially in defining the nutritional status of persons by making use of the techniques of anthropometry. This area of defining the nutritional status is quite satisfactory as earlier the methods were highly technical and were looking for an internal agreement for their practical use. The application of anthropology and the underlying conjecture for use of anthropometry in nutritional assessment of population is unquestionable. Undeniably it forms the basis to the fact that although heredity contributes to growth, the genotype is competent enough of its different growth potential in different environment. Thus the induction by introducing the specialised sub-discipline within applied physical anthropology called Nutritional Anthropology. Nutritional anthropometry employs three basic measurements age, weight and height. These three basic values hold importance for physical anthropologists since they compute the indices and compare these indices with reference to population or persons. There are basic indices which exhibit geographical variation, to assess the nutritional status. Nutritional anthropologists have provided indicators in terms of cut-off points to assess nutritional status along with the range for different categories. In recent years, international consensus has been achieved to a large extent for defining the nutritional status of an individual with the help of anthropometry. The contribution of heredity in the growth and development cannot be overlooked, yet it is undisputable that the same genotype is responsible for different growth potentialities in different environments. This is the foundation for using anthropometry in nutritional assessment of populations. The health status of any population all over the world can be evaluated and appropriate health plans can then be enforced.

3.4 SUMMARY

This unit must have made an impression that academic knowledge can be best utilised if we are able to use it practically. The different applied aspects of physical anthropology, right from measurements to suit the equipment and furniture designing, clothes, choice in sports, health status and in the health field, reflect its wide spectrum. It is astoundingly fascinating to bring into practice the knowledge of physical anthropology with other disciplines. This corroboration has done wonders for the benefit of mankind. The unit to follow would take you through the journey of physical anthropology along with genetics and am sure you will realise the wonders of applied physical anthropology in understanding mankind.

Suggested Reading

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Sample Questions

- 1) What do you understand by the concept of applied physical/biological anthropology?
- 2) Illustrate the application of physical anthropology in designing equipment, sports and forensic anthropology.
- 3) Epidemiology, nutrition, aging and public health have applied component of physical anthropology. How?