UNIT 4 BIO-CULTURAL FACTORS INFLUENCING PATTERNS OF GROWTH AND VARIATION

Contents

Learning Objectives:

After going through this unit, you will:

- understand the basic concept of growth;
- know about genetic factors affecting growth and variation;
- understand the ecological factors affecting growth and variation; and
- learn about socio-cultural factors affecting growth and variation.

4.0 INTRODUCTION

First of all, let's introduce the basic ideas of growth in human beings and understand what growth is? Understanding growth is important in order to understand the totality of human beings- which is the main venture of anthropology. Growth, although generally understood and studied in the limited biological sense, can be taken as an important manifestation of the genetic, environmental and psychological well being of a person. Simply, growth may be defined as the changes in shape and size over a period of time.

Growth study is very important to make clear understanding of the evolution. It also occupies a crucial place in the study of individual variation in form and function of man. Human growth is uneven from birth to adulthood. It occurs in different patterns and also influenced by many intrinsic and extrinsic factors such as genetic, environment and social factors.

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Human growth patterns are affected by various factors such as environmental factors, social factors as well as the biological factors. Growth is the effect of the intensive change of a multifaceted system of various regulatory factors with changing interactions. Both prenatal period and postnatal life may be modulated by several factors because each individual has a genetic base with a distinct growth potential (Eveleth & Tanner, 1990). When all these factors run normal, the optimal growth can be achieved. Prenatal growth as well as post-natal growth is determined by both hereditary factors as well as environment factors. For example, the prenatal growth i.e. the length of the newborn baby and the postnatal growth after which the child is exposed to different environment are governed by both hereditary and environmental factors. There is a sudden increase in height during puberty which is also known as the pubertal growth spurt that gives an extra increase in height and after that the growth ends soon. The growth process has close connection with pubertal development, and the onset of puberty is more correlated with skeletal age than with chronological age (Marshall et al, 1976). In many countries, the environmental conditions are such that there is incomplete expression of hereditary components, and this may have consequences on prenatal and postnatal growth (Wall et al, 1993).

Many scientists have defined 'growth' in their own ways. Being seen as a quantitative dimension of the process of development, it obviously results in the increase in size. Bogin (1991) defines growth as a quantitative increase in size or mass. There are various factors influencing growth and variation, broadly classified as genetic and environmental factors. Environment is a broad term that includes a large number of interacting variables. It is a complex condition and each condition influences the organisms differently at different stages of growth. Environmental factors influencing growth may be categorised as ecological and socio-cultural factors. Ecological factors include climate, altitude and seasonal variations etc. Socio-cultural factors incorporate nutrition, socio-economic status, family size, psychological disturbances, generation changes, migration, and urbanisation.

Check Your Progress 1

1) What are the factors influencing human growth and variation?

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4.1 GENETIC FACTORS

The genetic control of growth is determined by the variations observed in the total extent and rate of growth between children and adults of varied populations living in more or less similar environments. Ethnic variation may also affect in growth patterns. The most reliable support of hereditary control over growth can be provided by twin studies. The parents' height has an influence on the stature of their children is well recognized (Wall et al, 1993; Sinha and Kapoor, 2006). On the other hand, the relationship between parent's height and the height of the

baby is not noticeable at birth but becomes more apparent toward the age of 2 years, and subsequently the association becomes greater with growing age (Smith et al, 1976).There is a large difference in the height of monozygotic twins, with identical genetic composition when reared apart than when reared together, whereas, that difference was less when compared with the difference between dizygotic twins (Shields, 1962). The possible reason for the difference in height of monozygotic twins might be environmental factors. In addition to this genetic control may also influence body proportions. In comparative terms, the Australian Aborigines and the Africans in Ibadan have the longest legs (Eveleth & Tanner, 1990). The increase of leg length in comparison to increase in total length can be proportionally different in diverse populations during the growth phase. Admixture of races lead to production of children with stature and body proportions midway between the parental populations (Eveleth & Tanner, 1990). The growth process may also be affected by hereditary diseases and chromosomal aberrations due to suppressive influence. Some of the examples are Turner's syndrome (karyotype 45,XO), other X chromosomal abnormalities, and Klinefelter's syndrome are well-known diseases related with either short or long stature. It is difficult to manipulate genetically defined growth features in spite of many new developments in endocrine therapy such as growth hormone treatment for Turner's syndrome (Ranke et al, 1991).

Hormones or secretion of the endocrine glands are of great importance in the control of growth and development. Somatotrophin is the most important growth hormone that controls growth from birth to maturity. Other important hormones that play major role in regulating growth and development are thyroid hormone and steroid hormone.

During prenatal growth, poor environmental conditions do not support optimal development of the foetus.The first parameter to be inhibited is weight gain, however after prolonged inadequacy there is negative impact on weight also (Usher & McLean, 1974). Environmental settings account for about 60% of the variability of birth weight and genetic factors for the remaining 40% (Polani, 1974). Birth weights of first-born babies have 100 g lesser than second or third babies, in case of multiple pregnancies the weight gain of each foetus after the 30th week of gestation is less than that of single-pregnancy foetuses (Underwood, 1985). Illness in the mother, malnutrition, therapeutic drug treatment, alcohol and other social drug addiction, and cigarette smoking also make an inhibiting effect on fetal growth. High risk of congenital malformations and the incidence of abnormalities is related to poor control of blood sugar levels in the first trimester to the offspring of mothers with insulin-dependent diabetes. Ensuring specific diabetic control in early gestational period is important in order to maintain a more normal environment of glucose, insulin, and ketone levels which may help in diminishing congenital anomalies (Miodovnik et al, 1988). Consumption of alcohol, addiction of drug, and smoking may have a severe effect on the height and weight of babies (Jones et al, 1973; Hoff et al, 1986; Fulroth et al, 1989). It is known that smoking increases the risk of prematurity of foetus (Fedrick et al, 1978). During prenatal growth, maternal malnutrition with a deficiency of trace elements and placental dysfunction in addition to a direct toxic effect on the foetus has been appeared to be the underlying mechanism. The incidence of congenital malformations is also increased by addiction to alcohol (Streissguth et al, 1978).

4.2 ECOLOGICAL FACTORS

4.2.1 Climate

Heat, cold and relative humidity are associated with variation in body size, proportion and composition. People living in different climatic conditions tend to show differences in their body size. Usually, people living in a hot dry climate tend to have taller and lighter body in comparison to people living in a cold climate. During the year, there are periods of more rapid growth when growth rate is three times greater than the time of slowest growth. Most rapid growth occurs in spring season and all those periods of growth rate are coordinated with the seasons. In the tropics, lower food supply during the rainy season may be responsible for the changes in growth rate (Marshall, 1971).

4.2.2 Altitude

The 'sparse air' at high altitude creates environmental stress among the people living there. The existing conditions at high altitude have an impact on the growth and maturation of children (Kapoor and Kapoor, 1986). Growth and skeletal maturation are more retarded among mountain dwellers as compared to coastal dwellers because of environmental stress. Climate is also affected by high altitude, where people exposed to lower oxygen saturation in the air have a shorter stature (Eveleth and Tanner, 1990). One of the causative factors may be seasonal food scarcities (Leonard, 1989). Size of the body appears to be more adaptive under diverse ecological conditions (Frishancho et al, 1973).

Check Your Progress 2

2) What are the ecological factors influencing growth and development? Discuss.

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4.3 SOCIO-CULTURAL FACTORS

4.3.1 Nutrition

The problem of malnutrition is still a worldwide health issue. Foetal growth is affected by maternal malnutrition whether it is a deficiency of protein, calories, or trace elements. Foetal brain development may also be reduced due to malnutrition. There are three phases of cellular growth and organ development, the first being a phase of cell proliferation, followed by a phase of proliferation with concomitant hypertrophy, and a third phase of hypertrophy alone. Disturbances of the proliferation phase of brain tissue, for example, results in a lower DNA and protein content, which is irreversible and from which the brain does not recover. Therefore, the more serious is the lack of brain growth that

occurs in the earlier phase due to malnutrition. Climate also has a regulatory effect on birth weight. The socioeconomic environment in even the well-developed countries is undergoing changes, and modern women have the opportunity of working in male-oriented industries. Over the next decade, information will be gathered about possible factors such as toxins and workload, which may interfere with providing a safe internal environment for the developing fetus (McCloy, 1989). During the postnatal period, the prenatal effects on weight and height may disappear. During infancy, catch-up growth with reference to height occurs but this may be incomplete (Fitzhardinge et al, 1989), which may severely compromise the final height.

Nutrition during post natal seems to be the most important factor influencing growth. Nutrition influences both growth and development. A required amount of food and nutrition is essential at different ages for proper growth and development. Undernutrition during childhood results in slow skeletal growth. Malnutrition results in failure to grow, involving both weight and height. Increased growth hormone secretion occurs in protein malnutrition which probably help in inducing mobilization of the enduring fat tissue (Primestone et al, 1968). On the other hand, growth hormone levels are decreased in calorie malnutrition. The affected children soon recover if malnutrition is corrected at proper time. If this reversal occurs at an early age, most children will attain a complete remission in height and weight, equal to their siblings before puberty. In fact, the retardation of growth rate is an indication of malnutrition and this condition can be improved by supplementing the diet. Higher calories are essential during the stage of adolescence. Lack of calories leads to reduced or delayed pubertal growth spurt. Anorexia nervosa is a common disease in adolescent girls. Alterations in endocrine may also occur depending on the harshness of the anorectic state which includes an increased growth hormone levels related with hidden gonadotropin and sex steroid levels (Brown et al, 1978). All of these are primarily the consequences of malnutrition, on the other hand a central mechanism with direct effects on hypothalamic function may also be involved (Eisenberg, 1981).

Skeletal development is also important for the growth process. Different hormones are involved in growth in which each of them have their own regulatory effect on skeletal maturation. Malnutrition causes retardation of skeletal deformity. Separation lines can be seen on X-ray films when there are periods of delayed growth caused by either disease or malnutrition (Blanco et al, 1974).

Check Your Progress 3

3) Explain the role of nutrition in human growth.

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4.3.2 Socio-Economic Status

The impact of socio-economic differences on the height and weight of children is well known (Kapoor et al 2013). Several studies have shown that children

belonging to a high economic group grow faster than those belonging to a low socio-economic group. Family with higher socioeconomic status includes higher income associated with better education, better nutrition, better child care, and better medical and social services. The so-called secular change occurs when all these factors induce a change in size, rate of growth, and timing of pubertal development (Eveleth and Tanner, 1990).

4.3.3 Family Size

The size of a family also influences the rate of growth of children, especially in the lower socio-economic class. Children do not get adequate care and sufficient quantity of food in a large and poor family. As such, the rate of their growth in such families is found to be comparatively more retarded growth than in big families belonging to a higher socio-economic class.

4.3.4 Generation Changes

Studies conducted during the last one hundred years in different parts of the globe revealed a marked tendency in children to become progressively larger-taller and heavier besides maturing more rapidly. Factors like better nutrition, improved hygienic conditions, control of infectious diseases, reduced family size, improved and widespread medical facilities etc. might have been responsible for the occurrence of an increase in height and weight. This trend has been termed as the 'secular trend'. The phenomenon has also been noted as regards the age at menarche. It has been found that the average menarcheal age of girls is gradually going down. The social, emotional and mental development of children may also be influenced through parental love, care and proper parent-child relationship. Adverse psychological conditions can affect the functioning of the endocrine system, which may in turn cause retardation in growth.

4.3.5 Culture

Culture too influences nutritional conditions. Nutrition not only depends on the availability of food or the socio-economic condition of the person or population concerned but also on the utilisation of food resources. The kind of food eaten, meal time, food restriction, food habits, lifestyles etc. are all culturally determined. Thus, cultural behaviour influences nutrition and thereby growth and development.

4.3.6 Migration and Urbanisation

The impact of migration and change of environment on physical characteristics are observed. Migration has been taking place for rural and urban areas. This has been due to the search for livelihood or employment, occurring more rapidly today than ever before. Migration redistributes the genetic, physiological, morphological and socio-cultural differences found in human populations (Bogin, 1991). Thus, it is likely that migration would have some effects on the growth and development of migrants and the recipient populations. A taller stature is thought to be the result of urbanization (Tanner and Eveleth, 1976), and this is almost certainly a consequence of ample food supply, sufficient health and hygiene services, education, recreation, and welfare. Various studies have shown that there are differences in growth rate in many ethnic groups but how far these are due to heredity or ecology is still not clear. Hereditary factors are clearly of

immense importance as they lay down the basic plan of growth. But environmental factors constantly condition and modify the expression of genetic potentials.

Check Your Progress 4

4) Discuss role migration and urbanization influencing growth.

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4.4 SUMMARY

Human growth patterns are influenced by various factors such as biological / genetic factors and social factors. Growth is an effect of the intensive change of a multifaceted system of various regulatory factors with changing interactions. Both prenatal period and postnatal life may be modulated by several factors influencing growth and variation in these phases of life. These factors can be broadly classified as genetic and environmental factors. Environment is a broad term that includes a large number of interacting variables. It is a complex condition and each condition influences the organisms differently at different stages of growth. Environmental factors influencing growth may be categorised as ecological factors and socio-cultural factors. Ecological factors include climate, altitude and seasonal variations etc. on the other hand socio-cultural factors incorporate nutrition, socio-economic status, family size, migration, and urbanisation etc. Human growth and variation is a complex interplay of these factors. The growth of a child to an adult is the result of both genetic and environmental forces acting together. Genetic factors set the limits of growth and environmental factors help to reach the limit.

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4.6 ANSWERS TO CHECK YOUR PROGRESS

1) Human growth patterns are affected by various factors such as environmental factors, social factors as well as the biological factors. Refer to section 4.0

2) Climate and altitude. Refer to section 4.2

3) The problem of malnutrition is still a worldwide health issue. Foetal growth is affected by maternal malnutrition whether it is a deficiency of protein, calories, or trace elements. Foetal brain development may also be reduced due to malnutrition. There are three phases of cellular growth and organ development, the first being a phase of cell proliferation, followed by a phase of proliferation with concomitant hypertrophy, and a third phase of hypertrophy alone. Refer to section 4.3.1

4) The impact of migration and change of environment on physical characteristics are observed. Migration has been taking place for rural and urban areas. This has been due to the search for livelihood or employment, occurring more rapidly today than ever before. Migration redistributes the genetic, physiological, morphological and socio-cultural differences found in human populations Refer to section 4.3.6