CHAPTER I
INTRODUCTION

This thesis is concerned with the growth and nutritional status of Khasi children in West Khasi Hills district of Meghalaya. By the term growth we mean a regular process of quantitative increase in size or mass of different tissues and organs of the body especially from conception to adulthood (Bogin, 1999). Nutritional status, on the other hand, is defined as a physical expression of the relationship between the nutrient intakes, or bio-availability of nutrients, and the physiological requirements of an individual (Brown, 1984). This physical expression of the relationship between nutrient intakes and physiological requirements of a person can be measured by a number of methods. Of the different methods, anthropometry is one that is generally used for measuring the nutritional status at both individual and population levels. Anthropometric measurements and indices like weight, height, mid upper arm circumference, skinfold thickness, weight-for-age, height-for-age, weight-for-height, body mass index, indices of upper arm circumference, etc., (WHO, 1963; Jelliffe, 1966; Frisancho, 1990) are used for assessing the nutritional status of children.

The study and conceptualization of human growth and development can be traced back to the very early part of the history of human civilization. The earliest written record on human growth, dated about 3500 Bc from Mesopotamia, gives an account of fertilization to birth (Bogin, 1999). Nevertheless, the genuine observation of children’s growth is that of Hippolyt Guarinoni of Germany published in 1610 when he wrote his observation on growth retardation caused by emotional stress at school, and the late development of peasant girls (Tanner, 1998). Forty-four years later, Johann used “Anthropometria”(1654), meaning “measurement of man” and called the instrument he used for measurement as “Anthropometron.” Then, the real story begins with the first textbook on human growth written by Johann Augustin Stoller (1703-1780) in 1729. According to Tanner (1998), Stoller was the first to give a clear description of catch-up growth. However, he confused “post-illness catch-up growth” with normal adolescent growth spurt, and such confusion lasted right through the time of Quetelet (1716-1874), who proposed the body mass index and introduced the statistics of normal growth curve. Nevertheless, the first thesis on human growth was presented at Halle in 1754 by C. F. Jampert, i.e., twenty-five years after the work of Stoller. Jampert’s thesis entitled Causas incrementum corporis animalis
limitantes (factors which control the growth of the animal body) was considered the first work that was comparable to the modern writing. The thesis consisted of cross-sectional data on growth of the children at the Berlin Friedrich’s orphanage, and it pointed out the problems of sampling variation. Jampert was also the first to point out the difference between longitudinal and cross-sectional methods of growth study. Consequently, Count Phillip Gueneau de Mountbeillard made the first longitudinal growth study during 1757 to 1777. Mountbeillard was inspired by G. L. Buffon, the father of modern geology and the first to study the growth of fetuses and newborns, to take measurement on the height of his son from birth to adulthood. Mountbeillard’s growth study was well known to Quetelet and others during the 19th century, and it is still considered to be one of the best in the history of longitudinal growth study.

Nowadays, the study of physical growth and development of children has become a major interest not only among the auxologists, but also among the biologists, anthropologists, nutritionists and other social and behavioural scientists with different interests and objectives of study. To paediatricians and other medical researchers, the main focus of attention is on the impact of the environment on the individual or a small group of individuals and the aim is to cure or alleviate ill-health and distress. To human biologists, growth is a major concern in understanding the complexity of nutritional and hormonal mechanisms that control changes in the human body. To epidemiologists, growth is often used as a summary measure of environmental influences and increasingly as a proxy for environmental influences during childhood and adolescence, which may affect the later health of an individual. To practical nutritionists, growth is the measure of success of intervention in dietary supplementation. To economists, physical growth and strength help to determine individual labour productivity and the magnitude of poverty in a population since growth is a good indicator of nutritional status which is greatly influenced by economic condition of a given individual or population. To anthropologists, growth is of considerable interest in understanding human adaptation to physical, biological and cultural environments, especially to understand the interaction between growth and culture.

As for the study of human growth in anthropology, one may argue that the study of human growth and development has been an essential part of anthropological research since the birth of the discipline itself. Early anthropologists, especially Franz Boas are well known for their contribution to growth studies. One of the main reasons for such an interest in growth
studies is that human growth serves as a mirror that “reflects the biocultural evolution of our species” (Bogin, 1999). Of course, the basic objective of anthropology is to understand the biological and cultural evolution of human population. Human growth and development may be considered as the product of the interplay between the biology of our species, the physical and the socioeconomic environment where we live (Bogin, 1999). Therefore, the pattern of human growth and development reflects the biological and socio-cultural aspects of our society as well as the evolutionary history of our species. According to Tanner (1988), “The study of growth is important in elucidating the mechanism of evolution for the evolution of morphological characters necessarily comes about through alteration in the inherited pattern of growth and development. Growth also occupies an important place in the study of individual differences in form and function of man, for many of these also arise through differential rates of growth of particular parts of the body relative to others”. Thus, growth as a constant and regular process is important in identifying population variations, differences between the sexes, intra-population variation and other health implications. In addition, the study of human growth is essential in understanding not only the health and nutritional status of a population, but also the interaction between biology and culture. For example, the pattern of human growth is indirectly influenced by several socio-economic factors through their direct influence on nutrition and infection. Several studies have revealed that children belonging to different socio-economic groups have shown differences in their growth pattern (Eveleth and Tanner, 1976; Frisancho, 1978; Hauspie et al., 1992; Misuraca et al., 1995; Edward et al., 1996; Milani et al., 1999; Reddy and Rao, 2000).

Further, Eveleth and Tanner (1990) have also observed that. “A Child’s growth rate reflects perhaps better than any other single index, his state of health and nutrition and often indeed his psychological situation also. Similarly, the average values of children’s height and weight reflects, perhaps better than any other single index, his state of health and nutrition and often indeed his psychological situation also. Similarly, the average values of children’s height and weight reflect accurately the state of a nation’s public health and the average nutritional status of its citizens, when appropriate allowance is made for differences, if any, in genetic potential. This is especially so in developing and disintegrating countries” Therefore, a well-designed growth study is very important tool for assessing the health status of the population concerned. Since human growth and development is also largely influenced by socio-
environmental factors like nutrition, infection, occupation, income and religion, it is very vital to understand the bio-cultural variation and evolution of human populations (Tanner, 1988: Eveleth and Tanner, 1990).

In the light of the above backdrop, physical growth is not only helpful in understanding the process of human evolution and variation, but also reflects the health and economic condition of a population. In India, the large sample of growth study was first carried out by the Indian Council of Medical Research between 1956 and 1965 and reported in 1972, although stray researches began since the 1930s by workers like Aykroyd and Rajgopal (1936). Narinder Singh (1939), and others. However, growth studies in India are still limited in number especially those which are concerned with the assessment of health and nutritional status of different ethnic groups in the country (Sharma, 1992). Therefore, it is essential to conduct more researches on physical growth and development of children with a view to understanding the economic conditions and nutritional status of the different populations in different parts of the country.

Population Variation
There is a considerable difference between and within populations in the rate of physical growth and attainment of body size at any given age (Eveleth and Tanner, 1990; Bogin, 1999). It has been observed that the largest differences take place between the developed and developing countries as well as between the higher and lower socioeconomic groups within the same population (Ulijaszek, 1994). Such differences are attributable to both genetic and environmental factors. However, it is believed that the growth patterns of under-five children all over the world are likely to have a similar genetic potential for growth and development, and the differences between them are mainly due to environmental factors including infections and socioeconomic conditions (Habitch et al., 1974; Waterlow, 1988; Gopalan, 1990; Neumann and Harrison, 1994). According to Ulijaszek (1995), from the anthropological point of view, these differences may be considered as 'adjustment and adaptation to both the nutritional and disease environments; smaller body size may offer an advantage if it adjusts the size of individuals to available nutritional and energetic resources, but it may be disadvantageous in other respects such as greater susceptibility to infectious disease, or lower physical work capacity.'

The assessment of growth status of children’s are generally carried out by comparing the attained height or weight for a given age with reliable growth references. For example, the
U.S. National Center for Health Statistics (NCHS) growth references, now known as the Centers for Disease Control (CDC) growth references (Kuczmarski et al., 2000), and that of the WHO (2007) growth references are used widely used for the assessment of growth and nutritional status of children. The basic reason for the use of such international growth references is related to the empirical evidence that children belonging to higher socioeconomic strata of developing countries have shown similar growth patterns of their coevals at a given age group in the developed or rich countries. For this reason, Gopalan (1989) is of the opinion that "the genetic potential for growth and development is nearly similar among most peoples of the world." In fact, the Lancet (1984) concluded in its editorial part that "growth of privileged groups of children in developing countries does not differ importantly from those in the developing countries", and that "the poorer growth so commonly observed in the underprivileged is due to social factors - among which malnutrition-infection complex is of primary importance - rather than to ethnic or geographical differences." Thus, the growth curves of well-nourished children in the developed world were used to determine desirable rates of growth, and optimal anthropometric standards for assessing the nutritional status of children all over the world. The underlying principle is as follows: since the children in the reference group are unhindered by nutritional deprivation and hence are enjoying the maximal growth permitted by their genetic potential, they constitute an ideal standard against which to judge the nutritional adequacy of all other groups. As results, international standards, or growth references, like CDC standards or references (Kuczmarski et al., 2000) are developed for assessing the growth and nutritional status of children. The children who are below these standards are considered to have failed to achieve genetic potential, and they are therefore regarded as undernourished. Thus, it is clear that the main objective of the genetic potential theory is to set a normative target of growth, which every community could aspire to achieve.

However, there has been a limited consensus over the use of these growth references especially in populations of Southeast Asia like India (Seckler, 1982; Ulijaszek, 1994). Ulijaszek (1995) has argued that "any use of growth references internationally should acknowledge that they can act, at best, as imperfect yardsticks, since human populations may show similar growth characteristics, but are unlikely to ever become so homogeneous that they show the same genetic potential for growth" because these growth references do not represent the greatest possible human potential for growth. Of course, there are considerable population
differences in growth and development that need further studies to have a better understanding of the problems, especially in populations of developing countries like India.

In his observation on the populations of India and Nepal, Seckler (1982) has argued that the children treated as mild and moderate undernourished, according to height-for-age with reference to international standards, may be considered as "small but healthy." According to Seckler (1982), about 90% of all the malnutrition found in these countries involved people with low height for age but with proper weight for height ratio (author's italic). Now, if one thinks of malnutrition in the conventional imaginary of thin, wasted bodies, rather than in terms merely of short people, the incidence of malnutrition must be considerably reduced. Of course, since short people with proper weight for height ratio will also be light people, their consumption requirements will also be less than conventionally estimated. Seckler is of the view that there are no impairments in the range of mild to moderate malnutrition according to conventional standards, "because this range represents an adaptive response of body size to adverse conditions in order to avoid these impairments." To support his argument, he also writes, "I have tested this conjecture on a sample of Indian children who were medically screened and known not to be malnourished or unhealthy and who had a normal medical history. Over 90% of the 17 year olds in this healthy study would be considered malnourished, and some even severely malnourished." Accordingly, he suggests that appropriate reference standard for the assessment of undernutrition should be lower than the maximal growth path permitted by genetic potential theory. Payne (1992), though in a different way, has also supported that the scientific concept of nutrition refers not to the failure to meet some normative targets, but to the failure of maintaining the functional capabilities that depend on the level of nutrition. On the contrary, most of the individuals below the standards as proposed under the genetic potential theory do not show such functional impairment. Payne (1992) has criticized the genetic potential theory as supporting the armpit of obesity, which is generally associated with cardiovascular diseases and risks of morbidity and mortality.

It may be mentioned that the origin of Seckler's hypothesis – small but healthy - can be traced to a group of biologists who have been much concerned with the processes of human growth. For instance, J.M. Tanner, who is one of the leading authorities on human growth and whose influence was acknowledged by Seckler, explicitly warns against assuming that being small is necessarily bad. In fact, he coins the phrase "bigger not better" and argues that,
"Though rate of growth remains one of the most useful of all indices of public health and economic well-being in developing and heterogeneously developed countries, it must not be thought that bigger, or faster, is necessarily better" (Tanner, 1978). The advantage is that a small body enables a person to survive and sustain his level of activity in a world of nutritional constraint, because a smaller body requires less energy both for maintaining itself within certain bounds and for performing physical activity relative to the environment where the people live. However, if the level of productivity in such small people is low, it proves to be disadvantageous (Uljaszek, 1995; Strickland and Tuffrey, 1997; Shetty, 1999).

**Growth Curve**

Most of our knowledge about the growth of children is concerned with the post-natal period based on sequential measurement of sizes like height, sitting height, etc. which are taken on the same subject (longitudinal) or a group of subjects with different ages (cross-sectional). These data especially longitudinal data, allow us to determine the underlying continuous process of growth, that is, to produce a smooth growth curve which fits our observations, and which can be used to estimate the different biological parameters taken during growth and development (Hauspie, 1998). Different mathematical models have been proposed in order to develop a growth charts or standards for growth monitoring, to understand and describe the distance and velocity curve and to figure the pattern and process of growth, apart from predicting and describing the final height of the children (Preece and Baines, 1978; Cole, 1990; Jelicoeur et al., 1992; Karlber, 1998; Hauspie, 1998). Also, since growth is a continuous process, the cessation and default of growth in man raised some problems, therefore the smooth-distance curve is used to suppress the measurement error and determine the final attainment in body-size, and to monitor whether an individual has been growing satisfactorily (Preece and Baines, 1978; Cole, 1990, 1994).

The fit of a model to growth data is nothing but a regression technique, which consists of a set of values for the function parameters that are used for obtaining the best-fitting criterion. The oldest and most widely used method in curve fitting is the: least-squares” method, which gives the value of the function parameters that minimize the sum of square deviation of the
observed values from those predicted by the equation. There are basically two types of growth models, namely “structural” and “non-structural.” Non-structural models merely give a description of the growth process as given by the empirical data, and they are linear in nature. On the other hand, “structural models are based on the idea that growth pattern has a basic functional form to which a direct biological interpretation can be attributed” (Hauspie, 1998). As a matter of fact, structural models are basically non-linear in nature and give a good description of growth pattern. They are often used to estimate the biological parameters of the growth curve such as age, size and velocity at take-off of adolescent growth spurt, and at the age of peak velocity during adolescent growth spurt. Such biological parameters include age at take-off, size at take-off, velocity at take-off, age at peak velocity, size at peak velocity and peak size velocity. Many other quantities, characterizing some aspect of the shape of the growth pattern, are also derived from the smooth fitted curve. According to Hauspie (1998), these “biological parameters form the basis for studies comparing growth pattern between individuals or between groups of individuals.” Thus, it is generally believed that curve fitting is a technique, which allows the estimation of smooth growth curves based on empirical data. It can also be used to summarize growth data with certain number of biological parameters which carry the same meaning for all subjects and which can be easily be used for further analysis of the shape and form of growth pattern. In the present study, Preece-Baines model 1 (PB1) was adopted for fitting the mean values for certain anthropometric variable (Preece and Baines, 1978) as used in many other studies (Cameron et al., 1982; Lindgren and Hauspie, 1989; Dasgupta and Das, 1997; Milani, 2000; Ward et al., 2001).

**Sex dimorphism**

One of the focuses of growth studies is sexual dimorphism. Differences between the sexes in growth pattern have long been the major interest in the study of human growth and development since the 19th century (Garn, 1980). Many of the sex differences in adult body size and form are believed to be due to the differential growth pattern at adolescence. The adolescent growth spurt occurs in all children, although it varies in intensity and duration from one individual/population to another. It is reported that the “peak velocity of growth in height averages about 10 centimeters a year in boys, and slightly less than this in girls. In boys, the spurt takes place on average between 12.5 years and 15.5 years of age, and in girls some two years earlier” (Tanner,
Several authors have suggested that this feature of difference between boys and girls is a consequence of the timing variation, a positive value for the growth spurt and intensity of the adolescent spurt (Tanner, 1978; Bogin, 1999). Tanner (1998) has also suggested that the differences between the sexes in height during adulthood are mainly due to the longer period of male growth. The differences in pre-pubertal growth males have a relatively much greater spurt than females in respect of shoulder width, whereas in the case of hip the latter exceeds the former. However, “the greater length of the male legs relative to the trunk is a consequence of the longer pre-pubescent period of male growth, because the legs are growing faster than the trunk at this time. The male forearm is longer, relative to the upper arm or the height, than the female’s. This difference is already established at birth, and increases gradually throughout the whole growing period” (Tanner, ibid). Marshall (1978) also claims that the longer period of preadolescent growth in boys is largely responsible for the fact that the men’s leg are relatively longer then women’s because the legs grow faster than the trunk before adolescence.

During the process of growth and development, girls are reported to be more tolerant to the effects of different stresses as compared to boys. According to Wolanski (1973), one of the basic reasons is perhaps related to differential number of X-chromosomes, which are two in females and one on males. Nevertheless, it is generally pointed out that growth during childhood and juvenile stages is more sensitive to environmental factors and during adolescence is determined more by genetic factors, and girls are better ‘buffered’ against environmental determinants of growth, especially undernutrition and diseases (Bogin, 1999).

The achievement of adolescent growth spurt is an important biological event in identifying the process of children’s growth and development. The peak velocity is one of the unique features in the process of human growth and development. Children’s body dimensions attain peak velocity at different times and in varied magnitudes. According to Bogin (1999), the adolescent growth spurt must have its own intrinsic evolution values, and is not just a by-product of slow pubertal development. The earlier appearances of adolescent growth spurt in girls over the boys by about 2 years of age is normally seen in growth process and for this reason the body dimension of the girls remain greater during this stage. During puberty there is a spurt in growth and the body undergoes functional and structural changes making it capable of procreation; the
sexual organs mature and the secondary characteristics develop (Emslie-Smith, et al., 1988). Attainment of adolescent growth spurt during pubertal stage is generally followed by the slow growth rate, and finally by growth cessation.

**Growth as Indicator of Nutritional and Socioeconomic Inequality**

Human growth is a regular process that is characterized by the changes in form, or size and function of an individual from conception till attainment of adulthood. It is believed that environmental factors, especially nutrition are of crucial importance in the expression of genetic potential of growth. In other words, although growth is subject to the genetic influence, it is considered that environmental factors, particularly nutrition, are very important in influencing human growth and development. Therefore physical growth of children is regarded as one of the best indicator of the nutritional status of a given population. In fact, the effects of under nutrition and over nutrition on growth and maturation of children are the major research problems in the field of nutrition and auxology.

One of the major health problems in many developing countries is the widespread prevalence of undernutrition and infectious diseases (WHO, 1990). It is generally reported that the basic causes of malnutrition and infections in developing countries are poverty, poor hygienic conditions and little access to preventive and health care (Mitra, 1985; WHO, 1990). Hence, the assessment of nutritional status of population has attracted the attention of not only the nutritionists and other biological scientist, but also the economists and other social scientists with a view of understanding the health and socioeconomic status of the population (Gopaldas Seshadri, 1987; Osmani, 1992). Nutritional status is defined as the physical expression of the relationship between the nutrient intakes, or bio-availability of nutrients, and the physiological requirement of an individual (Brown, 1984). The physical expression of the relationship between nutrient intake and physiological requirement of a person can be measured by a number of methods. Of different methods, anthropometry is one that is generally used for measuring the magnitude of undernutrition at both individual and population levels. Anthropometric measurements and indices like weight, height, mid upper arm circumference, skin fold thickness, weight for age, height for age, weight for height, body mass Index, indices of upper arm circumference, etc. (Jelliffe, 1996; Frisancho, 1990) are used for assessing the nutritional status of children.
According to Tanner (1986), growth may be described as “mirror of the conditions of the society” and height as a proxy for health. It is observed that growth retardation, or delay in growth appropriate for an individual or a population, takes place even in some sections of the populations in developed countries due to deprivation, illness, psycho-social stress and increased family size (Norgan, 2000). Growth retardation due to inadequate nutrition and infection is reported to be common in developing countries especially in the early stages of growth and development.

Martorell et al., (1994) has suggested that after 3 years of age, growth patterns of children in developing countries are similar to that of the international growth references. On the other hand, other authors have rejected this claim and argued the growth pattern of children in developing countries deviate significantly at the lower rate after 5 years of age. For example, Cameron (1992) has shown that the rural South African children followed near the 50th percentile at 5 years of age, but thereafter growth rate was slower than the reference rate, and it was near the 3rd percentile by the onset of adolescence. Similar findings can be observed in the growth studies in Northeast India (Begum and Choudhury, 1999; Khongsdier and Mukherjee, 2003). Earlier findings have, however, indicated that the affluent Indian girls are similar to the 50th percentile of the NCHS growth references up to 12 years of age, thereafter the increments in height of Indian girls were significantly lower than the NCHS references (Gopalan, 1996). Thus, if growth is also a good indicator of socioeconomic status, the earlier findings indicates that there is an urgent need to conduct more research works on growth patterns of children in different populations of India with a view to understand the population variation in socioeconomic conditions.

Several studies have revealed the association between physical growth and socioeconomic condition of populations (Lindgren, 1976; Smith et al., 1980; Garn et al., 1984; Johnston, 1986; Lasker and Mascie-Taylor, 1989; Visweswara Roa et al., 1990; Terrell and Mascie-Taylor, 1991; Hauspie et al., 1992; Khongsdier, 1993 Misuraca et al., 1995; Mockus et al., 1995; Post et al., 1997; Milani et al., 1999) Some studies suggest that within a given country children from economically advanced areas are taller and heavier than children belonging to the economically underprivileged areas (Ferro-Luzzi, 1967; Ferro-Luzzi et al., 1979) It is generally agreed on the basis of data from different continents, that variation in growth pattern of children in developed countries of Europe and North America on one hand and in the developing
countries of Asia, Africa and Latin America on the other are mostly due to differences in their socio-economic status, and not because of genetic differences (Habicht et al., 1974; Stephenson et al., 1983; Eveleth and Tanner, 1990; Gopalan, 1992). Thus growth and development of children may also be considered an indicator of socio economic status of a given population. In the present study; we shall also consider the variation between populations in respect of growth pattern as mainly due to variation in nutritional status which is greatly influenced by the socioeconomic condition of an individual or a population.

Some studies in India also revealed that children from the well to do sections of the same community are heavier and taller than their counterparts belonging to the poor socio-economic groups (Mitra, 1939; Mukherjee, 1951; Dutta Banik et al., 1970; Bharati and Basu, 1990) Rajyalakshmi (1981) has also observed that the children of higher income groups are heavier and taller than those of lower income groups. Indian Council of Medical Research (ICMR 1972) has also reported that the height, weight subcutaneous tissue and other anthropometric variables are positively associated with socioeconomic status. Similarly Vijayaraghavan et al. (1974) and Visweswara Rao et al. (1980) reported that the arm economic groups were considerably smaller than those of well to do children of corresponding ages. The effect of socio economic condition on growth pattern of Indian children also been revealed in other studies (Roa and Sastry, 1977; Satyanarayana et al., 1980; National Nutrition Monitoring Bureau 1980; Bharati and Basu 1990).

In Northeast India, most of the growth studies were carried out in order to understand the population variation in growth patterns of children (Khongsdier and Ghosh, 1998). Very few growth studies have been carried out with a view to assessing the health and nutritional status of a population, especially in the state of Meghalaya (Khongsdier, 1996; Mukherjee, 2002). In addition, there are still limited studies on the role of socio-economic factors in influencing growth. It may be mentioned that growth studies in Northeast India were initiated by the late Priya Bala of Gauhati University. Das (1973, 1974) initiated the biocultural studies of growth by taking into consideration the caste hierarchy as a social factor that may influence the growth status of children. Choudhury (1979) studied the growth of Rabha boys of Assam aged 4 to 18 years and compared his findings with the Assamese caste boys. He found that the Rabha boys were taller and heavier than the Assamese caste boys during the early stages of growth. On the
hand, the adult Rabhas were found to be the shorter than the caste and other population groups. Choudhury suggested that the population differences during the early stages of growth were mainly due to culture and food intake. The findings of this study are very interesting because other studies also indicated that children, not only from Northeast India (Begum and Choudhury, 1999; Mukherjee and Khongsdier, 2003a, 2003b) but also from other developing countries, are somewhat comparable to the 5th or 10th percentile of the international growth references, especially in the lower age groups. The implication is that growth retardation during the early stages of growth is mainly due to nutritional deprivation, or a failure in the expression of the genetic potential for growth (Gopalan, 1992).

Recently, the National Family Health Surveys (NFHS-2 and NFHS-3) (IIPS & Macro International, 2000, 2009) have revealed that Assam and Meghalaya are the two states with the highest prevalence of undernutrition in Northeast India, i.e., as indicated by anthropometric measurements and indices of the growth of children under 3 years of age. In Meghalaya, the high prevalence of undernutrition was also observed even in urban area for children aged 3-18 years (Mukherjee, 2002). It is likely that the prevalence of undernutrition will be higher in rural areas. Therefore, we propose to undertake a study on growth and nutritional status of Khasi children aged 2-18 years in rural areas of the West Khasi Hills district, Meghalaya, in order to find out certain socioeconomic factors responsible for the growth failure and malnutrition, if any.

**OBJECTIVES OF STUDY**

In view of the short review given above, we propose to undertake the study on "Growth and Nutritional Status of Khasi Children in the West Khasi Hills District of Meghalaya" taking into consideration the following objectives:

1. To describe the growth pattern of Khasi children aged 3 to 18 years in terms of anthropometric variables.
2. To assess the nutritional status of these children, using certain anthropometric indices relative to the recommended growth references.
3. To analyze the effects of demographic and socio-economic factors such as age, sex, birth order, family size, occupation of parents, household income and educational level of parents on growth and nutritional status of children.
AREA OF STUDY

Location and Topography
Meghalaya is essentially a small tribal state in the north eastern region of India. It lies between 25° 47’ and 26° 10’ N latitude and 89° 47’ and 92° 87’ E longitude. The state covers an area of about 22,429 km. It is bounded by Assam on the north, east and north west, and by Bangladesh on the south and south west.

Initially, Meghalaya was a part of Assam, which was composed of only two districts, namely, the united Khasi and Jaintia Hills district and Garo Hills district. It was bifurcated from Assam as an autonomous state on April 2, 1970, and subsequently a full-fledged Statehood was given on January 21, 1972. The Khasi Hills district was itself bifurcated on 12th October 1976 into two districts known as East Khasi Hills district with its headquarters in Shillong and the West Khasi Hills Districts with its headquarters at Nongstoin.

Several hills in the Khasi Hills district have a firm place in mythology and traditions of the Khasi people. For example, Shillong peak (Lum Shillong) is the highest peak (1964m) in the Khasi Hills. It associated with the legends of the Khasi with U ‘Lei Shillong (Lei being the abbreviated form of Blei meaning God), the titular deity of the old kingdom of Shillong and progenitor of the royal family, Ka Pah Syntiew. The base of the peak is the source of four important rivers – the Umngot, Um-Iew, Um-Jasai (important tributaries of the Um-Iam or Barapani) and Um-Khen, from which the water supply of Shillong is obtained.

Geological Composition
Meghalaya may be broadly divided into five Geological formations, namely Archean Gneisses complex, Shillong group of Rocks, Lower Gonduana Rocks, Cretaceous Tertiary Sediments and sylhet Traps (Bhakta, 1992). Shillong Group of Rocks is exposed in the central parts of the Khasi hills comprising mostly quartzite. Rocks of this group rest un-conformably over the gneissic rocks with basal thick bed of conglomerate in the western part. The mildly folded sediments have suffered low grade metamorphism and are dissected by numerous faults. These rocks are intruded by ultra basic and acidic sills and dykes. The granite intrusive along the axial region of the Shillong group of rocks around Mylliem is termed as Mylliem granite. Several
other granite bases such as Kyllang Plateau are intrusive into the gneissic complex in different parts of the region.

The Khasi hills area is endowed with a number of economically important minerals, the major ones being limestone, coal, uranium, sillimanite and clay.

Climate
Because of the considerable variations in altitude and exposure, differences in climatic condition do exist within the Khasi hills. Shillong is situated about 1500 m above sea level. Its climate is pleasant, neither extremely cold nor hot. The temperature rises above $24^\circ C - 34^\circ C$ in the summer and falling below $4^\circ C$ in winter. The average temperature and annual rainfall vary from one region to another. But Cherrapunji and Mawsynram areas receive the heaviest rainfall in the world (1270 cm).

Flora and Fauna
The vegetation of Khasi hills may be broadly classified into two major types, viz., the Tropical and warm temperate types. The forest of Mehglaya is the rich source of timber. The important timber-yielding free species are Khasi pine ($Pinus Khasiya$), sal ($Shore robustra$), teak ($Tectana grandis$) gamari ($Gmelina or borea$) etc. Different types of bamboo also grow in abundance.

Major crops of this state are paddy, maize, millet, pulses, potato, and ginger, turmeric, black pepper, sugarcane and oil seeds. Among the vegetables, cabbage, cauliflower, bean, radish, chilly, onion, lady’s finger, carrot, peas and brinjal are extensively cultivated. The cultivated fruits include guava, orange, lemon, banana, naspati ($Pyrus senensis$), papaya ($Carica papaya$) black berry ($Prinus nepulems$), etc.

About 250 species of orchids have been reported form this region, which include species ranging from tiny ones to tall one or more meters high (Gazetteer of India, 1991) Ferns are also found in abundance. The above mentioned flora of Khasi hills are mostly found in Shillong area.

The fauna of Meghalaya include a unique assemblage of Indo-Chines elements of Oriental and Palaearctic fauna (Gazetteer of India, 1991). The tropical and subtropical evergreen forests ensure the survival of rich mammals and also other groups of animal life. Of
mammals, the Khasi hills possess some interesting animals like the hillock (aibcon), the only ape in India (Hylobates), the golden cent (Felies temminckei), the leopard (Felids bengalensis veer), the jungle cat (Felis chaus), the Himalayan black bear (Selenarctos thebethanus), the banking deer (Muntiacus muntjak) and the Panglen (Manis pentadaetyla).

Different types of birds are also found in East Khasi hills of Meghalaya. Snakes and lizards are also abundance. Besides, the Khasi Hills also reveal a number of interesting amphibians and fish species. Insects of the region present an interesting assemblage of fauna in the state. It may however be noted that most bird and animal species tend to decrease in number due to increasing deforestation.

THE PEOPLE
According to 2001 census, the total population in 2306069 of which 1167840 are males and 1138229 females. In East Khasi Hills, the total population is 6, 60, 994 of which 3,33,187 are males and 327807 females. The sex ratio is 984 females per 1000 males with a literacy rate of 76.98%.

The people of Meghalaya are mostly tribals, among which the Khasis and Garos are the most dominate tribal groups. The other tribal populations like the Hajongs, Nagas, Mizos, etc. along with some non-tribal populations like Bengalis, Assamese, Nepalis, Biharis, Panjabis, etc. have also settled in Shillong.

The Khasi tribe consists of five major sub-groups, namely, the Wars, Khynriams (Upland Khasis), Jaintias (Pnars or Syntengs), Bhois and Lyngngams. The Khynriams are mostly found in upland region of the East Khasi and West Khasi districts of the State. The Jaintia Hills district is dominated by the Jaintias. The Bhois predominantly live in the Ri-Bhoi district on northern parts of the Khasi Hills. The Lyngngams are mainly confined to the southern and western parts of the West Khasi Hills district.

Physical Characteristics and Affinity
From the anthropological point of view, the Khasis (or Khynriams, Pnar, Bhois, Wars and Lyngngams) belong to the Indo-Mongoloid of the Mongoloid racial stock (Das, 1981). Das (1987) has described that the “Khasis have brown skin color. Their head hair is dark brown with a reddish tinge in color, straight or flat, wavy in form and coarse in texture. They have scanty
beard and moustache. The colour of eye is brown to dark brown. The eye slit is mostly oblique and palpebral fissure is medium. Eye fold is present in most of the cases. They are short in stature. Their head is mosocephalic and nose in mesorrhine”. Regarding the four sub-groups of the Khasis, Das (1978) says that these four divisions (i.e., Khynriams, Pnars, Bhois and Wars) do not deviate much from the average Khasis in relation to stature and trunk height. He, however, points out that the “Pnars and the Bhois show most often deviation in higher magnitude and that these two populations are standing porpoise to one another in relation to average Khasis”. It may be mentioned that the people have so far treated the Khynriams, Pnars, Bhois, Wars and Lyngngams as one and the same ethnic group. Marwein (1987) says that the Khasis are known sometimes by different names at different places. The names are either confined to a particular Syiemship or state or a particular geographical region”. All these sub-groups claim to have descended from the same origin, i.e., U Hynniew Trep Hynniew Skum (Seven Huts). Recently, the government of Meghalaya has published one volume of Meghalaya (DIPR, 1991). In this volume, it is clearly stated that these Khasi groups are of the same ethnic origin. They share common traditions and customs, though there may be some variations, owing to different geographical conditions and admixture with other communities.

All the sub-groups of the Khasis follow the matrilineal system of the society and linguistically they speak a different dialect of the Monkhmer language, which belongs to the Austric (Austro-Asiatic) group. So far as the Austric language in concerned, it is believed to be spoken by the earliest inhabitants of the country, particularly the Australians and their descendants (Ghosh and Khongsdier, 1997). At present, besides the Khasis, other peoples like the Kols, Mundas, Nicobarese of Nicobar islands, etc., are the Austric speakers in India. Das (1987) has reported that the Wanchoo of Arunachal Pradesh also use some Austric words in their language.

With regard to the position of the Khasi, Dixon (1922) says “the Khasis in spite of their linguistic isolation among the peoples of Assam, are racially closely related to the majority of the Burmese tribes. With them they represent a very old western drift of south-western Asia peoples unlike their neighbors. However, they have succeeded in retaining their old speech”. Haddon (1924) has also tentatively suggested the presence of ancient dolichocephalic platyrhine (Pre-Dravidian) type among the Khasis. Linguistically, Chatterjee (1951) was of the
opinion that “In Burma Indo-China lived speakers of Austric language, who are largely of Proto-Australoid race from India”. Accordingly, Das (1978) has proposed that the “Khasi is an Australoid population speaking the Austric language. Their physical features were modified by a strong intrusive Mongoloid strain. They have retained their language but have undergone remarkable changes in physique”.

The other possibility is that the Khasis are a Mongoloid people, who came from south-east Asia as suggested by many scholars like Gurdon (1907), Chatterjee (1951), Bareh (1967), Das (1979), and others. According to Gurdon (1907), “The Khasis are an offshoot of the Mon people of Further India in the light of historical fact.” Chatterjee (1951) says, “They would appear to be a Mongoloid people who have adopted the language of the earlier race, the Austrics (or Proto-Australoids), after they have come down from south Tibeto-Burman area of dispersion. They may have changed their speech to the Austric (Mon khmer) Khasi even while they were in Burma.” He has also pointed out that the admixture of proto-Australoids and Mongoloids “in very early times in Burma and Indo-China is very likely, this mixture producing the ancient Rmen or Mon people of central and southern Burma, the Palaungs and Was of upper Burma, as well as the Khmers, the Chams, the Stings, the Bahnars and other Austric or Austro-Asiatic speakers of Saim and Indo-China”. It may be mentioned here that the Proto-Australians are known by different names like Pre-Dravidians, Australoids, Veddids and Nishadas. The Proto-Australoids are similar to Caucasoids in respect of many characteristics. Sometimes, they are also considered a sub-division of the Caucasoids known as Archaic Caucasoids (Das, 1970). In view of the above suggestions, it appears that the Khasi are a Mongoloid people, who might have learned their language form the Australoids (or Proto-Australoids) on their way to India or they might be one of those peoples resulting from the admixture between the Mongoloids and Proto-Australoids (Australoids), somewhere in Burma or Indo-China. Some scholars (like Gurdon, 1907; Bareh, 1967; Das, 1970; and others) have also supported this view on the basis of cultural evidence. It may however, be noted that there are also some cultural similarities between the Khasi and the Kolarian tribes of Central India.
Occupation

The community was basically a land owning community, the land belonging to the individual proprietress. Along with the advent of Christianity, drastic economic changes also came about in this area. Previously, jhuming (shifting) was the chief mode of cultivation besides the dry land cultivation of rice. The forest resources were immense and the supply of wood, bamboo and cane was another lucrative business. However, after independence and the opening up of greater opportunities there was a rapid rate of urbanization with the result that people got attracted toward towns. Those who were educated got white-collar jobs. The young are usually attracted by vehicles and take up driving as a profession. The men take up jobs as laborers at various construction sites. Some people are also engaged in business and services. Traditional industries were never important as occupations (Syiemlieh, 1994). The main occupations today are jobs in offices, teaching, contractor and the professional services where there are a large number of Khasis as university and college teachers, engineers, doctors, etc. There is no bonded labor, child labor exists but not in disturbing proportions and there has been little change in the occupational pattern, as industrialization has made no important in terms of the employment.

Religion

The majority of the Khynriam Khasis of Shillong have embraced Christianity, while next to Christian group are the Niam Khasis- believers of Khasi traditional religion (Ka Niam Khasi). There are also a few Khasi Muslims in Shilling, i.e., those Khasis who have converted to Islam through marital alliance with the Muslims who migrated from Bangladesh and other parts of India.

Among the Khasis, Christianity dates back to about 150 years when Krishna Chandra Pal converted two Khasi people in a village, called Pandua (Pyrdiwah) on the border of the Khasi hills and Sylhet District (Bhat, 1975)

But the number of converts to Christianity among the tribal was few, until Thomas Jones of the Wales Presbyterian Mission in 1841 propagated the use of the Latin alphabet to write the tribal dialect. At present there are different Christian denominations like Presbyterian, Roman Catholics, Church of God, Church of Christ, Seven day Adventist, United Pentecostals church, etc. In the present study, data on various denominations were not taken into consideration. By ‘Christians’ we mean only those Khasis who believe in Christianity. The spread of Christianity
in the Khasi and Jaintia Hills has brought about tremendous change in the field of education (Nag, 1965; Das Gupta, 1984). Nag (1965) has shown that the Christian Khasi have better education standard and economic condition that their non-Christian counterparts. "The spread of education is perhaps the most significant effect of Christianity among the Khasi" (Nag, 1965).

The people, who are still following their traditional religion, are monotheistic, though others are of the opinion that the Khasi religion is animism (Gurdon, 1907; Bareh, 1967, Bhowmik, 1971) and demon worship (Natarajan, 1977) and so on. This is due to the fact that the others have a vague understanding of the Khasi religion as said by Gurdon (1907), "The Khasi have a vague belief in God, the Creator". They believe in one Supreme God, the Creator and Master of Universe (U Blei Nongbuh Nongthaw). They also believe in life after death and the presence of God and evil spirit (Marwein, 1987). The breaking of eggs and sacrifice of birds and animals like fowl, pig, cow, goat etc., are their important religious rites and ceremonies. The priest locally known as U Nongknia or Nongshat Nongkhein performs these religious rites either for the individual cause or for that of the community as a whole. They do not have any religious scripture, or any common place of worship. "To a khasi, religion is a personal contract between man and God," (Hipshon Roy, 1990). It may also be mentioned here that the movement for revivalism of the traditional religion (Ka Niam Khasi) has also been started under the leadership of the Seng Khasi Organization, established first on August 23, 1899.

As already mentioned, some Khasis have also embraced Islam through the marital relationship mainly between the Khasi females and other Muslim males who migrated from Bangladesh and other parts of India like Assam, Uttar Pradesh and Bihar. Historically, the Khasi are also believed to have trade relationship with the Mughal emperors through their viceroy at Murshidabad during the 17th century (Irshad Ali, 1992). So, the Khasi came into contact with the Muslims mainly through trade and commerce. Some of them also visited the Khasi hills as wonderers and hunters. As a result, a good number of them have settled in the Khasi hills and, in course of time, these Muslims adopted the Khasi customs (Irshad Ali, 1992). Gradually, they have settled down in the area and accepted the local women as spouses. This group so mainly confined within the state capital of Meghalaya. No specific census work has ever been attempted amongst them. Hence even rough estimate of the number of individuals is not available. Unlike the Muslims of the other states, the Khasi Muslims do not share a common dialect. The dialect varies from household to household (Roy, 1994). The Khasi Muslims are
non-vegetarians, beef-eaters, but they abstain from taking pork. The staple food is rice. They regularly consume available vegetables and fruits. After marriage, most of the women adopt the elaborate style of cooking as praised by the Muslims, especially on festive occasions. Due to religious sentiments, they try to abstain from alcoholic beverages (Roy, 1994). The marriage is performed according to Islamic rules (Roy, 1994). In fact, the Khasi mothers, who get converted to Islam and her children, are known as Muslims. "But for all practical purposes they are treated as Khasis". (Irshad Ali, 1992). Nowadays, it has been reported that among these Muslim Khasi there is a compromise between Islam and matrilineal system of society with regard to patterns of Kinship, residence, inheritance, etc (Mathur 1975, Irshad Ali, 1992).

**Food Habits**

The food habits of the Khasis are simple. Rice is their staple food. The Khasis are non-vegetarians and take pork, beef, chicken and fish, depending upon their economic status. They are rice eater, but have also taken wheat flour as snack. The principal pulse taken by the people is lentil, which is available in local market. In the case of vegetables, potatoes, sweet potatoes, pumpkin, tomato, onion and various kinds of green leafy vegetables are some of their favorites. Besides a variety of mushroom, which is found in abundance in this hilly regions, form a part of their regular diet. Milk is not a part of their regular diet. Instead, tea without milk is a beverage which is continuously taken during the day. Traditionally, rice bear or Ka-kiad used to be fermented in each house for daily consumption. With the increased urbanization, rice beer has been replaced by distilled liquor and other spirits bought from the market. Seasonal fruits, available locally, are consumed by the Khasis. They have also the habit of taking betel nut leaf and lime.

In the next chapter, we shall describe the materials and methods used for the present study.