UNIT 2 RELATIONSHIP AND APPLICATIONS OF BIOLOGICAL ANTHROPOLOGY*

Contents

Learning Objectives

After going through this unit, you will be able to:

- understand the relationships of biological anthropology with different fields of study; and
- comprehend the importance of interdisciplinary and collaborative learning.

2.0 INTRODUCTION

Anthropology is a holistic study of mankind with four major branches, hence the scope and subject matter is diverse. Both the theoretical and applied aspects of anthropology have close associations with other disciplines and are co-dependent at different levels.

The subject matter of physical or biological anthropology mainly consists of human biological diversity with reference to time and space. It includes the evolution of humans, their variability, and adaptations to environmental stresses. Using an evolutionary perspective that is, not only the physical form of humans such as bones, muscles and organs are examined but their functioning that allows survival and reproduction is also examined. Within the field of biological anthropology there are many different areas of focus. The center of all of them is biological variation that unites five special interests within biological anthropology:

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- Human evolution as revealed by the fossil record (paleoanthropology),
- Human genetics,
- Human growth and development,
- Human biological plasticity (the body's ability to change as it copes with stresses, such as heat, cold, and altitude),
- The biology, evolution, behavior, and social life of monkeys, apes, and other nonhuman primates (Martinez, 2013).

Biological anthropology studies man as a member of the animal kingdom. Generally, its approach is focused on the common theme of human evolution, variation and adaptation. Anthropologists basically seek to answer two sets of question:

(i) About the origin of humans and their evolution, this is generally studied under the topic of Human Paleontology or Paleoanthropology. The paleontologists/paleoanthropologists try to understand how humans evolved from apes to modern 'homo sapiens'. Anthropologists who specialize in study of primates are called Primatologists.

(ii) The second set includes questions about how and why contemporary human populations vary biologically; this is studied under the topic of Human variation. To understand human variation, it seeks the help of other 3 disciplines i.e. Human Genetics, Population Biology & Epidemiology. These interests link biological anthropology to other fields of science such as biology, zoology, geology, anatomy, physiology, medicine, and public health (Dhall, 2016).

The new physical/biological anthropology today mainly depends on radiographs, reflection calorimeters and spectrophotometers to study biological traits. Biophysical techniques are used to estimate mineral constituents of bone of the present and past human remains. Growth studies in relation to nutritional parameters are undertaken. To know the human variability and adaptation in a scientific way, human genetics, physiology, bio-chemistry are studied in a more extensive manner to widen the scope of physical/biological anthropology (Dash, 2004)

2.1 RELATIONSHIP WITH OTHER DISCIPLINES

Physical or biological Anthropology has an interdisciplinary approach in understanding the issue related to human evolution and variation, public health and epidemiology, nutritional studies, earth sciences, forensic science and environmental sciences to name a few. This subfield of anthropology along with different disciplines attempts to solve various human issues at different platforms.

2.1.1 Biological Anthropology and Biological Sciences

Biological or Physical Anthropology is closely associated with biological sciences in the pursuit of better understanding of human variation and evolution. Physical or Biological Anthropology studies the physical features and functioning of man, using the general principles of biology. It utilizes

the findings of physiology, anatomy, embryology, zoology and others into anthropological studies. The principle of genetics remains the same in human and other organisms (both plants and animals). Anthropological genetics is a synthetic discipline that applies the methods and theories of genetics to evolutionary questions posed by anthropologists. These anthropological questions concern the processes of human evolution, the human diaspora out of Africa, the resulting patterns of human variation and bio-cultural involvement in complex diseases. Anthropological geneticists tend to focus more on normal variation in non-Western reproductively isolated human populations. It also attempts to measure environmental influences through co-variates of quantitative phenotypes, while human geneticists less often attempt to quantify the environment in order to assess the impact of environmental-genetic interactions.

Anthropology is related to zoology, in terms of the relationship to other animals and the places of mankind in animal kingdom and the process of evolution from early pre-human forms. It is also related with anatomy and physiology as it concerns with the structure and function of the human body, the relationship of the various parts and the operation of these different parts.

Check Your Progress 1

1) Write a short note on the subject matter of physical/biological anthropology.

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2) Delineate the major difference between anthropological genetics and human genetics.

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2.1.2 Biological Anthropology and Earth Sciences

Earth science is the study of physical constitution of earth and its atmosphere. This field of study also deals with the nature and structural pattern of earth including formation of land, rock and strata. Various happenings of the past and records of the oldest life forms that flourished millions of years ago is brought into light with the help of systematic study and analysis of the earth's crust and different fossil-laden strata employing geological methods. In the study of human evolution as well as various cultural stages of man, the biological/physical anthropologists are to go a long way into the past. To study the various layers of earth and to understand the time sequences, biological anthropologists employ the knowledge and findings of the geologists. Geology plays a key role in the study of humans, particularly in the sub disciplines of paleoanthropology and archaeology. Anthropologists work closely with geologists and employ geological tools in order to reconstruct aspects of past environmental and ecological contexts from the time of our earliest human ancestors to that of modern peoples. Extrinsic selective pressures, or those that are derived from a human's surrounding environment, are revealed through the study of the earth sciences. Anthropologists place the human individual, community and population back into the environment

and attempt to understand how humans interacted with that environment. From the origins of hominins, humans' bipedal ancestors, to the appearance of modern people, anthropologists want to know about temperature, aridity and rainfall, landforms and vegetation cover, among many other factors. From these basic environmental indicators, they surmise the kinds of habitats that may have been available and exploited by humans during those times and are simultaneously compared with those of the contemporary species (Dhall, 2016).

2.1.3 Biological Anthropology and Chemical Sciences

Pollution is a worldwide problem and its potential to influence the physiology of human populations is unquestionable. Studies of human growth and development in relation to pollution have increased in number and quality since the mid-twentieth century. Many studies have found that some pollutants have detrimental effects on human growth, particularly prenatal growth. Lead, a heavy metal, is commonly found in human populations and is related to smaller size at birth and studies have reported decrements that range up to about 200 grams. Studies of humans exposed to polychlorinated biphenyls, one of the persistent organic pollutants, have reduced size at birth, advanced sexual maturation and altered hormone levels related to thyroid regulation. Thus, different pollutants exert effects through different physiological pathways. However, some studies have not observed these effects, which indicate that the situation is complex and requires further study with better study designs. Determining the effects of pollutants on human physiology and growth is rather difficult as it requires fairly large numbers of subjects who are not purposely exposed but for whom exposure can be measured. These effects of pollutants and the mechanisms of effect require further study to understand and, it is hoped to blunt or block any detrimental effects on human health and well-being.

2.1.4 Biological Anthropology and Health Sciences

Biological anthropology to a large extent is concerned with the study and understanding of human health. Anthropometry, one of the major tools of biological anthropology facilitates to understand biological variability, including morphological variation. Anthropometry, literally 'measure of humankind', was defined by Ales Hrdlicka in 1939 as 'the systematized art of measuring and taking observation on man, his skeleton, his brain or other organs, by the most reliable means and methods, for scientific purposes'. Anthropometry is the single most universally applicable, inexpensive, and non-invasive method available to assess the size, proportions and composition of the human body. Moreover, since growth in children and body dimensions at all ages reflect the overall health and welfare of individuals and populations, anthropometry may also be used to predict performance, health and survival. These applications are important for public health and clinical decisions that affect the health and social welfare of individuals and population. Anthropometric measures have been the subject of much epidemiologic and patho-physiologic research involving obesity, overweight, body fat distribution and health outcomes. In short, the assessment of health risks by using anthropometry is a well-established and time honored concept in the scientific literature.

In recent years, anthropometric indicators such as body mass index (BMI) and waist circumference (WC) are repeatedly shown to be simple yet powerful predictors of common adult chronic conditions such as type 2 diabetes mellitus (T2DM), cardiovascular disease (CVD) etc. The importance of anthropometric indices for promotion of health and primary care can be summarized at three levels: individual, community and population level. At the individual level, the measurements can be promoted both for health care providers' use in clinical applications and for patients' use in self-monitoring over time. At the community level, simple anthropometric measurements can help in identifying sub-populations in which the risk of chronic disease is concentrated, allowing these individuals to benefit from targeted interventions to reduce health risks. At the population level, secular trends in body measurements can be tracked to help evaluate societal and environmental changes that affect individual energy balances and to monitor the effects of large-scale prevention strategies (Seidell et.al., 2001).

Check Your Progress 2

3) What is Anthropometry? Explain the importance of anthropometric indices in health care sector.

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2.1.5 Biological Anthropology and Medical Science

Now-a-days, Biological anthropology tries to explore the nature and extent of various hereditary or genetic diseases. The impact of genetics on biological anthropology has opened a new dimension in which various diseases and genetic abnormality oriented happenings have now, become the important issues of discussion of biological anthropology. Various nutritional patterns, growth, deformations and their impact, anthropologists study in the light of medical sciences. In this way physical anthropology has been combined with medical science to bring forth a new discipline-Medical Anthropology (Jaiswal, 2011).

In addition to the above, family history and pedigree analysis are other important sources often used by biological anthropologists which are yet powerful clinical tools. Although traditionally associated with the evaluation of rare Mendelian single-gene disorders in individuals and their relatives, family history play an important role in risk assessment and prevention of common chronic diseases. On the other hand, pedigree analysis helps to foresee the possible genetic defects by studying the nature of inheritance of a particular trait. Numerous studies on diseases of major public health importance (e.g., cancer, heart disease, diabetes, and stroke) consistently show that the odds of developing one of these conditions are significantly increased by having one or more close relatives with the disease. The development of family history as a public health tool has experienced major advances in recent years. Family history is a significant and independent risk factor for major common, chronic diseases. As such, it is often included in risk assessment tools and professional guidelines on assessing health risk and intervening early among those at risk. A clear consensus is also emerging about shaping the future of family history as a key element of personal medical records.

Furthermore, anthropological genetics tries to find out the evolutionary questions, patterns of human variation and bio-cultural involvement in complex diseases through methods and theories of genetics. Since 1984, there has been a shift in emphasis in anthropological genetics, primarily from population structure (based on blood group and protein markers) and genetic epidemiology, to the study of human origin and the human diaspora (Crawford, 2007).

2.1.6 Biological Anthropology and Biostatistics

The modern physical or biological anthropology has increased its dependence on statistical techniques to measure the extent of homogeneity and heterogeneity among different population groups or communities. Additionally, the use of bio-statistical methods becomes very crucial when the set of all possible items in a population is very large and the study requires lots of money and time in order to do a comprehensive analysis of all of the items. For example, during a field survey, there is just not enough time or resources to talk to every participant, informant, every process step or look at every quality of life (e.g. socio-economic variables). If the study unit is large, it may be too costly to survey all the villagers to determine their socio-economic level. Evaluating or estimating attributes or characteristics of the entire system, process, product or project through a representative sample can be more efficient while still providing the required information. To legitimately be able to use a sample to extrapolate the results to the whole population requires the use of one or more of the following statistical sampling methods- random, systematic, stratified, cluster, haphazard and judgmental sampling.

2.1.7 Biological Anthropology and Biomedical Research

Anthropology particularly biological anthropology is concerned to a large extent with the study of human biological variability by racial and ethnic groups. Now a days it is even more common to compare the prevalence of risk factors for various diseases and health outcomes between members of different racial and ethnic groups in epidemiologic and public health studies. When these comparisons are made, health disparities between racial and ethnic groups have been well documented. In fact, one of the two primary goals of the US Department of Health and Human Services' (USHHS) "Healthy People 2010" was to eliminate health disparities among segments of the population, including differences that occur by gender, race or ethnicity, education or income, disability, geographic location or sexual orientation.

The use of race or ethnicity in epidemiologic and public health research affects the quantification and explanation of health outcomes, including health disparities. Although researchers have questioned the value of using race and ethnicity as scientific variables. Methodological guidelines have been purposed that aimed at increasing the integrity of these variables. It is quite clear from studies pertaining to racial and ethnic groups that researchers have not yet come to a consensus concerning their scientific use. Continued professional commitment is needed to ensure the scientific integrity of race and ethnicity as variables. At a minimum, researchers should clearly state the context in which these valuable epidemiologic and public health research variables are being used, describe the method used to assess these variables and discuss

all significant findings. Doing so will ensure continued constructive scientific dialogue about the interpretation of findings regarding race or ethnicity and will promote the successful development of intervention strategies aimed at eliminating health disparities linked to race and ethnicity.

2.1.8 Biological Anthropology and Nutrition

Nutritional anthropology has emerged as a new branch of applied anthropology over the past twenty years and its methods are having an important influence on the methods of nutritional survey and nutritional epidemiology. The field of nutritional anthropology has continued to develop rapidly. It requires the use of physical or biological anthropological techniques for studying key aspects of the nutrition of individuals, families, and communities. The methodological options in nutritional anthropology and strategies for field research also provides a background for more specialized information on social behaviour and household functioning, the determinants of food intake, the analysis of energy expenditure, and appropriate statistical methodologies. Nutritional anthropology studies food and nutrition from evolutionary, behavioral, social and cultural perspectives.

Check your Progress 3

4) How does biological anthropology play an important role in family risk assessment?

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2.2 APPLICATIONS OF BIOLOGICAL ANTHROPOLOGY

As an important branch of anthropology, biological anthropology itself is further divided into several sub-fields. Owing to its interdisciplinary nature, biological anthropology offers many applications in the fields of health and epidemiology, nutrition, medicine, forensics, human ecology and sports. Here we will be learning some of the significant applications of physical/biological anthropology:

- Ergonomics (Gr. ergon, meaning “work,” and nomos, meaning “law.”) or human engineering, deals with designing of machines, work methods and environments to take into account the safety, comfort, and productiveness of human users and operators. As learnt earlier in this unit, anthropometry is the science of measurement of the human body, which is divisible into static measurements and dynamic measurements. Static measurements are useful to determine the space to fit persons and necessary clearance around the body. While working different parts of the body move and accordingly the objects to be used are designed for which dynamic measurements are important. The body size and limb proportions vary from population to population. Age and sex are two other factors that should be taken into account. Physical/Biological Anthropology provides necessary information on these different aspects, which are useful in designing machines, weapons, furniture, garments and footwear, etc.

- Health is the most precious wealth. Physical Anthropologists have roles to play for healthy existence of mankind. Examination of clinical symptoms and anthropometry are important methods for assessment of health and nutritional status. Indices like BMI (Body Mass Index), weight for age, height for age, etc. are some of the common methods used by anthropologists in the assessment of growth and nutritional status, especially among the children of different populations. Anthropometric characters of individuals are also indicative of certain diseases like diabetes, cardiovascular problem, tuberculosis and malarial infection, etc.
- Knowledge of prevalence of certain defective genes in the populations, such as G-6-PD deficiency will be of great help to the physicians while treating malarial patients. Such persons cannot be given malarial drugs because it is fatal to them. Anthropological knowledge about the merits and demerits of inbreeding, blood group compatibility of the couples and genetic diseases will be of immense value for the common people in making decision about choosing life partners. Recent trend of molecular anthropology probes into human origin and dispersion at DNA level which entails identification of genetic codes that determine susceptibility and resistivity to diseases and subsequently determinants of adaptation, which are likely to discover in different human populations of different echo niches. This kind of knowledge will be of invaluable help in the advancement of genetic medicine.
- Kinanthropology (Gr. kineein meaning to move) is the anthropology of sports. It is, in fact, the application of anthropological knowledge in the selection of suitable sports persons for different events to achieve maximum performance. Individuals are of different body structures and temperament. Some are stocky and sluggish while some are lean and agile; some have proportionately longer limbs and shorter trunk while some have just the reverse. They can be categorized into different somatotypes, such as ectomorphic, mesomorphic and endomorphic. People from different continents and countries are of different body structures, such as height, weight, muscular structure and limb proportions, etc. Kinanthropologists deal with sorting of jargon of such data on human variation, so that exploitation of sports talents by mistaken selection and unnecessary training can be avoided. Kinanthropologists take anthropometric measurements of the sports talents and the latter are also subjected to physiological and biochemical tests along with various motor performance tests. By doing so, young and grooming sports talents can be sorted in accordance with their suitable events so as to achieve maximum human performance in different fields of sports.
- Physical anthropological knowledge about mechanism of inheritance of various genetically determined traits and about their frequencies in different populations is useful in the settlements of medico-legal cases, such as disputed paternity or maternity, identification of biological relatives, etc. Forensic anthropology, an important branch of physical anthropology deals with the identification of individuals with the help of biological remains for forensic purposes. With the help of expert knowledge of the human skeleton, dentition, hair, fingerprints (dermatoglyphics), saliva and blood genetics, DNA sequencing, and

archaeological methods, physical anthropologists provide invaluable assistance in the identification of victims and perpetrators of crimes and casualties of accidents and wars. Because of the wide spectrum of problems, methods, and practical applications, physical anthropologists specialize in one or a few subareas (Tuttle, 2018).

Besides these general applications of physical anthropology there are many specific applications which deserve mention in this connection. A number of studies have been conducted by the scholars who reflected the usefulness of physical anthropology in diverse fields of human life (Jaiswal, 2011).

- The anthropometric study of men and women conducted by the Bureau of Homo Economics in America in order to improve the clothing size, may be regarded as remarkable contribution in this field. Another study concerning the human body in relation to the physical surroundings include Hooton's study for seating accommodation in trains. During recent time much emphasis is being laid to design the seats and thereby making the sitting arrangements more comfortable. It has been understood that a close correlation exists between health and good posture. If a seat creates trouble in keeping the body in a good posture, it results in various disabilities in skeletal, muscular and other parts of the body.
- On the other hand the correctness in sitting posture enhances alertness and endurance as well as improvement in circulation and respiration of the persons concerned. Body measurements in working position can thus improve the design of seats in offices, educational institutions, in public vehicles, etc. Therefore the designers of these sitting arrangements are required to have a knowledge regarding various anthropometrical perspectives. Modern furniture designers in many countries utilize the results of anthropometrical studies to plan their activities in a scientific way.
- In the army, the data of anthropological investigations are extensively used in the Western countries. The anthropometric surveys on the military personnels are considered essential to get their body measurements done which are used to meet various demands. In Mexico, the National Military Academy has been doing effective work in this line since 1951. Here the results of biometric investigations are extensively used in the selection of cadets. The anthropometric data are greatly used in military research and development.
- The Air Forces very often utilize the anthropometric data in solving spatial problems in aircraft and also in improving flight clothing. Anthropometry is used to design the cockpit according to body size, gun-turrets, and seats for the passenger aircraft, designing of tank and gun-sight, pressure suits and helmets, anti-gravitational suits and so on. The quartermaster Corps takes the help of anthropometry for making better fitted and efficient clothing. They emphasize on finding out the relationship between clothing sizes and body measurements so that the clothes may fit a good number of the military personnel with minimum or no alteration. It can then be easily said that measurements of the body are extensively used to meet the various requirements to solve practical problems (Jaiswal, 2011).

2.3 SUMMARY

Biological anthropology extends the study of what it is to be human through time and space to focus on humans from a biological perspective. Biological anthropology deals with the evolution of humans, their variability, and adaptations to environmental stresses. Within the field of biological anthropology there are many different areas of focus. And the different subfields are interrelated with different disciplines of study for better collaboration, understanding and efficiency in dealing with human situations and issues. It plays major role in understanding the process of human origin, evolution, variation and adaptations. The subject matter of biological anthropology is of immense applied value in the fields of health, nutrition, medicine, forensics and sports.

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2.5 ANSWERS/HINTS TO CHECK YOUR PROGRESS

1) Physical or Biological Anthropology studies the physical features and functioning of man, using the general principles of biology. It utilizes

the findings of physiology, anatomy, embryology, zoology and others into anthropological studies. For further details kindly refer section 2.0

2) Anthropological geneticists tend to focus more on normal variation in non-Western reproductively isolated human populations. Anthropological geneticists also attempt to measure environmental influences through co-variates of quantitative phenotypes, while human geneticists less often attempt to quantify the environment in order to assess the impact of environmental-genetic interactions.

3) Anthropometry is a major tool to study and understand human biological variability, including morphological variation. It consists of measurement of humankind. The importance of anthropometric indices in health care sector can be summarized at three levels: individual, community and population level. For further details kindly refer section 2.1.4

4) Family history, a source often used by biological anthropologists, is a simple yet powerful clinical tool of risk assessment. Family members resemble each other in risk of disease because of shared biological, cultural, and behavioral factors. Although traditionally associated with the evaluation of rare Mendelian single-gene disorders in individuals and their relatives, family history can play an important role in risk assessment and prevention of common chronic diseases. For further details kindly refer section 2.1.5.