UNIT 3  EPIDEMIOLOGICAL ANTHROPOLOGY

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Suggested Reading

Sample Questions

Learning Objectives
Once you have studied this unit, you should be able to:
- explain the relation between ecology and disease;
- describe the infectious diseases;
- indicate the ecology of malnutrition; and
- explain the effects of nutritional stress.

3.1  INTRODUCTION

Epidemiology is often defined as the study, distribution and determinants of disease and injuries in human population. Epidemiological anthropology elucidates etiological factors involved in a disease incidence; and emphasis on population variation in incidence and occurrence.

Human growth occurs along a genetically destined trajectory, but is influenced by environmental factors consequently affecting its longevity and health status. Consequently diseases exhibit the whole spectrum of causation, ranging from hereditary factors which play predominant role, to the environment. In many instances both factors have to be taken into account. We need to consider not only man’s physical environment but also his social, cultural and psychological circumstances. For instance, environmental components of causation lie in lung cancer and degenerative arterial disease as in tuberculosis and small pox.

Distribution of diseases as a special manifestation of human variation and ecology can be observed not only at individual level but also at population level which exhibit genotypically and phenotypically similar individuals and inhabit more or less uniform environments.
There exist a competitive interaction between man and environment. Man has been able to control his nearby environment or at least mitigate its worst effects by various adaptive mechanisms. On one hand, this struggle may be against unalterable and passive opponent, e.g. physical and climatic factors (temperature or atmospheric pressure) and on the other hand, biological environment which is in itself capable of adaptive responses. Therefore, in the context of eradication of infectious diseases appropriate steps must be adopted to ensure adaptation of individual and mal-adaptation of disease causing agent to the environment.

The ecological aspects of disease can be revealed in two ways:

- Physical environment: It is a direct and immediate source of injury and ill health. There is consequently a clear geographical distribution of pathology manifested as a consequence of extreme climatic effect e.g. heat stroke (desert), mountain sickness (high altitude) and rodent ulcer (ultra-violet light). In recent years, air pollution due to smoke and associated substances has become an important environmental hazard in many countries.

- Biotic component of the environment harbours pathogenic organisms (viruses, bacteria, protozoa, fungi) dangerous animals as well as poisonous plants and insects. In addition nutritional disorders arise due to improper utilisation of food sources – animal and vegetable (and also mineral).

Besides, environmentally produced diseases, some illnesses make their overt appearance due to maladjustment of metabolic and regulatory functions during growth, but manifest completely in response to the external environment. Genetic defect may refer to an inability of the individual to support him, while psychological disorder is an inability to apprehend and respond to external events and demands.

Hunting-gathering practices, deforestation, swamp drainage and other activities have enabled man to dispose off his major competitors for space and food. This struggle for existence has even lead to extermination of many species. Indeed, a readjustment of ecological balance and an enlightened policy of conservation are urgently necessary if numerous species are to be saved from total extinction (this tragedy seems soon likely to overtake our hominoid relative the gorilla, an anthropoid probably even more intelligent than the chimpanzee and whose biology and ethology are far from well known).

Man contends with smaller creatures such as rodents, insects, fungi, and microorganisms. Some of them are parasitic on his food and shelter while other to his body. The diseases emerged from man’s contact with other living organisms and represent phases of ecological conflict which have not been yet entirely resolved in man’s favour.

The geographical background is the prime single factor governing the abundance of specific type of parasites and pathogens in a region. Micro-organisms may be water-borne, air–borne, or carried by insects and other animals. The host-parasitic relation often takes a complex course depending on the number of stages and factors involved in a life cycle of parasite–vector, intermediate host and one or
more reservoirs. Analysis of the locality eventually reveals that ecological relationships are strongly influenced by physical features such as wind, rainwater, drainage, temperature and humidity. The pathogen itself may have limited environmental tolerance. The vector usually requires specific conditions for breeding, e.g., ticks or fleas may need a dry climate. The carrier may have a restricted habitat, e.g., tree-living squirrels in the Malayan rain forest. The female Anopheles utilize water bodies for breeding. Site specific rainfall, soil type and its water-retaining properties determine persistence of water pools. The tsetse fly, vector of African sleeping sickness, requires a relatively dense vegetational cover.

The geographical distribution of many diseases is similar to that of their intermediate hosts and vectors. Schistosomiasis is common among reverie populations of warm climates as the bladder-worm needs a particular snail during one of its developmental stage. Rickettsial diseases, e.g. Rocky Mountain spotted fever, are linked with ticks found chiefly in North America, Bengal, and North Africa. The Asiatic form, scrub typhus, carried by mites, occurs in Japan, Formosa, and Oceania; the typhus group of Europe and central Asia is linked with fleas and lice. Brucellosis is transmitted through contaminated and untreated milk and milk products, and by direct contact with infected animals and hence is geographically related to cattle herds as the main reservoir.

The ecological relations are complex. A relatively few out of the thousands kinds of human parasites characterise any given locality. Thus, the ecological relations of most micro-organism disease will be unraveled only by specific regional analysis. For instance, Yaws, a microbial disease has strong relationship to climate. 80 per cent of the yaws affected areas have the 80° F mean annual isotherms. This disease is endemic where the annual rainfall ranges from 50 to 70 inches. The disease occurs therefore mostly between the north and south 40th parallels.

Somaliland, a semi-desert country consists of thorn scrub country and has dry climate. Hence, cataract and eye infections are causally associated with the flying sand, sun-glare as well as the flies which breed freely due to the dry climate. The climate also favours the existence of soft ticks which causes relapsing fever. There is moderate incidence of Madura foot caused by inoculation of the fungal spores into the skin by the thorns. The intense dryness and frequent sand storms encourage sore throats, which the Somalis have been led to treat by snipping off the uvula. Thus sand, dryness, and glare are the prime physical factors that can be identified in this ecological complex. Another example may be drawn from the Arctic. Here, despite the enormous number and variety of mosquitoes and other arthropods, none are known to transmit infectious disease. But throughout the North American Arctic, dogs, which still provide the chief means of winter transport, serve as a reservoir in transmission of numerous infections among humans including salmonellae, meat and fish tape-worm, and rabies. The seasonal incidence of these diseases is due to unsanitary disposal of waste in the vicinity of dwellings which render pathogens innocuous in the frozen state but are released with the spring thaw.

The characteristic housing structure and settlements pattern of man may introduce favorable factors to the spread of particular diseases. Human settlement may require deforestation which may provide conditions favourable for the propagation of infectious diseases. Deforestation of the hills of Ceylon led to frequent pool
formation during dry spell and successively to mosquito-breeding. In Malaya certain rats capable of carrying tick disease are very rare in the natural forest but after deforestation they occur in great numbers.

3.3 BIOLOGICAL RESPONSES

There are two fold responses to infectious diseases: immediate which depend on the adaptive flexibility of the individual and long-term responses which become evident after a long period but is action-specific.

Immediate responses are the physiological processes which counteract the effects of the invading organisms evident by symptoms and signs of the disease such as inflammation, pain, fever, etc. Prolonged exposure to infection may result into immunological responses. The proteins or polysaccharides of the invading organisms act as antigens and stimulate the production of antibodies. Once such antibodies are formed they may persist in the body or may rapidly be reformed during second infection.

If a disease is wide spread or severe in nature then it may act as an efficient selective agent. Individuals who are able to combat the disease will survive while others are eliminated. Such a resistance may be due to increased physiological adaptability, enhanced immune response or both. Prior exposure to such diseases ameliorates its severity in successive generations. Otherwise, the population would experience high morbidity and mortality rate. Many of the infectious diseases occur during the pre-reproductive and reproductive phases of life, thereby increasing their selective significance.

3.4 NON-INFECTIOUS DISEASES

In non-infectious disease, the whole complex of environmental factors and biological responses (inborn and acquired) must be considered to account for regional variation. The fact that Negroes are more susceptible to frostbite than Eskimos or North American Indians may be attributed to both lack of acclimatisation and genetic susceptibility. Many diseases have been accorded a ‘racial pathology’ but the distribution was entirely related to environmental peculiarities. Primary cancer of the liver, common among Africans seems to be a sequel of the widely prevalent liver cirrhosis. It is caused by consumption of diet chronically low in animal protein and rich in carbohydrate since infancy. Striking ‘racial’ differences in the incidence of coronary disease is associated with diets high in fat.

Many diseases and malformations are known to have genetic basis; the afflicted individual is usually homozygous for the recessive gene, though dominant genes are also involved in some conditions. Genetic diseases are very rare. However, certain populations have high frequency of such diseases. Thalassemia and sickle-cell anemia are haemoglobin variants caused by mutation in hemoglobin gene. Haemolytic disease of the new-born due to rhesus incompatibility is characteristic of European but not of most Mongoloid or Amerindian populations, since they are devoid of Rh-negative individuals. There is an increased risk of duodenal ulcers in individuals of blood group O and individuals with blood group A are more prone to stomach cancer than others.
3.5 ECOLOGY OF MALNUTRITION

The nutritional status of individuals and population span a broad range from extremes of deficiency to excess. Malnutrition refers to cellular imbalance between the supply of nutrients and energy and the body’s demand for them to ensure growth, maintenance and specific function. It is more prevalent among developing nations, primarily those undergoing the urbanisation. Severe malnutrition is frequent during war. Protein-caloric malnutrition is most common form of undernutrition. It includes Kwashiorkor and Marasmus.

Kwashiorkor, a Ghanaian word means ‘second-child disease.’ Kwashiorkor is usually associated with the period immediately following weaning, which often takes place after the birth of second child. In many parts of the world, especially in the tropics, the child is resorted from mother’s milk to a diet adequate in carbohydrates and has insufficient protein. The food usually comprises a starchy gruel made from yams, taro, corn, rice or millet. Animal protein is scarce and if available, is expensive. Thus the child may receive enough food to satisfy hunger, but does not receive the proteins vital for normal health, growth and development.

Characteristic symptoms of Kwashiorkor include edema or fluid retention in the feet, lower legs and seldom in other parts of the body. Growth and psychomotor development is retarded. Severe wasting of muscle and adipose tissue can be depicted from the thinness of upper arms. The child is unable to balance its head when pulled from a lying to sitting position. Extra vascular fluid retention distend the abdomen (potbelly). The child is apathetic, miserable, withdrawn and indifferent to its environment.

Marasmus is derived from Greek word which means withering or wasting. It results from a diet low in both protein and calories. It is more frequent among children younger than 5 years, but usually soon after weaning. Symptoms of Marasmus include extreme growth retardation, wasting of muscles and subcutaneous fat, diarrhea, and severe anemia. Since vital nutrients are absent during the period critical for brain growth, mental retardation often occurs. It results into death.

Kwashiorkor and Marasmus represent extreme examples of malnutrition and growth retardation. Lack of specific nutrients in the diet may lead to less severe form of malnutrition and other health risks.

Excessive amounts of nutrients are also hazardous to health. For example, excessive amounts of vitamin D lead to hypercalcemia, characterised by high levels of calcium in the blood. It results into sluggish nerve reflexes, weak muscles and unnatural calcification of soft tissue.

Obesity refers to excess fat accumulation which may unfavorably affect health of an individual leading to reduced life expectancy and increased health problems. An adult with BMI > 30kg/m² is said to be obese while a child is considered obese when his or her body weight is 20 per cent greater than that for his sex and age-specific weight-for-height standard. Obese children mature earlier.
3.6 DISTRIBUTION OF DEFICIENCY DISEASES

American Geographical Society has provided an eminent image of the distribution of the nutritional deficiency diseases in different parts of the world. Protein deficiency is predominantly found in the South American, African, Indian and South-East Asian populations. Mineral deficiencies predominate in Northern American continent, upper part of South-East Asian countries and some African populations. The incidence of multi-vitamin deficiencies is rampant in Africa, Middle-East and some islands of Pacific Ocean.

3.7 EFFECTS OF NUTRITIONAL STRESS

- **Infant Mortality and Childhood Death**
  
  Infant mortality rate in India is very high, computed as 80/1000 live births. Prolonged nutritional stress, specifically during infancy and preschool age is a major, although indirect factor leading to infant and early childhood mortality. For instance, diarrhea usually occurs during weaning period due to combined effect of infection and low food intake.

  Decreased Resistance to Infection: The resistance to infections in human is adversely affected by malnutrition.

  - The skin and mucosa do not provide effective physical barriers against infection.
  - Cell mediated immunity responses against bacterial infection get reduced in severely malnourished individuals. The thymus gland and thymus dependent lymphoid tissues are atrophied.
  - Humoral antibodies: Circulating immunoglobulin levels are usually normal or elevated in malnourished subjects due to frequent infection. As the secretary IgA is generally reduced, recovery from infections is delayed.

- **Under nutrition and Learning Abilities**
  
  The period of active growth of human brain extends from 30th week of gestation to the end of the second year of life. Undernutrition during this period, appears to adversely affect the development of brain. In recent years, intensive investigations have focused on the relationship of nutritional deprivation in early life and subsequent development of brain and cognitive abilities. Evidences have been derived either from the association of malnutrition in early infancy with poor mental performance later in childhood or with the retarded brain growth or size as observed in autopsy specimens. In a study, 45 malnourished infants and age matched controls from similar socio-cultural background were investigated after a period of 4-6 years. The previously malnourished group showed poor inter-sensory organisation for recognition of geometric forms. However, the differences observed by Wechsler primary and preschool Scale of Intelligence in the I.Q. were minimal.

  A recent study from Brazil on nineteen marasmic children aged less than six months, successfully treated for malnutrition, did not show significant lag in their IQ compared with their siblings and peers. Thus, malnutrition does not affect intelligence or is cause of mental retardation.
3.8 NUTRITIONAL STRESS IN MODERN SOCIETY

Prior to middle age, rice was used in South East Asia and some parts of Indian subcontinent, maize in central America, potatoes in South America, wheat in South West Asia and millets in Africa and parts of China. However, during middle age, long voyages undertaken by several groups of people led to the world wide dispersion of new domestic crops and animals. Rice cultivation was brought to Africa. The potatoes were also spread to many parts of the world. Horses, donkeys, cattle, sheep etc. were introduced into America that provided essential nutrients to many native populations.

Disruption of traditional diets and introduction of new food stuffs caused nutritional stress in many societies. The estimate of such a stress in earlier times is not known completely but by the beginning of 20th century epidemics of goiter, pellagra and beriberi were evident. In urban areas, movement of people into the cash economies decreased the supply of proteins, making it costlier. Poorer sections of society in urban areas thus became victims of Kwashiorkor.

Though nutritional stresses are declining in the contemporary society, infectious diseases are being replaced by non-infectious diseases. An increased genetic heterosis is also indicated. Children in modern society are growing faster and taller. They are maturing sexually at an earlier age. However, in many third world countries the nutritional deficiency diseases are still found in a large scale.

3.9 SUMMARY

Epidemiological Anthropology confers to the determination, manifestation and distribution of certain diseases and disorders in human communities spread all over the globe. The spectrum of disease causing factors ranges from genetic to environment. Socio-cultural background also exhibit influential role as human settlement pattern enhance the spread of diseases. The biotic and abiotic components of the environment contribute to ecological aspects of diseases. The epidemiological aspects consider two kinds of diseases namely, infectious and non-infectious. Malnutrition is another contributory factor for the affliction of certain diseases. Nutritional stress is frequently observed during infancy and early childhood consequently causing infant and childhood mortality. Nowadays, nutritional stress is incident in different developing countries and effect different communities to a varying degree. African continent has maximum incidence of nutritional disorders.

Suggested Reading


Sample Questions

1) Explain the concept of Epidemiological Anthropology.
2) Discuss the different factors responsible for infectious diseases.
3) Explain the relationship between environmental factors and non-infectious diseases.
4) Evaluate the role of malnutrition in relation to ecological conditions.