

STUDY ON DEMOGRAPHY AND GROWTH PATTERN AMONG  
THE KHASI CHILDREN OF SHILLONG, MEGHALAYA

By

NANDITA MUKHERJEE  
DEPARTMENT OF ANTHROPOLOGY

THESIS SUBMITTED  
TO  
THE NORTH-EASTERN HILL UNIVERSITY  
FOR PARTIAL FULFILLMENT OF THE DEGREE OF DOCTOR OF  
PHILOSOPHY  
IN  
ANTHROPOLOGY

NORTH-EASTERN HILL UNIVERSITY  
SHILLONG, MIZO  
MARCH, 2002

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MARCH, 2002**


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Dated: 15<sup>th</sup> March, 2002

**CERTIFICATE**

*Certified that the thesis entitled " **Study on Demography and Growth Pattern among the Khasi Children of Shillong**" is the record of the original work done by Smt Nandita Mukherjee. To the best of my knowledge, the contents of this thesis did not form a basis of the award of any previous degree to her, and that the thesis has not been submitted by her for any research degree in any other University, or Institute.*

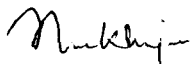
*In habit and character, Smt Nandita Mukherjee is a fit and proper person for the degree of doctor of philosophy.*

  
(R. Khongsdier)  
Supervisor

Dated, Shillong, the 27<sup>th</sup> March, 2002

**DECLARATION**

*I, Smt Nandita Mukherjee, hereby declare that this thesis entitled "Study on Demography and Growth Pattern among the Khasi Children of Shillong" is my bona fide research work, and that the thesis has not been submitted by me for award of any research degree in any other University.*

  
(Smt Nandita Mukherjee)  
Candidate

## ACKNOWLEDGEMENT

*I wish to express my deep heartfelt gratitude to my supervisor Dr. R. Khongsdier, Reader, Department of Anthropology, NEHU for his valuable suggestions and untiring guidance with constant encouragement throughout the study, without which this work could not have been brought into its present form. I am very much grateful to Dr. A. K. Ghosh, my former guide, for his unhesitating help and personal encouragement throughout the period of the work. I am also very much thankful to Dr. H. Lamin, Head of the Department of Anthropology, NEHU, for helping and providing necessary facilities.*

*I specially wish to express my gratefulness to Dr. Chumki Piplia and Dr. B. Mondal for their interest and sustained help in supplying the secondary materials related to the present work.*

*In the field areas, I received substantial help and co-operation from many people and organisations. Special thanks are due to Mr. Jamir Hussain Nongrum, Miss Saira Kharbuli, Miss Piecefully Kharkongor and Mr. P. Lyngdoh.*

*I am also grateful to my friends of Anthropological Survey of India, Shillong, Calcutta and I.S.I. Calcutta who extended their help in carrying out this work.*

*Last but not the least, I am very grateful to all my family members particularly my father for his constant interest in and encouragement to this study. I owe my special gratitude to my husband without whose help and encouragement this assignment could not have been completed.*

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## CHAPTER - 1

### INTRODUCTION

The study of human evolution and variation are the two major objectives of physical anthropology. These two objectives of study are overlapping in physical anthropology, and they cover a vast area of biological interest ranging from simple anthropometric study to molecular study of human evolution and variation. Recently, efforts have also been made to understand the relationship between human biology, especially to those aspects relating to health and nutrition, and various socio-cultural factors (Strickland Tuffrey, 1997). In fact, it is now believed that the human biological processes are largely influenced by various sociocultural aspects of the human society. Thus, it is quite imperative on the part of physical anthropologists to undertake such studies with a view to having a better understanding of not only the processes of human evolution, but also the health and nutritional aspect of human population.

From an evolutionary point of view, demographic parameters like fertility and mortality are very important to understand the genetic make up a population. It is theoretically belied that natural selection, one of the major evolutionary forces, is operating on human population through differential fertility and mortality (crow, 1958, Johnston, 1973). Similarly, other demographic parameters like population size, mating patterns admixture rate, migration, etc., are very helpful for understanding the biological characteristics of the population (Basu, 1969; Ghosh, 1976; Khongsdier and Ghosh, 1994). However, it may be noted that demographic parameters like fertility and mortality are also largely influenced by various socioeconomic factors (Davis and Blake, 1956; UN, 1967, Mandelbaum, 1974, Mitra, 1978; Mosley and Chen, 1984; Mahadevan, 1986; World Bank, 1999; Caldwell *et al.*, 1999; and others). So, it is quite imperative on the part of physical

anthropologists to undertake a study on the effect of socioeconomic conditions on demographic parameters, particularly on fertility and mortality.

Besides demographic aspects of population physical growth and development of children is another important field of anthropological research. By the term growth, we mean "quantitative increase in size or mass" of an organism, while development refers to "progression of changes, either quantitative or qualitative, that leads from an undifferentiated or immature state to a highly organized, specialized, and mature state" (Bogin, 1999). The pattern of human growth serves as a type of mirror that reflects the biocultural evolution of human population. "Human biocultural evolution produced the pattern of growth and development that converts a single fertilized cell, with its complement of deoxyribonucleic acid (DNA) into a multicellular organism composed of hundreds of different tissues, organs, behavioral capabilities and emotions" (Bogin, 1999).

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". Further, Eveleth and Tanner (1990) have also observed "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 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 for understanding the biocultural variation and evolution of human populations (Tanner 1988, Eveleth and Tanner, 1990, etc.)

In the light of the above circumstances, demographic parameters and physical growth are not only helpful in understanding, the process of human evolution and

variation, but also reflect the health and economic condition of a population. In India, growth studies are very recent in origin (as reviewed by Sharma, 1992), which still warrants further researches. So, it may be essential to conduct more researches on physical growth and development of children with a view to understanding the economic conditions and health and/or nutritional status of the different populations/communities. It may be worthwhile to mention here that in the North-Eastern Region of the country, very few growth studies have so far been published (Das and Das, 1969-71; Das, 1973, 1974; Hazarika, 1974; Choudhury *et al.*, 1992). Moreover, all these studies have been carried out among some populations of Assam only (Khongsdier and Ghosh, 1998). Similarly, demographic studies of populations are very few in number in this part of the country (Nag, 1965; Baruah, 1983; Khongsdier, 1991, 1992, 1993, 1995; Das and Das 1992)

With this end in view, we have undertaken a study on demography and growth pattern among the Khasi children of Shillong in Meghalaya with a view to understanding the following objectives:

1. To understand the demographic structure of the three religious groups of the Khasis, namely, Christians, Muslims and Niam Khasis of Shillong.
2. To understand the growth pattern and nutritional status of children aged 3 to 18 years.
3. To assess the effects of some socioeconomic factors like religion, income of household, etc., on demographic parameters, and growth patterns 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 of 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 head quarters at Nongstion.

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 in the legends of the Khasi with U 'Lei Shillong (Lei being the abbreviated form of Blei God), the tulelar 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 (an important tributary of the Um-lam or Barapani) and Um-Khen, from which water supply of Shillong is obtained.

**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° C – 34° C in the summer and falling below 4° 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).

### **Geological Composition**

Meghalaya may be broadly divided into five Geological formations, namely Archean Gneisses complex, Shillong group of Rocks, Lower Gondwana Rocks, Cretaceous Tertiary Sediments and sylhet Traps (Bhakta, 1992). Shillong Group of Rocks are exposed in the central parts of the Khasi hills comprising mostly quartzite. Rocks of this group rest unconformably 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 Myllicm is termed as Myllicm 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.

**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 Meghalaya is the rich source of timber. The important timber-yielding tree species are Khasi pine (*Pinus khasiya*), sal (*Shorea robusta*), teak (*Tectona 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 (*Prunus nepulems*), etc.

About 250 species of orchids have been reported from 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-Chinese 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 hill marten (*Ailurus*), the only ape in India (*Hylobates*), the golden cat (*Felis temminckii*), the leopard (*Felis bengalensis veer*), the jungle cat (*Felis chaus*), the Himalayan black bear (*Selenarctos thebethanus*), the barking deer (*Muntiacus muntjak*) and the Panglen (*Manis pentadactyla*).

Different types of birds are also found in East Khasi hills of Meghalaya. Snakes and lizards are also abundant. Besides, the Khasi Hills also reveal a number of interesting amphibians and fish species. Insects of the region present an equally 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 Meghalaya is 2306069 of which 1167840 are males and 1138229 females. In East Khasi Hills, the total population is 6,60,994 of which males-

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 dominant 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, Khyntriams (Upland Khasis), Jaintias (Pnars or Syntengs), Bhois and Lyngngams. The Khyntriams 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 Khyntriams, 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 color 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 mesocephalic and nose in mesorrhine". Regarding the four sub-groups of the Khasis, Das (1978) says that these four divisions (i.e., Khyntriams, 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 far apart to one another in relation to average Khasis". It may be mentioned that the people have so far treated the Khyntriams, 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 is 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 neighbours, however, they have succeeded in retaining their old speech". Haddon (1924) has also tentatively suggested the presence of ancient dolichocephalic platyrrhine (Pre-Dravidian) type among the Khasis. Linguistically, Chatterjee (1951) says "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), Barch (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 from 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; Barch, 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 job as laborers at various construction sites. Some people are also engaged in business and services. Traditional industries were never important as occupations (Syiemlich, 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

labour, child labour 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 Khyntiam 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 be 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 than 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 (Marwin, 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 viceroys at Murshidabad during the 17<sup>th</sup> century (Irshad Ali, 1992). So, the Khasis 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 is 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, Ali Irshad, 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 beer 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.

## CHAPTER 11

### REVIEW OF LITERATURE

In this Chapter, we shall make a brief review of the literature related to the present study. The review is far from being exhaustive, but the main purpose is to get the general idea of the ongoing researches related to the present study, especially in India in general and in Northeast India in particular.

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#### DEMOGRAPHY

In Chapter I, we have already pointed out that demographic parameters like fertility and mortality are very important to understand the genetic structure of a population. Thus, demographic study of population is a very important part of anthropological research. In the meanwhile, demographic parameters are also largely influenced by various socioeconomic factors. As such, demographic parameters are very vital for understanding not only the genetic structure, but also the socio-economic condition of a population. In the present study, we are not concerned with the genetic structure of the population, but we shall look into certain socio-economic factors that may influence fertility and mortality of the population.

It is widely accepted that fertility and mortality are influenced by a large number of biosocial factors like maternal age, parity, education, religion, economic conditions and so on (Caldwell, 1979, 1983; Lee, 1979; Nag, 1981; Cochrane, 1983; UN, 1985; Kost and Amin, 1992; Bicego and Boerma, 1993; Freeny and Feng, 1993; and others). For example, demographic transition from high to low levels of fertility and mortality is considered to be associated with the economic development of a population, or rising in the income of a household. However, recent studies have also suggested that the effect of economic condition is rather slow in comparison with other social variables like education, particularly female education (Murthi *et al.*, 1995). For example, Kerala recorded the lowest fertility rate in India during the 1980s, though the per capita income in the state was lower than that in many other states. Similarly, according to the National

Family Health Survey in 1993, the per capita income in Mizoram is the lowest in Northeast India, but the state has recorded the lowest fertility rates. The studies in Bangladesh by the World Bank (Cleland *et al.*, 1994) have also indicated that the lower fertility in that country with low per capita income is mainly because of the efficient implementation of family planning programmes.

### **Age at marriage**

The negative effect of age at marriage on fertility has been reported many studies (Bumpass, 1969; Busfield, 1972; Mandelbaum, 1974; Mahadevan, 1979; Patnaik, 1981; Choudhury, 1984; Bharati and Dastidar, 1990; Sengupta and Gogoi, 1995; Verma *et al.*, 1999; Khongsdier, 2001)

Dore (1953) has conducted a study on the population of Japan and found fertility is reduced with the rise of age at marriage. A negative relationship between age at marriage of woman and her intended family size at marriage in Britain has also been reported (Peel, 1970). A similar observation has also been made by Freeny and Feng (1993). Zathar (1988) has observed that the “Initial rises in mean age at marriage of women to around 18 in Pakistan may lead to higher marital fertility owing to higher fecundity and other factors which seem to lead to vary spacing between consecutive births.”

Many studies conducted in India have also revealed that fertility rate declines with the increasing mean age at marriage (Balakrishnan, 1951; Majumdar, 1960; UN, 1961; Mukherjee, 1962; Agarwala, 1962; Driver, 1963; Gulati, 1969; Raman, 1973; Patnaik, 1981, Bharati and Dastidar, 1990; Verma *et al.*, 1999; Khongsdier, 2001; etc).

In Northeast India also, Khongsdier (2001) has shown that the mean number of live births per mother decreases with the rise in age at marriage of the mothers. It may however be noted that age at marriage is also associated with different socio-economic factors. Husain (1970) has suggested that age at marriage has an inverse effect on fertility, but educational status of the mother exerts in turn a great influence on age at marriage. Some studies also show that age at marriage is associated with socio-economic conditions thereby it is difficult to assess its direct impact on fertility (Gulati, 1969, 1988). Nevertheless, it is obvious from the findings on other populations that age at

marriage has significant inverse association with fertility rate. In northeast India, especially Meghalaya, there has been hardly any study on age at marriage and its effect on fertility rate (NFHS, 1999; Khongsdier, 2001). Thus, it is imperative on the part of not only demographers but also the anthropologists to look into this problem in order to have a better understanding of the fertility trend in a population. -

### **Education**

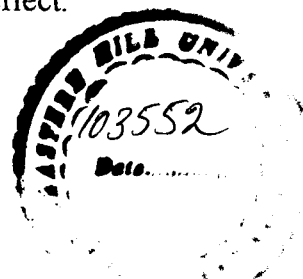
Education, especially female education, is generally considered a key factor to development. It is closely related to demographic parameters and other indicators of health and socioeconomic conditions of a population, or a nation as a whole. Female education is believed to have a great influence on the maternal and child health as it enhances the knowledge and skills of the mother concerning age at marriage, contraception, nutrition, prevention and treatment of diseases (Mosley and Chen, 1984). This also means that the higher infant and child mortality rates among the poorly educated mothers are due to their poor hygienic practices and lack of connection with the modern medical facilities. Moreover, maternal education is related to child health because it reduces the cost of public health programmes relating to information on health technology, increases household income and productivity of health inputs (Schultz, 1984, McIntosh and Finkle, 1995). Thus it is suggested that the best health development agenda for the developing countries is to increase investment in formal education, particularly female education (Caldwell, 1979, 1982; Cochrane, 1983; Bicego and Boerma, 1993). In fact, the 1994 International Conference on Population and Development (ICPD) in Cairo has strongly recommended that all countries should take immediate steps to achieve the goal of universal primary education before the year 2015, and to ensure that girls and women should get the widest and earliest possible access to secondary and higher levels of education (McIntosh and Finkle, 1995; Knodel and Jones, 1996). It is argued that about 75 per cent of 960 million illiterate persons in the world are women. India is one of the best examples of such a country with sex disparity in literacy rate till the last census, despite research evidences of the important role of female education in regulating demographic transition and other socio-economic parameters.

Besides, several studies have revealed that female education is more important than paternal education in exerting a negative effect on fertility, though the influence of the latter is also significant in certain studies (Murthi *et al.*, 1995). Female education is expected to reduce birth rates for the following reasons: First, educated women are likely to have more voice with regard to lightening the burden of repeated pregnancies because they have more control over household resources and personal behaviour. Second, educated women are likely to be less dependent on their children as a source of social status and old age security, thereby leading to a reduction in a desired family size. Third, educated women have higher aspirations for the better achievements of their children, which is conducive to a reduction in a desired family size. Fourth, educated women often have a higher age at first marriage, which is in turn affecting fertility rate. Fifth, educated women often have higher rate of adoption of family planning method, despite certain contradictory results.

### **Economic Condition**

The effect of economic condition on fertility has been revealed in many studies (Dutta and Seal, 1974; UN, 1976; Caldwell, 1977; Chang *et al.*, 1979; Bharati, 1981; Smith and Ward, 1984; Choudhury, 1988; UN, 1985; Lloyd, 1991; Adamchak and Mbizvo, 1994; Verma *et al.*, 1999; Das and Saikia, 1999);

Many studies revealed that there is an inverse relationship between fertility and occupation and/or economic condition (Johnson, 1960; Stoeckel and Choudhury, 1969; Chang *et al.*, 1979). In United States, during the period of urban growth and industrial development, higher economic status was typically associated with lower level of fertility (Freedman, Thompson and Lewis, 1980). The World Bank (1974) has reported that the average fertility rate as well as the average gross reproduction rate in the low income countries is about two times higher than those in the high income countries. Rao (1976) has observed that some countries in South<sup>East</sup> Asia like China, Srilanka, Philippines, and Thailand have experienced a rapid decline in birth rate with the increase in national income. Recently, it has been reported that the high fertility rate in Sub-Saharan Africa is the most acute symptom of poverty (Dasgupta, 2000). Becker (1981) has suggested that the increase in household income owing to an increase in labour productivity would lead to a decline in fertility if the substitution effect were to dominate the income effect.



The United Nations' (UN, 1985) study outlines several conceptual frame works on the relationship between women's employment and fertility. The major finding of the study was that the relationship between women's occupation and fertility appears to be strong in countries at higher levels of socioeconomic development, particularly in countries with strong family planning programs, and where women's status is relatively higher as measured by age at marriage and educational attainment. A similar observation was also made by Lloyd (1991) and Adamchak and Mbizvo (1999). Recently, the decline in fertility rate in China and Taiwan has also been attributed to higher level of social and economic development (Poston, 2000). In fact, many studies have made an attempt to correlate between low fertility and economic development. However, there is also considerable literature suggesting that standards of living as reflected in basic measures of social welfare like level of education and health care can be more relevant to fertility than the degree of economic prosperity and modernization (Freedman, 1982; Malhotra *et al.*, 1995). This suggests that there has been controversy among the scholars regarding the relationship between fertility and economic condition (Dasgupta, 2000).

In India also, many studies have revealed that fertility rate is higher among the lower income groups than that among the higher ones (Agarwala, 1972; Mukhopadhyay, 1981; Ghosh *et al.*, 1983; Choudhury, 1988; etc). Verma *et al.* (1977) observed that settled agricultural Santals were economically better off and had relatively higher fertility than the economically depressed hunting gathering nomadic Birhors. But Driver (1963) observed that economic status had only some indirect effects on fertility in Central India. Jain (1975) has also suggested that the effect of income particularly that of occupation on fertility is "fragmentary and inclusive." Thus, it is necessary to carry out further studies on the relationship between fertility and economic condition of the populations, especially in Northeast India where there has been a lack of such studies (NFHS, 1999).

With respect to mortality, several studies have revealed the effects of biosocial factors such as household income, education, religion, maternal age, sex, and birth order (Ekanam, 1972; Puffer and Serrano, 1975; Newman, 1975; Ayeni and Oduntan, 1978; Basu *et al.*, 1980; D'Souza and Bhuiya, 1982; Martorell and Ho, 1984; Rutstein, 1984; Rao, 1987; Amin, 1988; Aly, 1990; UNICEP, 1991; Redaiah and Kapoor, 1992; Kost and

Amin, 1992; Nath *et al.*, 1994; Arnold *et al.*, 1998; Rao *et al.*, 1998; NCHS, 1999; Wagstaff, 2000; Khongsdier, 2001; and many others).

Improvement in socioeconomic status is generally considered to be essential for improvement in children's health condition, thereby reducing infant and child mortality. In other words, improvement of the health of the poor can lead to reducing the health inequality between the poor and non-poor, and this is the central goal of many international organizations, including the World Health Organization (Wagstaff, 2000). It is reported that infant and child mortality has been declining in many developing countries from the mid 1980s and throughout the 1990s. Rutstein (2000) has suggested that such a trend in infant and child mortality is no doubt associated with improvement in socio-economic status along with the improvement in a number of factors like nutritional status, environmental health conditions, breastfeeding and the use of health services. In this connection, it may also be mentioned that the World Bank (1974) has reported that mortality rate is independent of economic development. It has suggested that the decline in mortality rate in many developing countries is mainly due to important in the fields of public health and disease control methods.

In India, Murthi *et al.* (1995) have suggested that the relationship between mortality and poverty may deserve careful examination. They have observed that the association between poverty and child mortality is rather weak in India. "The question remains whether poverty has a strong effect on mortality or fertility after controlling for other explanatory variables." The general opinion is that infant and child mortality is lower in the higher economic groups as they are able to afford better health care facilities, and they have higher educational standard, thereby becoming more conscious of the health of their children. Thus, although different factors are associated with mortality, the effect of household income has been revealed in many studies (Miller, 1981; Chen, 1982; Mosley and Chen, 1984). The above suggestion given by Murthi *et al.* (1995) may be taken into consideration with a view to having a better understanding of the effect of family income on infant and child mortality. Such type of further study is likely to be more important especially in Northeast where there has been lack of information, except those given by the NFHS (1999) and few researchers (Saikia *et al.*, 2001).

## Religion

Several studies have revealed a relationship between fertility and religion (Nag, 1962; Westoff, 1962; Kirk, 1968; Mandelbaum, 1974; Rele and Kanitkar, 1977; Mahadevan, 1979; Choudhury, 1982; Irudaya Rajan and Rao, 1991; Kollehlon, 1994; Knodel *et al.*, 1999).

Balakrishnan and Chen (1990) have observed that more religious women are less likely to use contraceptives, thereby having higher fertility rate. Most studies revealed that Muslims have higher fertility rate than that of non- Muslims (Davis, 1951; Sinha, 1957; UN, 1961; Nag, 1962; Driver, 1963; Kirk, 1968; Rele and Kanitkar, 1977; Choudhury, 1982). Some have observed the absence of significant difference in the fertility between Muslims and non- Muslims (Irudaya Rajan, <sup>and Rao,</sup> 1991). The Koran states that good deeds are better than wealth or children, Islam considers Children to be 'among the richest blessings granted by Allah,' and the Koran makes references to marry and generate (Kirk, 1968). Among the Muslims, the traditions (hadiths) and legal opinion (fatwas) of Islam support temporary measures to prevent conception. But, abortion after quickening of the embryo is forbidden.

In India, many studies have indicated that among the religious groups, the Christians have the lowest fertility rate, which is followed by Hindus and then by Muslims (UN, 1966; Rele, 1963; Agarwala, 1964; Kirk, 1968; Mandelbaum, 1974; Ghosh *et al.*, 1983; Irudaya Rajan and Rao, 1991).

Srinivasan (1967) have observed that in all age groups except in the age group 25-29 and 35-39 years, the Muslim married women have higher fertility rate in comparison with the Hindu and Christian married women. A similar observation was made recently by Dastidar and Gupta (2000) among the Slum dwellers of Kolkata city where fertility is higher among the Muslims as compared to the Hindus. National Sample Survey (NSS, 1977) has conducted a study, which indicates that of the religious groups in India, the Christians have the lowest birth rate, which is followed by Sikhs, and it is highest among the Muslims. The higher fertility rate among the Muslims is believed to be associated with the lower acceptance rate of family planning methods (Khan and Prasad, 1983; Dastidar and Gupta, 2000). However, some studies do not confirm the observation that

the fertility rate is always higher among the Muslims than that among the other religious groups (Nag, 1962; Rao and Mather, 1970).

Northeast India, there is hardly any study on the religious differences in fertility rates. Khongsdier (1993) conducted a study among the war Khasi of Meghalaya and he observed that Christian have higher fertility rate than the non-Christian. He explained the higher fertility rate of Christian is not because of religious effect, but due to differences in educational attainment.

As far as mortality is concerned, only few studies have revealed the effect of religion on infant mortality. Ewbank *et al.* (1986) have reported that there is no significant difference between the Muslim and the Roman Catholics in respect of mortality rate. It is, however, higher in the Muslims than in the Protestants. In India, the National sample survey (NSS, 1970) has shown that the mortality rate in rural areas, is high among the Hindus, but low among the Sikhs. But in urban areas, the death rate among the Hindus is found to be similar to that among the Muslims. Also, the Christians are similar to the Sikhs in respect of infant and child mortality.

According to Hindu tradition, sons are needed for the cremation of deceased parents because sons can light the funeral pyre. Girls are often considered to be an economic burden because of the dowry system, as well as the high cost of weddings. Son preference is believed to be the principal cause of excess female mortality that often manifests during childhood. Research studies suggest that parents with strong son preference consider their daughters to be less valuable and provide inferior care to daughters in terms of food allocation, prevention of diseases and accidents. (Arnold *et al.* 1998).

Chandrasekhar (1972) has suggested that although the Christians form a small part of the total population, the low infant mortality rate among them is more perceptible than that among the Muslims due to better child care and higher standard of education in the former.

In the north eastern region of the county, as study conducted by Das & Das (1982) among the rural Assamese women revealed that the mortality rate varies even within the same religious group, i.e, the Hindu religion.

## PHYSICAL GROWTH

The study of human growth 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, as mentioned in Chapter I, the basic objective of anthropology is to understand the biological and cultural evolution of human population. Besides, the study of human growth is also essential to understand 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 (Tanner, 1962, 1966; Garn, 1966, 1980; Scrimshaw and Gordon, 1968; Goldstein, 1971; Eveleth and Tanner, 1976; Frisancho, 1978; Musaiger *et al.*, 1989; Hazzaa, 1990; Terrell and Mascie-Taylor, 1991; Hauspie *et al.*, 1992; Rao and Busi, 1993; Misuraca *et al.*, 1995; Edward *et al.*, 1996; Russo and Toselli, 1997; Dasgupta *et al.*, 1997; Milani *et al.*, 1999; Reddy and Rao, 2000; and many others).

### Nutrition

Eveleth and Tanner (1990) have shown that populations living under chronic low dietary intakes have a pattern of growth characterized by (1) slow growth during childhood and adolescence, (2) late adolescence growth spurt and (3) a prolonged period of growth. Adequate nutritional intakes are generally considered to be necessary for normal growth and development as well as for prevention of deficiency diseases (Mitchell *et al.*, 1976; WHO, 1986). Inadequate intake of protein and other nutrients during the preschool age period had an adverse effect on the child, leading to retardation in both physical growth and mental development (Downs, 1964; Grounds, 1964; Jelliffe, 1966; Winick, 1968). In Kenya, Ongeri (1975) has suggested that malnutrition, particularly protein calories, is a common cause of poor growth in preschool children. Hertzog *et al.* (1972) have observed through a controlled study of children in Jamaica that malnourished

children were shorter, and had lower intelligence and smaller head circumference than controlled children in the same school or their sibs. In fact, small body size of children in developing countries is largely due to effects of poor diet and frequent infection (Martorell and Ho, 1984).

Greulich's (1957) study on Physical growth and development of the American born and the native Japanese children has revealed that those children brought up in the United States were taller and heavier than their counterparts in Japan because of improved standard of nutrition and physical environment. Data from Malaysia (Chong *et al.*, 1984) have also shown a positive effect of protein energy malnutrition on growth pattern of the pre-school and primary school children. In Nigeria (Antinmo and Hart, 1980; Nnanyelugo, 1983) have indicated that malnutrition in primary school children could be attributed to low nutrient intake, low socio economic conditions and unfavourable environmental factors. A relationship between chronic childhood malnutrition and scholastic backwardness has been demonstrated by Botha-Antom (1968) and Barnes (1969).

Lampl *et al.* (1978) have reported that among the New Guinean school children, protein supplement has contributed largely to a faster growth and malnutrition. Similar observation has been made by Addo *et al.* (1987) while studying the school children of Nigeria. Thus, in developing countries, low socio-economic status of the family, poor nutrition, and vigorous physical activity are seen as major factors affecting childhood growth (Beall *et al.*, 1977; Stinson, 1980, 1982).

Turning to Indian situation also, Rao (1961) pointed out that the pattern of growth was strongly influenced by dietary intakes. Easwaran *et al.* (1972, 1974), observed that boys and girls in the 'better fed' groups were heavier and taller than those in 'poorly fed' ones. A study conducted by Satyanarayana *et al.* (1980) has indicated that the main cause of growth retardation among the pre-school boys in rural Hyderabad is nutritional deficiencies. However, it is suggested that in a vast and multiethnic country like India, the extent and type of malnutrition among children varies from region to region, depending upon the geography, socio economic factors, food habits, level of literacy, climate, and religious cultural practices (ICMR, 1972; Gopalan, 1988; WHO, 1989).

### **Economic condition**

Socioeconomic status plays a dominant role in determining growth and physical development of children as it has a positive relationship with nutritional intakes. Many studies have revealed the association between physical growth and socio economic condition of a population (Hamill *et al.* 1972; Lindgren, 1976; Smith *et al.*, 1980; Garn *et al.*, 1984; Johnston, 1986; Lasker and Mascie-Taylor, 1989; Rao *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).

Bransbey *et al.* (1956) observed that children from homes defined as 'poor' were consistently smaller and lighter than those from 'good' homes. 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). In American children, height and weight were found to increase with increasing annual income or educational level (Hamill *et al.*, 1972).

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). In fact, the World Bank (1986) conducted a study on 20 countries and concluded that about 730 million people in developing countries did not have adequate energy intakes and nearly 340 million of them were at the risk of stunted growth and health problem.

Fry *et al.* (1965) suggested that Chinese children from higher socio economic groups tended to have thicker skin folds than those from the lower ones. Desai *et al.* (1970) observed that a strong relationship between socioeconomic status and growth in Jamaican children. A similar observation has also been made by Campbell (1978) while studying the Jamaican children. Verghese *et al.* (1969) have pointed out that head, chest circumferences and weight of North-American Negro children belonging to the low income families are significantly lower than those belonging to the middle income families. Abraham *et al.* (1975) also observed that in the United States, the boys and

girls aged 1-17 years of above poverty level were taller, heavier and greater in skinfold thickness than those belonging to the below poverty level group. Rona *et al.* (1978) reported that children of unemployed fathers were shorter on average than those of employed ones. In England, it has been reported that children, belonging to the middle and upper classes are taller than those belonging to the unskilled working class (Goldstein, 1971).

Amirhakimi (1974) conducted a study among the Iranian school children and found that the children of better economic condition are heavier and taller than those with low economic status. A similar observation has also been made by Lampl *et al.* (1978) while studying the New Guinean school children. Groenewold and Tilahun (1990) have observed the effect of income and father's occupation on weight for age and weight for height of Ethiopian children.

A study conducted on Malaysian children by McKay (1969) has also revealed that the mid upper arm circumferences of the higher income group children are greater than those of children with lower socio economic status.

In developing countries such as Bolivia, low socioeconomic status of the family, poor nutrition, and vigorous physical activity are seen as major factors affecting children growth (Beall *et al.*, 1977; Stinson, 1980,1982; Yep *et al.*, 1988). Post *et al.* (1997) carried out a study among the high altitude Bolivian children and suggested that nutritional intake was influenced by socioeconomic status, but not by altitude.

Although many studies have suggested the positive effect of socio-economic status on growth pattern of children, there are also certain controversies which need to be better understood through further studies. For example, Rona and Chin (1982) have suggested that father's social class and mother's education are not related to the variation in triceps skinfold thickness and weight for height of the children. Similarly Sukkar *et al.* (1979) have also observed that weight and height of the children have hardly changed owing to improvement in economic condition. The rural Zapotec children living in the valley of Oaxaca (Mexico) have similar height and weight to the well nourished U.S. children (Malina and Himes, 1978). Lindgren (1976) have also found that, in Swedish urban area, the girls from the lowest socio-economic status have more weight for height than the higher strata. Mackus *et al.* (1995) have reported that there is no correlation

between socioeconomic status and height or weight. The negligible prevalence rates of wasting and low hemoglobin levels suggests that acute undernourishment in preschool children of Libya is not related to economic deficiency but to nutritional habits on the part of the caretaker (Bredan *et al.*, 1984). Therefore some studies have also revealed that there are less difference between socio-economic groups in respect of growth rate.

Turning to Indian situation some studies have shown that within the same community children from the well-to-do sections had higher values of height and weight than their counterparts in poor economic groups (Mitra, 1938; 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. The Indian Council of Medical Research (ICMR, 1972) has also reported that height, weight, subcutaneous tissue and other anthropometric variables are positively associated with socio-economic status. Similarly Vijayaraghavan *et al.*, (1974) and Rao (1980) reported that the arm circumference and fat fold at triceps of Indian children belonging to low socio-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 (Rao and Sastry, 1977; Satyanarayana *et al.*, 1980; National Nutrition Monitoring Bureau, 1980; Bharati and Basu, 1990).

In north-east India, some growth studies have been published (Das, 1969-71, 1972; Hazarika, 1974; Das 1973, 1974; Choudhury *et al.*, 1992; Das and Choudhury, 1992; Khongsdier, 1996a; Begum and Choudhury, 1999; etc). But there is hardly any study, which shows the effect of nutrition and other socioeconomic factors on growth pattern of children. Besides, most of the studies have been carried among a different populations of Assam only (Khongsdier and Ghosh, 1998). Khongsdier (1993) conducted a study on War Khasi of Meghalaya and found that "anthropometric variables are more sensitive to environmental factors (which include nutrition, socio-economic conditions, etc)."

## Religion

There are very few studies which are concerned with the effect of religion on growth and nutritional status of children. In Northeast India, Das and Devi (1982) have pointed out that the female babies of Hindu Assamese origin are heavier than those of their Muslim counterparts. Khongsdier (1994) have also observed that the Christian War Khasi children are heavier and taller than their Non-Christian counterparts.

The brief review given above has revealed that a large number of studies have been carried out all over the world with a view to understanding how socio-economic factors like household income, education, religion, etc., affect the demographic and growth and nutritional status. With respect to demographic parameters, i.e., fertility and mortality, most studies are carried out in other parts of the world and some parts of India. Besides, there has been controversy regarding the role of certain economic factors like income in influencing fertility and mortality. For example, infant and child mortality is reported to be negatively associated with improvement in environmental conditions and health care services rather than with economic growth.

With respect to growth and nutritional status, the review indicate that it is greatly influenced by such factors like nutrition and economic condition. But such studies are limited in India, especially in Northeast India. Thus, it is imperative on our part to undertake this study with a view to how demographic parameters and growth pattern of children, which reflect the health status of a population, are subject to the influence of various environmental and socioeconomic factors.

## **CHAPTER III**

### **MATERIALS AND METHODS**

In this chapter, we shall describe the materials and methods adopted in the present study. These materials and methods are related to those adopted for collecting, analysing and interpreting the data in the present study.

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#### **Selection of area and population**

Khasi population is mainly distributed in Khasi and Jaintia hills of the State of Meghalaya. As has been pointed out in Chapter I, the term "Khasis" is a generic name referring to any one or all the four major subgroups, namely, Khyntriams, Pnars, Bhois, Wars and Lyngngams. However, in the present study, we are mainly concerned with the Khyntriams, who are also known as the Khasi proper. No sampling technique was applied for the selection of samples at both individuals and population levels. But an effort was made to include in our study the three major religious groups, namely, Christian Khasis, Khasis of traditional religion (Niam Khasis), and Muslim Khasis. The Christian Khasis and Niam Khasis are distributed all over Khasi hills, but the Muslim Khasis are mainly concentrated in Shillong, the capital of the state. Therefore, the present study was confined to Shillong only. According to our list of Muslim households prepared with the help of Islamic Organization of Shillong, the Muslim Khasis are restricted to certain localities such as Laban, Bishnupur, Garikhana, although some of them are also scattered in Nongthymmai, Laitumkhrah, Lawsohtun and Lummawbah areas. In the present study, we are concerned mainly with the three religious groups inhabiting in the above mentioned localities of Shillong.

The fieldwork was conducted in different intervals between November 1996 and February 1998.

## **NATURE OF DEMOGRAPHIC DATA**

The nature of demographic data collected for the present study was based on those parameters suggested by the World Health Organization Working Group (WHO, 1964, 1968). These may be briefly described as follows:

*Individual records:* These include name of informant, age, sex, marital status, relationship to head of the household, date and place at which record was taken, clan, tribe, religion, community affiliation, total number of family members, place of birth, place of residence, etc.

*Fertility records:* They include pregnancy history of each married woman or mother, present age of mother, approximate age at each conception, total number of live-births, birth order, age, sex and marital status of each offspring.

*Mortality records:* These include total number of conception, number of dead children, sex, date of birth, age at death, causes of death, if any, number of reproductive wastage (abortions and still- births), etc.

*Social proximates:* These include occupation, education, monthly and annual income of the household, monthly expenditure of the household, age at marriage, and religion.

## **DATA ON GROWTH OF CHILDREN**

A cross-sectional method of study was followed for collection of data on physical growth of 2719 children aged 3 to 18 years (Eveleth and Tanner, 1990), taking into consideration the following anthropometric measurements:

Weight (kg)

Height vertex (cm)

Sitting height (cm)

Biacromial diameter (cm)

Bi-iliac diameter (cm)

Head circumference (cm)

Mid upper arm circumference (left) (cm)

Chest girth (cm)

For assessing the nutritional status of children, we have adopted three anthropometric indices - weight for age, height for age and weight for height - which are considered as the indicators of nutritional status. These indices were derived as percentage of the international standard or reference, i.e., the growth reference of the U.S. National Centre for Health Statistics (NCHS, 2000). The body mass index (BMI) was also calculated as weight in kg divided by square of height in cm (i.e., weight in kg/height<sup>2</sup> in cm).

Since the exact dates of births were not available for some children, the age grouping of children is done according to the method suggested by Sen (1994), that is, 5 year age group includes children of 4.50 (i.e., 4 years 6 months) to 5.49 (i.e., 5 years 5 months 29 days) years of age, where 30 days = 1 month, and 12 months = 1 year.

## **METHODS OF TAKING THE MEASUREMENT**

Standard techniques of measurements described in Hooton (1946) Weiner and Lourie (1981) and Sen (1994) were followed while taking the anthropometric measurements of children. These may be briefly described as follows:

### **Weight**

The body weight was taken with a spring weighing machine, asking the subject to stand on it with an erect posture and light apparel. The weighing machine was checked from time to time with a known standard weight. No deduction was made for the weight of light apparel while taking the final reading.

### **Height**

It measures the vertical distance from the floor to the vertex. The subject was made to stand as erect as possible with his/her arms hanging at the sides with thumbs forward, heels holding together and eyes directing towards the horizon (Hooton, 1946). The anthropometer was placed at the back and between the heels of the subject, taking care that it is kept absolutely vertical. The sliding sleeve of the anthropometer was then lowered down towards the middle of the head (Sagittal line) so that it would touch the vertex lightly. Reading in centimeter and its fractions was recorded.

### **Sitting height**

It measures the vertical distance from the vertex to the sitting surface of the subject. The subject was made to sit on the stool, or a flat wooden chair, or at the end of wooden bench.

Then he/she was positioned in an erect sitting posture, with ankles crossed, knees spread about 20 cm apart and hands rested on the thighs. The anthropometer was placed at the back and between the two buttocks, taking care that the lumbar curve of the subject was not flattened, but concave from behind. The sliding sleeve was then lowered down to touch the vertex lightly.

### **Biacromial Diameter**

This measurement is the maximum breadth of the bony shoulder girdle taken from acromion to acromion. The measurement was taken from the back of the subject with the rod compass (i.e., the first segment of anthropometer), while he/she was standing in an erect posture with his/her arms hanging at the sides. When the two acromion points were located by palpating along the outside edge of the scapular spine, the measuring points of the left and right hand bars were pressed against the left and right acromia, respectively. Reading was then recorded. This measurement was taken with moderate pressure to indent the deltoid muscle, but not to cause discomfort to the subject.

### **Bi-iliac diameter**

It measures the straight distance between the two most lateral points of the iliac-crests. The measurement was taken from the back of the subject with a rod compass, holding the fixed sleeve of the compass on the left hand and the sliding sleeve on the right hand. As in the case of biacromial diameter, the most lateral points on the iliac crests were palpated with fore-fingers while holding the two sleeves of the rod compass.

### **Mid upper arm circumference**

The measurement was taken with a steel tape at the middle (midway between acromion and elbow) part of the left upper arm on the naked skin (Sen, 1994), while the arms are hanging at the sides of the body.

### **Head Circumference**

The measurement was taken with a steel tape taking into consideration the glabella and opisthocranium points in such a way so as to get the maximum circumference.

### Chest Girth

It measures circumference of the chest of subject when he is breathing normally. This measurement was taken with a steel tape (Precision-1mm) at the level of the mesosternale, at the right angle to the axis of the body and reading was taken.

## SOCIO-ECONOMIC CATEGORIES

In the present study, three important socio-economic variables were taken into consideration. These include religion, monthly income of the household and level of education. These socio-economic variables were classified arbitrarily into a different group and/or category with a view to understanding their influence on demographic characteristics and growth and nutritional status of the study population. Our classification may be briefly described as follows:

**Religious groups:** The Khasi population (mostly Khyntriams) of the present study is divided into three broad religious groups, namely, the Christian Khasis, Niam Khasis and Muslim Khasis. By *Christian Khasis*, we mean those Khasis who have embraced Christianity or those Khasis who are Christians by faith, and the *Niam Khasis* refer to those Khasis who have followed and maintained their traditional religion. On the other hand, the Muslim Khasis are those Khasis who have embraced Islam, and the children belonging to this religious group are by and large the product of the intermixture between the Khasi females and Muslim males.

**Income groups:** Data on household income were collected directly from the head of the household and they were cross-checked taking into consideration some aspects of socio-economic conditions like housing condition, types of occupation, land holding, and monthly expenditure. The interval estimation based on standard deviation of the per capita monthly income of household was adopted for classifying the three economic groups (Khongsdier, 1997), which is as follows:

Above (  $\bar{X} + 4SD/\sqrt{N}$  ) = High income group (HIG)

(  $\bar{X} - 4SD/\sqrt{N}$  ) to (  $\bar{X} + 4SD/\sqrt{N}$  ) = Middle income group (MIG)

Below (  $\bar{X} - 4SD/\sqrt{N}$  ) = Low income group (LIG)

Where N stands for the number of households and  $\bar{X}$  is the average monthly per capita income of the households. In the present study, the average per capita monthly income for 584

households was found to be Rs.581.67/- with a standard deviation (SD) of Rs.326.32. Thus, following the above interval method, the households with per capita monthly income of below Rs. 525/- were classified as **LIG**, while the range of Rs.525/- to Rs.636/- were considered as **MIG**, and those households with per capita monthly income of above Rs.636/- were classified as **HIG**.

**Educational Level:** The data on educational attainment of individuals in the present study were arbitrarily classified as follows: Individuals who were unable to read and write were classified as **Illiterate**. The individuals who were able to read and write and those who attended school up to standard IV were grouped into **Primary** level of education. **Secondary** level of education includes all those persons who attended school up to below matriculation. The individuals with education of matriculation and above are included in the category of **Higher** level of education due to inadequacy of data.

## STATISTICAL METHODS

The data collected for the present study are quantified and analysed statistically, using SPSS Window software. The data are presented in terms of means, standard deviation, standard error and proportions or percentages. The differences between two means were tested, using t-student test, while the differences between more than two means were determined, using one-way analysis of variance (ANOVA). Analysis of covariance was also carried out for testing the differences among means, allowing for the effects of other covariates. The differences between proportions were tested, using chi-square test. Multiple regression analysis was also carried out for understanding the effects of socio-economic factors on demographic parameters and growth patterns of children. Logistic regression analysis was used for analyzing the effects of maternal age, education, income and religion on infant mortality. Some of these may be briefly described as follows:

**Mean:** The mean is also known as arithmetic average. It is defined as the value which can be obtained by dividing the total values of various items in a series by the total number of items.

It is worked out as under:

Mean ( $\bar{X}$ ) =  $\Sigma X_i / N = (x_1 + x_1 + \dots + x_n) / N$ , where  $x_i$  is the value of the i-th item  $X_i$ ,  $i = 1, 2, \dots, n$ , and  $N$  stands for the total number of items.

In the case of frequency distribution, the mean is obtained as follows:

Mean ( $\bar{X}$ ) =  $\Sigma f_i x_i / f_i N = (f_1 x_1 / f_1 + f_2 x_2 / f_2 + \dots + f_n x_n / f_n) / N$ , where  $f_i x_i$  is the product of the mid value ( $x_i$ ) of i-th class-interval and the frequency ( $f_i$ ) of the i-th item.

**Standard Deviation (SD):** Standard deviation is defined as the square root of the mean of the squares of the deviation of observations from their arithmetic mean. It is computed as follows:

$$SD = \sqrt{\{(X_i - \bar{X})^2 / N - 1\}}$$

Where  $X_i$  is the value of the  $i$ -th item,  $\bar{X}$  stands for the mean, and  $N$  is the total number of cases. In the case of frequency distribution, the SD is obtained as follows:

$$SD = \sqrt{\{(\Sigma fd^2 / N - 1) - (\Sigma fd / N - 1)^2\}} \times C$$

Where  $fd$  is the product of the deviation from the assumed mean ( $d$ ) and the frequency ( $f$ ) of item in the  $i$ -th class-interval; while  $C$  stands for class interval.

The divisor was taken as  $(N - 1)$  but not as  $N$  because we did not know the true mean and standard deviation of the population. So the mean and standard deviation were estimated through samples collected for the present study, and in doing so we lost what is known as a degree of freedom (Parker, 1973).

**Standard Error of Mean (SE):** It is calculated as  $SD/\sqrt{N-1}$ .

**Differences between two means:** In the present study, the number of observations in two sample means are almost more than 50. Therefore, the statistical difference between two means is worked out according to standard t-test given as follows:

$$t = (\bar{X}_1 - \bar{X}_2) \div \sqrt{\{(SE_1)^2 + (SE_2)^2\}}$$

where  $\bar{X}_1$  and  $SE_1$  are the mean and standard error of a given variable for the first sample, while  $\bar{X}_2$  and  $SE_2$  are the mean and standard error of the same variable for the second sample of the same population or different populations.

**Differences between proportions:** In the present study, the differences between proportions were tested by using the chi-square ( $\chi^2$ ). It is obtained as follows:

$$\chi^2 = \Sigma(O_i - E_i)^2 / E_i = (O_1 - E_1)^2 / E_1 + (O_2 - E_2)^2 / E_2 + \dots + (O_n - E_n)^2 / E_n$$

where  $O_i$  and  $E_i$  are the observed and expected frequencies of the  $i$ -th character in each class.

The value obtained is then compared with that given in the Table of Chi-square distribution with  $(N - 1)$  degree of freedom (d.f.). In the case of  $2 \times C$  contingency Table, the number of d.f. is  $(\text{Row} - 1)(\text{Column} - 1)$ . The expected frequency is calculated as  $(\text{Row}$

Total)/(Column Total)/(Grand Total) OR (Column Total)/(Grand Total) multiplied by Row Total.

**Analysis of Variance (ANOVA):** One way analysis of variance was used for testing the differences between the means of more than two samples (Snedecor and Cochran, 1967). The basic procedure consists in examining the amount of variance “Within Samples” in relation to the amount of variance “Between Samples”. Following are the steps followed for computing this test:

1. Correction factor (C) =  $(\sum X_i)^2/N$ , where  $X_i$  is the total number of  $i$ th item in all the samples, and  $N$  is the total number of items in all the samples.
2. Total sum of squares (TSS) =  $\sum X_i^2 - C$ , where  $X_i^2$  is the square of each  $i$ th item in all the samples.
3. Sum of squares for variance between samples (SSB) =  $n_1(\bar{X}_1 - \bar{X}) + n_2(\bar{X}_2 - \bar{X}) + \dots + n_k(\bar{X}_k - \bar{X})$ ,

where  $\bar{X}$  = Overall mean for all items in all samples

$\bar{X}_1, \bar{X}_2, \dots, \bar{X}_k$  = Sample means 1, 2,  $\dots$ ,  $k$

$n_1, n_2, \dots, n_k$  = Number of items in samples 1, 2,  $\dots$ ,  $k$ .

4. Sum of squares for variance within samples (SSW) = (TSS – SSB)
5. Mean squares for variance between samples (MSB) =  $SSB/(K - 1)$ , where  $(K - 1)$  is the degree of freedom between samples, i.e.,  $K$  = Number of samples compared.
6. Mean square for variance within samples (MSW) =  $SSW/(N - K)$ , where  $(N - K)$  is the degree of freedom for all individual items for all samples, i.e.,  $N$  = Number of individual items for all samples.
7. F- ratio =  $MSB/MSW$

The value obtained is then compared with that in the Table of F-distribution with  $(K - 1)$  as larger variance and  $(N - K)$  as smaller variance, taking 95% confidence interval.

**Regression Analysis:** Regression analysis has many applications. The main purpose is the regression analysis is to know if Y (dependent variable) does depend on X (independent variable), or to make a prediction of Y from X. In the present study, we are also concerned with the error in Y-variable after adjustments were made for the effects of X-variable. The regression coefficient (b) of Y on X is worked out as follows:

$$b = \frac{\Sigma xy}{\Sigma x^2}$$

$$\text{where } \Sigma xy = \Sigma XY - (\Sigma X)(\Sigma Y)/N$$

$$\Sigma x^2 = \Sigma X^2 - (\Sigma X)^2/N$$

The regression of Y on X is expressed as

$$\bar{Y} = a + bX, \text{ where } a = \bar{Y} - \bar{X}b, \text{ and } \bar{Y} = \text{Estimated value.}$$

## CHAPTER IV

### DEMOGRAPHIC CHARACTERISTICS

In this chapter, we shall describe the demographic characteristics of the three religious groups of the Khyntiam Khasi, namely, Christians, Muslims and Khasis.

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#### Age and Sex Structure

Table 4.1 shows the total population of the three religious groups by age and sex. About 46%, 50% and 4% of the total population in the Christians belongs to the age groups 0-14, 15-49 and 50 + years, respectively, which are more or less similar to the Khasis, i.e., 47, 49 and 4 per cent, respectively, and the Muslims (44, 51 and 5 per cent, respectively). Figures 3.1, 3.2 and 3.3 also show that the base of each population pyramid tends to be constricted, thereby indicating the tendency to decline in fertility rate, provided the infant and child mortality rates are low in all the three religious groups. According to Sundbarg's classification of population, a population is said to be *progressive* when the number of persons in relation to the total population are 40.00%, 50.00% and 10.00% in the age groups 0-14, 15-49 and 50 + years, respectively. The population is referred to as *stationary* if these frequencies are 33.00%, 50.00% and 17.00%, respectively; while the frequencies of 20.00%, 50.00% and 30.00%, respectively, are the characteristics of *regressive* population (Khongsdier 2001). Thus, the three religious groups of the Khasi population may be categorized as *progressive type*.

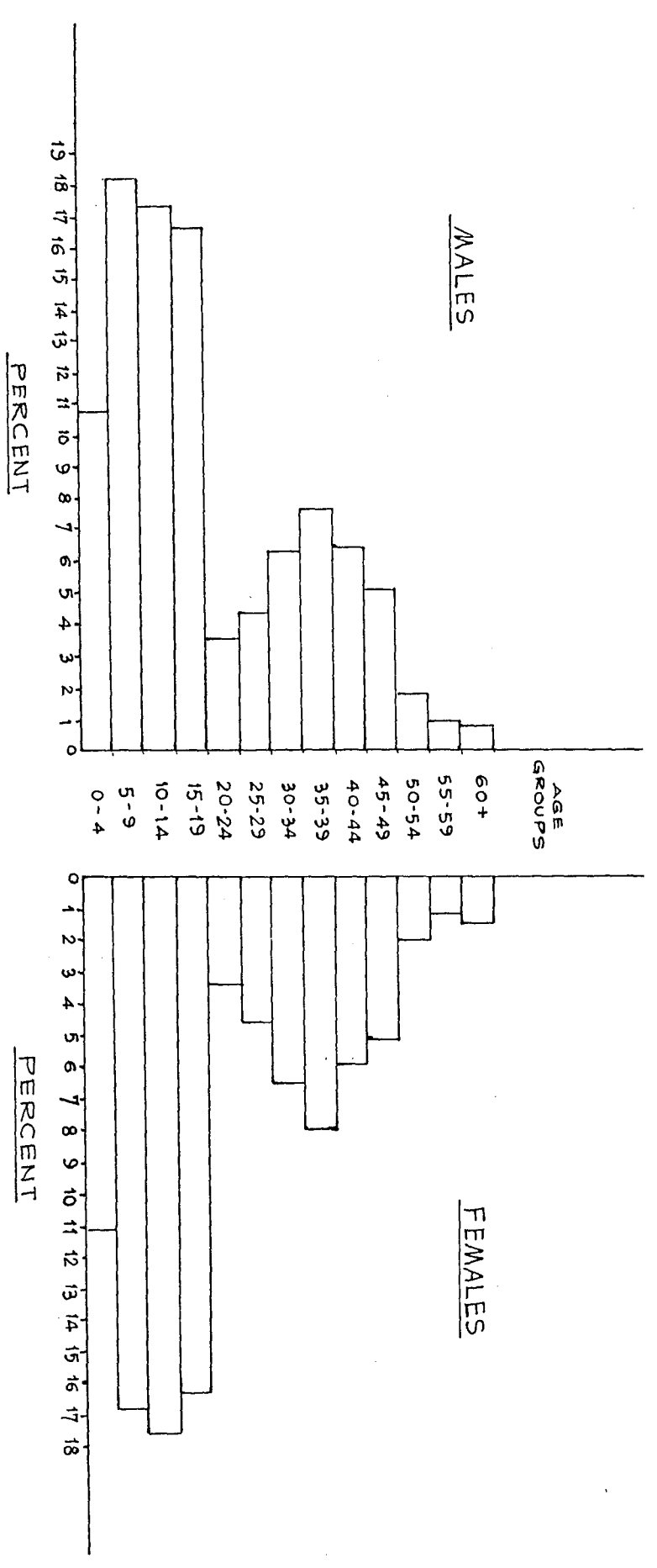
Table 4.1 also shows that the over all sex ratio, i.e., number of males per 100 females, is low in all the religious groups, especially among the Muslims (95.14) and Christians (96.54), which is much below the ideal sex ratio of 1:1. However, the chi-square value indicates that the deviation from the ideal sex ratio of 1:1 is not statistically significant in all the religious groups ( $\chi^2$  -value for: Christians = 0.51,  $P > 0.05$ ; Muslims = 0.75,  $P > 0.05$ ; and Khasis = 0.16,  $P > 0.05$ ).

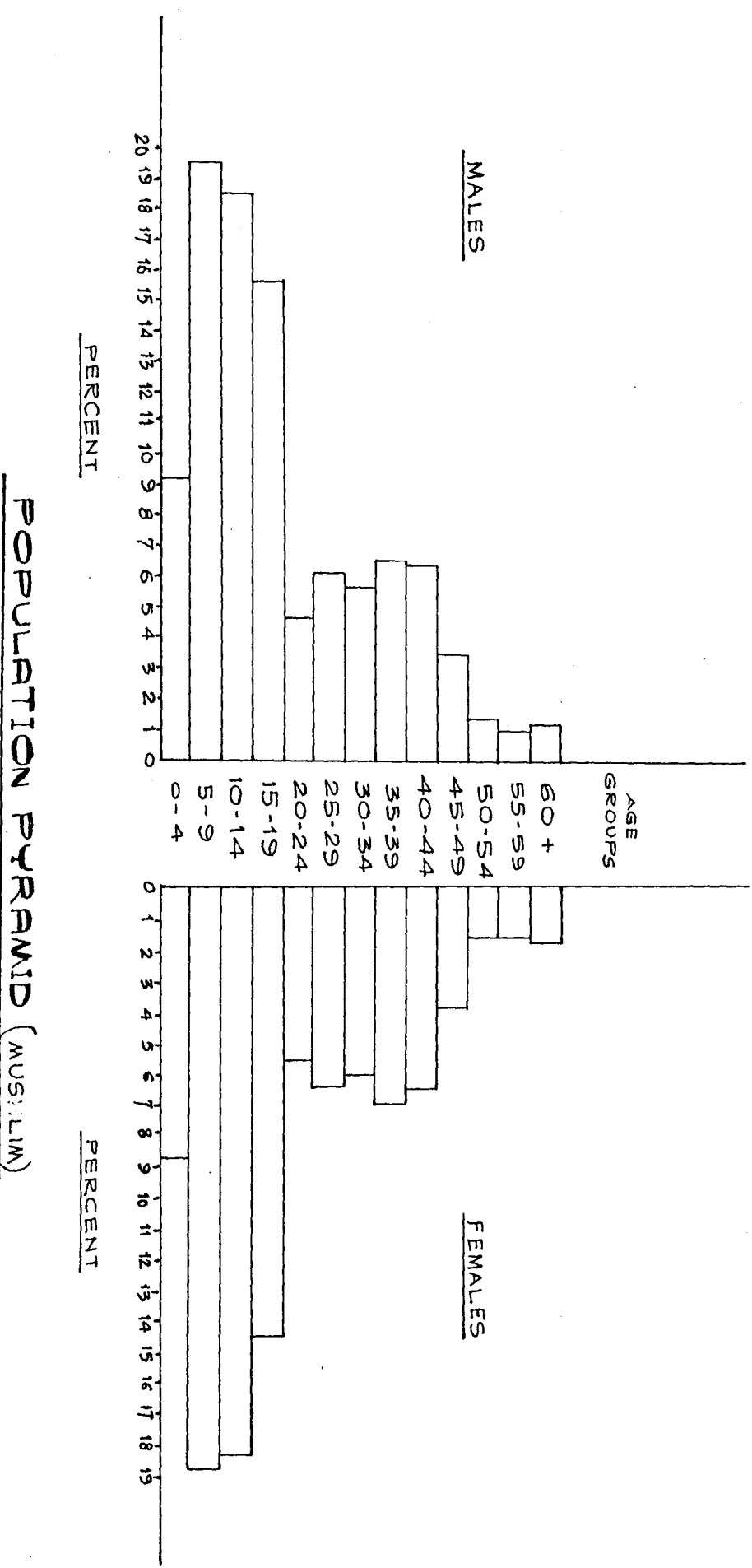
**Table 4.1.** Total population of the three religious groups by age and sex

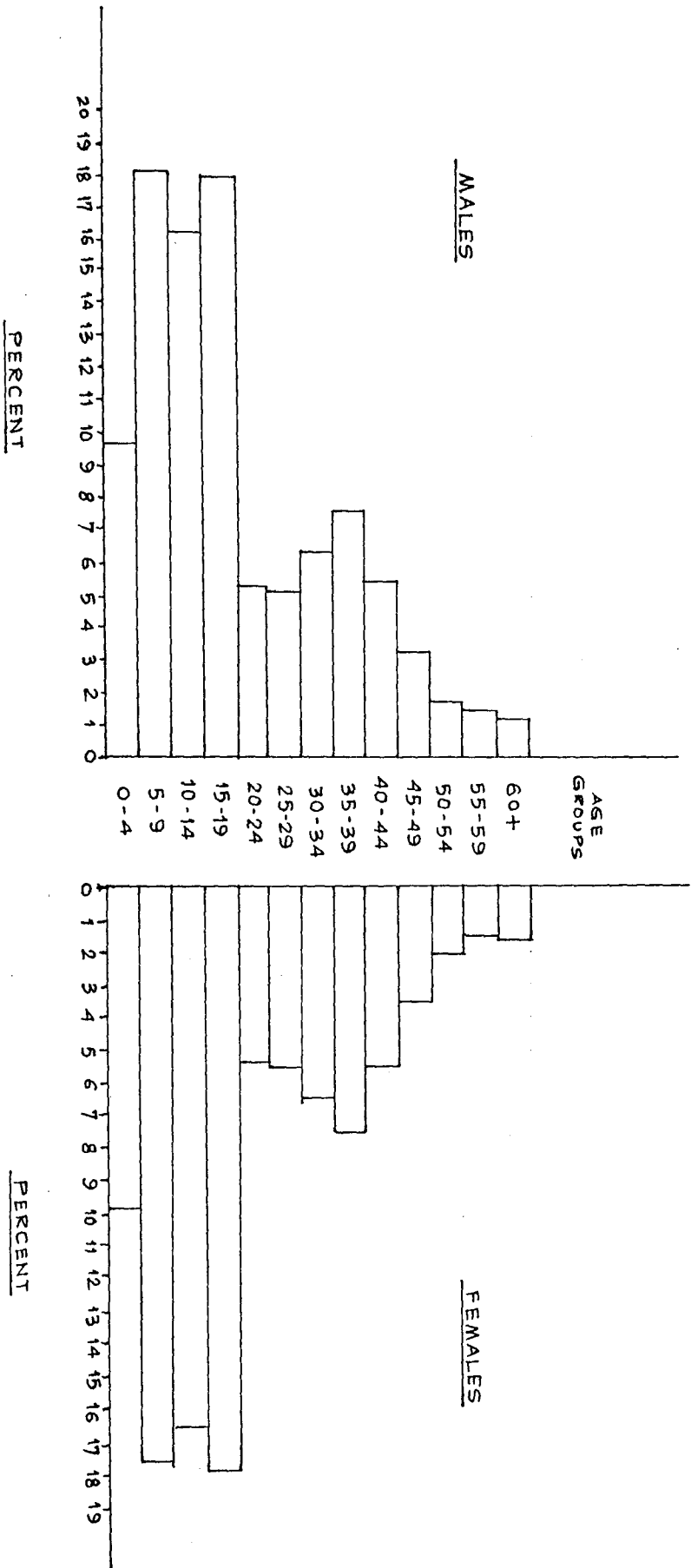
| Age groups (years) | Christians    |        | Muslims       |        | Niam Khasis   |        |
|--------------------|---------------|--------|---------------|--------|---------------|--------|
|                    | Male          | Female | Male          | Female | Male          | Female |
| 0 - 4              | 88            | 93     | 54            | 54     | 76            | 79     |
| 5 - 9              | 148           | 142    | 115           | 116    | 141           | 140    |
| 10 -14             | 141           | 148    | 109           | 112    | 126           | 131    |
| 0-14               | 760 (46.09)   |        | 560 (46.51)   |        | 693 (44.03)   |        |
| Sex ratio          | 98.43         |        | 98.58         |        | 98.00         |        |
| 15 - 19            | 135           | 136    | 92            | 90     | 140           | 142    |
| 20 - 24            | 28            | 27     | 28            | 34     | 42            | 41     |
| 25 - 29            | 36            | 39     | 36            | 39     | 40            | 42     |
| 30 - 34            | 51            | 55     | 34            | 37     | 49            | 52     |
| 35 - 39            | 62            | 67     | 39            | 43     | 59            | 60     |
| 40 - 44            | 52            | 50     | 38            | 40     | 43            | 42     |
| 45 - 49            | 41            | 44     | 21            | 24     | 26            | 27     |
| 15 - 49            | 823 (49.91)   |        | 595 (49.42)   |        | 805 (51.14)   |        |
| Sex ratio          | 96.89         |        | 93.81         |        | 98.28         |        |
| 50 - 54            | 15            | 17     | 8             | 9      | 15            | 16     |
| 55 - 59            | 7             | 9      | 6             | 9      | 13            | 11     |
| 60 +               | 6             | 12     | 7             | 10     | 9             | 12     |
| 50 +               | 66 (4.00)     |        | 49 (4.07)     |        | 76 (4.83)     |        |
| Sex ratio          | 113.16        |        | 75.00         |        | 94.87         |        |
| Total              | 810           | 839    | 587           | 617    | 779           | 795    |
| Persons            | 1649 (100.00) |        | 1204 (100.00) |        | 1574 (100.00) |        |
| Sex ratio          | 96.54         |        | 95.14         |        | 97.99         |        |

Figures within parentheses indicate percentage

POPULATION PYRAMID (CHRISTIAN)







**POPULATION PYRAMID (NIAM KHASI)**

In the age group 0-14, the sex ratios are 98.43, 98.58, and 98.00 respectively in the Christians, Muslims and Khasis, which are low in comparison with the ideal sex ratio of 1:1. However, the goodness of fit indicates that the deviation from the ideal sex ratio in this age group is not statistically significant for all the religious groups ( $\chi^2$ -value for: Christians = 0.05,  $P > 0.05$ ; Muslims = 0.03,  $P > 0.05$ ; and Khasis = 0.07,  $P > 0.05$ ). In the age group 15-49 years, the sex ratios are 96.89, 93.81 and 98.28 in the Christians, Muslims and Niam Khasis. Thus, in this age group also the sex ratio is low in all the religious groups, despite the absence of significant difference ( $\chi^2$ -value for: Christians = 0.21,  $P > 0.05$ ; Muslims = 0.61,  $P > 0.05$ ; and Khasis = 0.06,  $P > 0.05$ ). This low number of males in relation to per 100 females is also found in the last age group, i.e., 50 + years, in which the sex ratios are 96.54, 95.14 and 97.99 respectively for the Christians, Muslims and Niam Khasis. Like in the case of other age groups, the test of goodness of fit however indicates that the low sex ratios in all the religious groups are not statistically significant ( $\chi^2$ -value for: Christians = 0.21,  $P > 0.05$ ; Muslims = 0.61,  $P > 0.05$ ; and Khasis = 0.06,  $P > 0.05$ ).

**Table 4.2.** Marital status of individuals by present age groups

| Marital status by age groups | Christians  |             | Muslims     |             | Niam Khasis |             |
|------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|
|                              | Male        | Female      | Male        | Female      | Male        | Female      |
| <i>≤ 24 years</i>            |             |             |             |             |             |             |
| Married                      | 3 (1.55)    | 8 (3.02)    | 4 (2.84)    | 10 (5.52)   | 2 (0.84)    | 19 (7.98)   |
| Unmarried                    | 537         | 535         | 394         | 396         | 523         | 512         |
| DSW                          | 0           | 3           | 0           | 0           | 0           | 2           |
| <i>25-29 years</i>           |             |             |             |             |             |             |
| Married                      | 17 (8.81)   | 33 (12.45)  | 12 (8.51)   | 26 (14.36)  | 21 (9.68)   | 34 (14.29)  |
| Unmarried                    | 19          | 3           | 24          | 12          | 18          | 5           |
| DSW                          | 0           | 3           | 0           | 1           | 1           | 3           |
| <i>30-34 years</i>           |             |             |             |             |             |             |
| Married                      | 23 (11.92)  | 51 (19.25)  | 20 (14.18)  | 32 (17.68)  | 42 (19.35)  | 42 (17.65)  |
| Unmarried                    | 28          | 2           | 14          | 4           | 6           | 3           |
| DSW                          | 0           | 2           | 0           | 1           | 1           | 7           |
| <i>≥ 35 years</i>            |             |             |             |             |             |             |
| Married                      | 150 (77.72) | 173 (65.28) | 105 (74.47) | 113 (62.43) | 152 (70.05) | 143 (60.08) |
| Unmarried                    | 23          | 8           | 10          | 3           | 10          | 3           |
| DSW                          | 10          | 18          | 4           | 19          | 3           | 22          |
| Total                        | 810         | 839         | 587         | 617         | 779         | 795         |
| Married                      | 193         | 265         | 141         | 181         | 217         | 238         |
| Unmarried                    | 617         | 548         | 442         | 415         | 557         | 523         |
| DSW                          | 0           | 26          | 4           | 21          | 5           | 34          |

DSW = Divorced, widowed and separated.

Figures within parentheses indicate percentage

### Marital Status

Table 4.2 shows the marital status of both males and females in all the three religious groups. Of the married males, 1.55%, 2.84% and 0.84% belong to the age group 24 years and below in the Christians, Muslims and Khasis, respectively, while in the case of females these frequencies are 3.02%, 5.52% and 7.98%, respectively. It indicates that the Muslim males get married earlier than their Christian and Khasi counterparts, though it is not statistically significant ( $P > 0.05$ ). With respect to married females, Table 4.2 shows that about 3.02%, 5.52% and 7.98% in the Christians, Muslims and Niam Khasis, respectively, get married at the age of 24 years and below. Here it shows that the females in the Niam Khasi get married earlier than the Muslim and Christian females, and the differences are statistically significant ( $\chi^2 = 6.05$ ,  $DF = 2$ ,  $P < 0.05$ ). However, the over all differences in women's mean age at marriage between the three religious groups (Table 4.3) are not statistically significant ( $F = 0.2$ ,  $P > 0.05$ ). As regards the sex differences, it shows that the marriage is more delayed in males than in females as generally observed in other populations (Khongsdier and Ghosh, 1996).

**Table 4.3.** Mean age at marriage

| Religious groups | Male   |       |      | Female |       |      |
|------------------|--------|-------|------|--------|-------|------|
|                  | Number | Mean  | SE   | Number | Mean  | SE   |
| Christians       | 203    | 25.48 | 0.19 | 291    | 20.32 | 0.21 |
| Muslims          | 225    | 25.45 | 0.17 | 275    | 20.30 | 0.19 |
| Niam Khasis      | 145    | 25.94 | 0.21 | 202    | 20.35 | 0.25 |

**Table 4.4.** Mean age at first child birth.

| Religious groups | Male             |       |      | Female           |       |      |
|------------------|------------------|-------|------|------------------|-------|------|
|                  | Number           | Mean  | SE   | Number           | Mean  | SE   |
| Christians       | 203              | 26.92 | 0.22 | 291              | 22.24 | 0.23 |
| Muslims          | 225              | 26.78 | 0.17 | 275              | 21.63 | 0.21 |
| Niam Khasis      | 145              | 27.05 | 0.21 | 202              | 21.64 | 0.24 |
| F-ratio          | 1.82, $P > 0.05$ |       |      | 0.02, $P > 0.05$ |       |      |

Table 4.3 shows the mean age at marriage for both males and females in all the three religious groups. It can be observed that there is not much difference in mean age at marriage across religious groups. It holds good for both males and females. However, Table 4.4 indicates that the mean age at first child birth is slightly higher in the Christian women (22.24 years) than in the Niam Khasis (21.64 years) and Muslim (21.63 years) women. Like in the case of age at marriage, the one-way analysis of variance shows that the differences in mean age at first child birth between the religious groups are not statistically significant for both males and females (Table 4.4).

### Fertility

It is seen that the mean number of live births per woman, living in wedlock, increases with the rise in age groups in all three religious group of population (Table 4.5). Among the Christians, the mean numbers of live births per mother are  $3.34 \pm 0.23$ ,  $4.20 \pm 0.20$ ,  $5.03 \pm 0.20$ ,  $5.21 \pm 0.30$  in the age groups below 29, 30 – 34, 35 – 39 and 40 – 44 years, respectively. In the Muslims these mean values for different age groups of mothers are found to be  $3.31 \pm 0.21$ ,  $4.31 \pm 0.24$ ,  $5.32 \pm 0.34$ ,  $6.57 \pm 0.39$ , respectively, while among the Niam Khasis they are  $3.62 \pm 0.23$ ,  $4.38 \pm 0.27$ ,  $5.73 \pm 0.27$ ,  $5.64 \pm 0.36$ , respectively. The one way analysis of variance (ANOVA) indicates that there are significant differences between age groups of mothers in respect of live births for all the religious groups (Table 4.5). Considering the differences between religious groups, it is found that the mean number of live births per married woman (of all ages) living in wedlock is higher in the Muslims ( $4.89 \pm 0.18$ ) than in the Christians ( $4.50 \pm 0.13$ ) and Niam Khasis ( $4.52 \pm 0.15$ ). However, the ANOVA test indicates that the differences among all three religious groups are not statistically significant ( $F = 1.90$ ,  $P > 0.05$ ).

Table 4.6 shows the mean number of surviving children per woman living in wedlock. Like in the case of live births, the mean number of surviving children also increases with the rise in age group of the mothers. It is found that the mean number of surviving children per woman living in wedlock are  $3.07 \pm 0.19$ ,  $3.98 \pm 0.18$ ,  $4.74 \pm 0.17$ ,  $4.90 \pm 0.26$  among the Christians, and  $3.03 \pm 0.19$ ,  $4.00 \pm 0.22$ ,  $4.84 \pm 0.29$ ,  $6.00 \pm 0.32$  among the Muslims in the age groups  $\leq 29$ , 30 – 34, 35 – 39 and 40 – 44 years, respectively. In the Niam Khasis these mean values are found to be  $3.21 \pm 0.20$ ,  $4.00 \pm$

0.23,  $5.29 \pm 0.25$ ,  $5.13 \pm 0.32$ , respectively. The ONOVA test indicates that these differences between age groups in respect of surviving children are statistically significant in all the religious groups. Thus, the age of mother is very important in regulating the live births and mean number of surviving children. However, the differences between religious groups in respect of surviving children are not statistically significant ( $F = 0.84$ ,  $P > 0.05$ ), although it is slightly higher among the Muslims.

**Table 4.5.** Live births by age groups of women living continuously in wedlock.

| Age group (years)  | Number of mothers | Number of Live births | Mean number of Live births | Standard error |
|--|-------------------|-----------------------|----------------------------|----------------|
| <i>Christians</i>  |                   |                       |                            |                |
| ≤ 29   | 41                | 137                   | 3.34                       | 0.23           |
| 30-34  | 51                | 214                   | 4.20                       | 0.20           |
| 35-39  | 62                | 312                   | 5.03                       | 0.20           |
| 40-44  | 42                | 219                   | 5.21                       | 0.30           |
| Total  | 196               | 882                   | 4.50                       | 0.13           |
| One-way analysis of variance: F-ratio = 12.48, $P < 0.001$ |                   |                       |                            |                |
| <i>Muslims</i>   |                   |                       |                            |                |
| ≤ 29   | 36                | 119                   | 3.31                       | 0.21           |
| 30-34  | 32                | 138                   | 4.31                       | 0.24           |
| 35-39  | 38                | 202                   | 5.32                       | 0.34           |
| 40-44  | 35                | 230                   | 6.57                       | 0.39           |
| Total  | 141               | 689                   | 4.89                       | 0.18           |
| One-way analysis of variance: F-ratio = 20.94, $P < 0.001$ |                   |                       |                            |                |
| <i>Niam</i>  |                   |                       |                            |                |
| <i>Khasis</i>  |                   |                       |                            |                |
| ≤ 29   | 53                | 192                   | 3.62                       | 0.23           |
| 30-34  | 42                | 184                   | 4.38                       | 0.27           |
| 35-39  | 55                | 315                   | 5.73                       | 0.27           |
| 40-44  | 39                | 220                   | 5.64                       | 0.36           |
| Total  | 189               | 911                   | 4.82                       | 0.15           |
| One-way analysis of variance: F-ratio = 14.11, $P < 0.001$ |                   |                       |                            |                |

F-ratio = 1.90,  $P > 0.05$ .

**Table 4.6.** Surviving children by age groups of women living continuously in wedlock.

| Age group (years)   | Number of mothers | Number of Surviving children | Mean number of Surviving children | Standard error |
|---|-------------------|------------------------------|-----------------------------------|----------------|
| <i>Christians</i>   |                   |                              |                                   |                |
| ≤ 29  | 41                | 126                          | 3.07                              | 0.19           |
| 30-34   | 51                | 203                          | 3.98                              | 0.18           |
| 35-39   | 62                | 294                          | 4.74                              | 0.17           |
| 40-44   | 42                | 206                          | 4.90                              | 0.26           |
| Total   | 196               | 829                          | 4.23                              | 0.10           |
| One-way analysis of variance: F-ratio = 16.82, P < 0.0001 |                   |                              |                                   |                |
| <i>Muslims</i>  |                   |                              |                                   |                |
| ≤ 29  | 36                | 109                          | 3.03                              | 0.19           |
| 30-34   | 32                | 128                          | 4.00                              | 0.22           |
| 35-39   | 38                | 184                          | 4.84                              | 0.29           |
| 40-44   | 35                | 210                          | 6.00                              | 0.32           |
| Total   | 141               | 631                          | 4.48                              | 0.16           |
| One-way analysis of variance: F-ratio = 20.85, P < 0.0001 |                   |                              |                                   |                |
| <i>Niam</i>   |                   |                              |                                   |                |
| <i>Khasis</i>   |                   |                              |                                   |                |
| ≤ 29  | 53                | 170                          | 3.21                              | 0.20           |
| 30-34   | 42                | 168                          | 4.00                              | 0.23           |
| 35-39   | 55                | 291                          | 5.29                              | 0.25           |
| 40-44   | 39                | 200                          | 5.13                              | 0.32           |
| Total   | 189               | 829                          | 4.39                              | 0.14           |
| One-way analysis of variance: F-ratio = 17.02, P < 0.0001 |                   |                              |                                   |                |

F-ratio = 0.84, P &lt; 0.05

**Table 4.7.** Live births by age groups of all married women

| Age group (years)   | Number of mothers | Number of Live births | Mean number of Live births | Standard error |
|---|-------------------|-----------------------|----------------------------|----------------|
| <i>Christians</i>   |                   |                       |                            |                |
| ≤ 29  | 47                | 161                   | 3.43                       | 0.22           |
| 30-34   | 53                | 222                   | 4.19                       | 0.19           |
| 35-39   | 65                | 324                   | 4.98                       | 0.20           |
| 40-44   | 46                | 245                   | 5.33                       | 0.26           |
| 45 +  | 80                | 484                   | 6.05                       | 0.36           |
| Total   | 291               | 1436                  | 4.93                       | 0.14           |
| One-way analysis of variance: F-ratio = 13.07, P < 0.0001 |                   |                       |                            |                |
| <i>Muslims</i>  |                   |                       |                            |                |
| ≤ 29  | 37                | 124                   | 3.35                       | 0.21           |
| 30-34   | 33                | 144                   | 4.36                       | 0.24           |
| 35-39   | 41                | 224                   | 5.46                       | 0.33           |
| 40-44   | 39                | 256                   | 6.56                       | 0.37           |
| 45 +  | 52                | 324                   | 6.23                       | 0.36           |
| Total   | 202               | 1072                  | 5.31                       | 0.17           |
| One-way analysis of variance: F-ratio = 16.12, P < 0.0001 |                   |                       |                            |                |
| <i>Niam Khasis</i>  |                   |                       |                            |                |
| ≤ 29  | 58                | 201                   | 3.47                       | 0.24           |
| 30-34   | 51                | 232                   | 4.55                       | 0.25           |
| 35-39   | 58                | 328                   | 5.66                       | 0.27           |
| 40-44   | 41                | 231                   | 5.63                       | 0.35           |
| 45 +  | 66                | 427                   | 6.47                       | 0.36           |
| Total   | 274               | 1419                  | 5.18                       | 0.15           |
| One-way analysis of variance: F-ratio = 16.12, P < 0.0001 |                   |                       |                            |                |

F-ratio = 1.57, P > 0.05.

**Table 4.8.** Surviving children by age groups of all married women

| Age group (years)   | Number of mothers | Number of Surviving children | Mean number of Surviving children | Standard error |
|---|-------------------|------------------------------|-----------------------------------|----------------|
| <i>Christians</i>   |                   |                              |                                   |                |
| ≤ 29  | 47                | 148                          | 3.15                              | 0.18           |
| 30-34   | 53                | 209                          | 3.94                              | 0.17           |
| 35-39   | 65                | 304                          | 4.68                              | 0.16           |
| 40-44   | 46                | 227                          | 4.93                              | 0.22           |
| 45 +  | 80                | 425                          | 5.31                              | 0.29           |
| Total   | 291               | 1313                         | 4.51                              | 0.11           |
| One-way analysis of variance: F-ratio = 13.27, P < 0.0001 |                   |                              |                                   |                |
| <i>Muslims</i>  |                   |                              |                                   |                |
| ≤ 29  | 37                | 113                          | 3.05                              | 0.19           |
| 30-34   | 33                | 131                          | 3.97                              | 0.23           |
| 35-39   | 41                | 201                          | 4.90                              | 0.30           |
| 40-44   | 39                | 233                          | 5.97                              | 0.31           |
| 45 +  | 52                | 286                          | 5.50                              | 0.30           |
| Total   | 202               | 964                          | 4.77                              | 0.14           |
| One-way analysis of variance: F-ratio = 16.75, P < 0.0001 |                   |                              |                                   |                |
| <i>Niam Khasis</i>  |                   |                              |                                   |                |
| ≤ 29  | 58                | 171                          | 2.95                              | 0.20           |
| 30-34   | 51                | 213                          | 4.18                              | 0.22           |
| 35-39   | 58                | 301                          | 5.19                              | 0.23           |
| 40-44   | 41                | 209                          | 5.10                              | 0.31           |
| 45 +  | 66                | 370                          | 5.61                              | 0.28           |
| Total   | 274               | 1264                         | 4.61                              | 0.13           |
| One-way analysis of variance: F-ratio = 19.19, P < 0.0001 |                   |                              |                                   |                |

F-ratio = 1.01, P > 0.05.

Table 4.7 shows the number of live births to all married women by age groups. It is found that the mean live births per married woman are  $4.93 \pm 0.14$ ,  $5.31 \pm 0.17$  and  $5.18 \pm 0.15$  in the Christians, Muslims and Niam Khasis, respectively. Although the mean live births are higher in the Muslims and Niam Khasis when compared with the Christians, the ANOVA test indicates that these differences between religious groups of the Khasi populations are not statistically significant ( $F = 1.57, P > 0.05$ ). Like in the case of married women living in wedlock, the mean number of live births to all married women in all the three religious groups of the population increases as age advances. In the Christians, it increases from  $3.43 \pm 0.22$  for the women in the age group  $\leq 29$  years to  $6.05 \pm 0.36$  for the women aged 45 years and above. Among the Muslims, it increases from  $3.35 \pm 0.21$  in the age group  $\leq 29$  years to  $6.56 \pm 0.37$  for the women aged 40-44 years but it decreases again to  $6.23 \pm 0.36$  in the age group 45 years and above. Among the Niam Khasis, it increases from  $3.47 \pm 0.24$  for those women in the age group  $\leq 29$  years to  $6.47 \pm 0.36$  for the women aged 45 years and above. These differences in mean number of live births between age groups of mothers are statistically significant in all the religious groups (Table 4.7).

Table 4.8 shows the number of surviving children by age groups of all married women. Like in the case of live births, it is seen that the mean number of surviving children increases with the rise in the age group of mothers, although among the Muslims, it increases till 40 –44 years and lower in the age group 45 years and above. Nevertheless, the overall differences between age groups in respect of surviving children are found to be highly significant for all the religious groups. With respect to religious differences, Table 8 shows that the mean number of surviving children is  $4.51 \pm 0.11$ ,  $4.77 \pm 0.14$  and  $4.61 \pm 0.13$  in the Christians, Muslims and Niam Khasis, respectively. The ANOVA test indicates that the mean number of surviving children is more or less similar in all religious groups ( $F = 1.01, P > 0.05$ ).

Table 4.9 shows the age specific fertility rate among the three religious groups. It is found that the total fertility rate (TER) is slightly lower among the Christian (5.38) than the other two religious group (5.85). It is also seen that the age specific fertility rate (ASFR) reaches its peak, when the mothers are in the age group 25-29 years, then it starts decreasing with the rise in age of the mothers (Fig. 4. 4). This holds good for all the three religious groups.

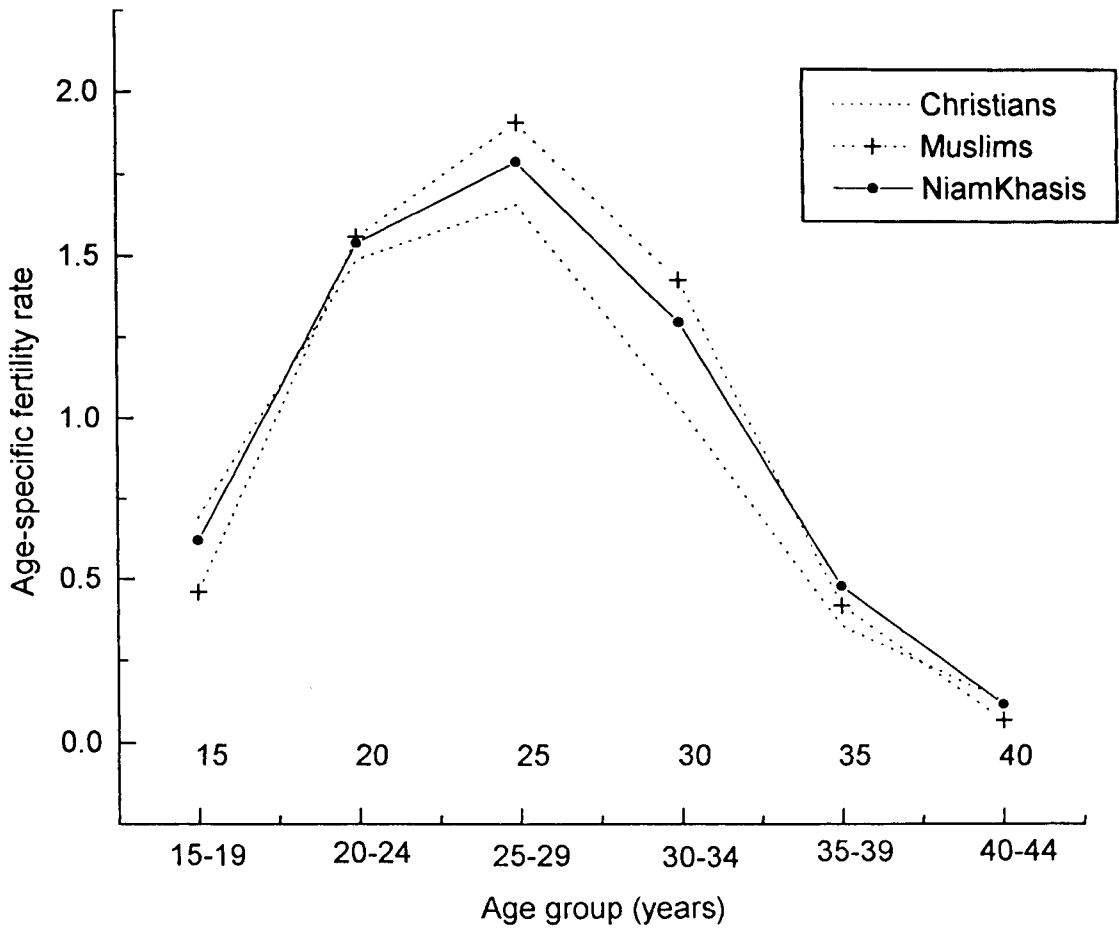


Fig.4.4. Age-specific fertility rates

**Table 4.9.** Age-specific fertility rate (ASFR) by religious groups

| Age group<br>(in years)    | Number of married women |         |                | Number of live births |         |                | Age-specific fertility rate |         |                |
|----------------------------|-------------------------|---------|----------------|-----------------------|---------|----------------|-----------------------------|---------|----------------|
|                            | Chris-<br>tians         | Muslims | Niam<br>Khasis | Chris-<br>tians       | Muslims | Niam<br>Khasis | Chris-<br>tians             | Muslims | Niam<br>Khasis |
| 15 - 19                    | 291                     | 202     | 274            | 202                   | 94      | 169            | 0.69                        | 0.46    | 0.62           |
| 20 - 24                    | 289                     | 201     | 270            | 430                   | 314     | 417            | 1.49                        | 1.56    | 1.54           |
| 25 - 29                    | 280                     | 192     | 257            | 466                   | 366     | 459            | 1.66                        | 1.91    | 1.79           |
| 30 - 34                    | 244                     | 165     | 216            | 253                   | 236     | 280            | 1.04                        | 1.43    | 1.30           |
| 35 - 39                    | 191                     | 132     | 165            | 68                    | 56      | 181            | 0.36                        | 0.42    | 0.48           |
| 40 - 44                    | 126                     | 91      | 107            | 16                    | 6       | 13             | 0.13                        | 0.07    | 0.12           |
| 45 +                       | 80                      | 52      | 66             | 1                     | 0       | 0              | 0.01                        | 0       | 0              |
| Total fertility rate (TFR) |                         |         |                |                       |         |                | 5.38                        | 5.85    | 5.85           |

**Table 4.10.** Infant and juvenile mortality rates

| Sex/religious<br>groups | Number of live births | Infant mortality <sup>a</sup> |          | Juvenile mortality <sup>b</sup> |          |
|-------------------------|-----------------------|-------------------------------|----------|---------------------------------|----------|
|                         |                       | Number                        | Per cent | Number                          | Per cent |
| Christians              |                       |                               |          |                                 |          |
| Male                    | 789                   | 61                            | 7.73     | 13                              | 1.65     |
| Female                  | 647                   | 37                            | 5.72     | 12                              | 1.85     |
| Total                   | 1436                  | 98                            | 6.82     | 25                              | 1.74     |
| Muslims                 |                       |                               |          |                                 |          |
| Male                    | 604                   | 53                            | 8.77     | 8                               | 1.32     |
| Female                  | 468                   | 37                            | 7.91     | 10                              | 2.13     |
| Total                   | 1072                  | 90                            | 8.39     | 18                              | 1.68     |
| Niam Khasis             |                       |                               |          |                                 |          |
| Male                    | 722                   | 63                            | 8.73     | 18                              | 2.49     |
| Female                  | 697                   | 59                            | 8.46     | 15                              | 2.15     |
| Total                   | 1419                  | 122                           | 8.60     | 33                              | 2.33     |

<sup>a</sup>Death before 1 year of life<sup>b</sup>Death between 1 and 14 years of life

## Mortality

The frequency of infant and juvenile mortality is given in Table 4.10. It is seen that the infant mortality rates (i.e., number of deaths before 1 year of life per 100 live births) are 6.82%, 8.39% and 8.60% in the Christians, Muslims and Niam Khasis, respectively. Thus the infant mortality rate is lower in the Christians than in the Muslims and Niam Khasis, despite the absence of statistical difference ( $\chi^2 = 3.60$ , DF = 2,  $P > 0.05$ ). With respect to juvenile mortality, the frequency is more or less same in the Christians (1.74%) and Muslims (1.68%), but it is higher in the Niam Khasis (2.33%). However, the Chi-square value indicates that the differences in juvenile mortality rate between the religious groups are not statistically significant ( $\chi^2 = 1.79$ , DF = 2,  $P > 0.05$ ).

**Table 4.11.** Reproductive wastage

| Parameters  | Christians | Muslims | Niam Khasis |
|---|------------|---------|-------------|
| Total number of mothers   | 291        | 202     | 274         |
| Total number of pregnancies                                       | 1552       | 1163    | 1545        |
| Total number of abortions   | 67         | 54      | 71          |
| Total number of still-births                                      | 49         | 37      | 55          |
| Abortion rate (%)   | 4.32       | 4.64    | 4.59        |
| Still-birth rate (%)  | 3.16       | 3.18    | 3.56        |
| Rate of reproductive wastage (%), i.e. abortions and still-births | 7.48       | 7.82    | 8.15        |

## Reproductive Wastage

The prevalence of reproductive wastage for all the religious groups is shown in Table 4.11. It is found that the still birth rates (i.e., number of still-births per 100 pregnancies) are 3.16%, 3.18% and 3.56% in the Christians, Muslims and Niam Khasis respectively, and the abortion rates to these three religious groups (i.e., number of abortions per 100 pregnancies) are 4.32%, 4.64% and 4.59%, respectively. Thus, the rates of reproductive wastage (i.e., number of abortions and still-births per 100 pregnancies) are 7.48%, 7.82% and 8.15% in the Christians, Muslims and Niam Khasis respectively. It appears that the Christians and Muslims are more or less similar in the frequency of reproductive wastage,

and it is slightly higher in the Niam Khasis. However, the Chi-square value indicates that there is no significant difference between the religious groups in respect of reproductive wastage ( $\chi^2 = 0.42$ ,  $DF = 2$ ,  $P > 0.05$ ).

## **SOCIOECONOMIC CORRELATES**

In this section, we shall deal with the relationship between the demographic parameters and socio-economic factors like age of mothers, age at marriage, education of mothers, and income of household for all the three religious groups.

### **Age at Marriage**

The mean number of live births to married women by age at marriage are given in Table 4.12. It is found that the mean number of live births per married woman decreases with the rise in age at marriage. It holds true for the Christians, Muslims and Niam Khasis. Table 4.13 shows the results of the multiple regression analysis on the effect of age at marriage on the number of live births after controlling for other factors like age, educational level, and income. It is found that the coefficient of regression ( $b \pm SE$ ) on the effect of age at marriage (independent variable) on the number of live births (dependent variable) is negatively significant for all the religious groups (Christians:  $b = -0.220 \pm 0.033$ ,  $t = 6.74$ ,  $P < 0.0001$ , Muslims:  $b = -0.218 \pm 0.041$ ,  $t = 5.43$ ,  $P < 0.0001$ , and Niam Khasis:  $b = -0.186 \pm 0.044$ ,  $t = 4.27$ ,  $P < 0.0001$ ). Thus, the present findings indicate that the age at marriage is a very important factor in controlling the fertility rates in the present population, irrespective of religious groups.

**Table 4.12.** *Mean number of live births to married women by age at marriage*

| Age at marriage    | Number of mothers | Live births       |                |
|--------------------|-------------------|-------------------|----------------|
|                    |                   | Mean              | Standard error |
| <b>Christians:</b> |                   |                   |                |
| ≤19 years          | 146               | 6.05              | 0.12           |
| 20-24 years        | 99                | 4.17              | 0.14           |
| ≥25 years          | 46                | 3.02              | 0.15           |
| ANOVA-F statistics |                   | 50.59, P < 0.0000 |                |
| <b>Muslims:</b>    |                   |                   |                |
| ≤19 years          | 61                | 6.49              | 0.35           |
| 20-24 years        | 101               | 5.16              | 0.20           |
| ≥25 years          | 40                | 3.88              | 0.25           |
| ANOVA-F statistics |                   | 17.66, P < 0.001  |                |
| <b>Niam Khasis</b> |                   |                   |                |
| ≤19 years          | 135               | 6.19              | 0.23           |
| 20-24 years        | 104               | 4.43              | 0.16           |
| ≥25 years          | 35                | 3.54              | 0.38           |
| ANOVA-F statistics |                   | 28.85, P < 0.001  |                |

**Table 4.13.** Results of multiple regression analysis of live births on age at marriage after allowing for other factors.

| Source of variation   | d.f. | Sum of squares | Mean squares | F-value | Probability |
|---|------|----------------|--------------|---------|-------------|
| <b>Christians:</b>  |      |                |              |         |             |
| 1. Age, age at marriage, education and income   | 4    | 678.997        | 169.749      | 54.26   | 0.0000      |
| 2. Age, income and education  | 3    | 536.710        | 178.903      | 49.51   | 0.0000      |
| 3. Age at marriage after age, income and education  | 1    | 142.287        | 142.287      | 45.47   | 0.0000      |
| 4. Residual   | 286  | 894.763        | 3.129        |         |             |
| Coefficient of regression ( $b \pm SE$ ) = $-0.220 \pm 0.033$ , $t = 6.74$ , $P < 0.0001$ |      |                |              |         |             |
| <b>Muslims:</b>   |      |                |              |         |             |
| 1. Age, age at marriage, education and income   | 4    | 433.572        | 108.393      | 30.97   | 0.0000      |
| 2. Age, income and education  | 3    | 330.375        | 110.125      | 27.51   | 0.0000      |
| 3. Age at marriage after age, income and education  | 1    | 103.197        | 103.197      | 29.49   | 0.0000      |
| 4. Residual   | 197  | 689.398        | 3.499        |         |             |
| Coefficient of regression ( $b \pm SE$ ) = $-0.218 \pm 0.041$ , $t = 5.43$ , $P < 0.0001$ |      |                |              |         |             |
| <b>Niam Khasis:</b>   |      |                |              |         |             |
| 1. Age, age at marriage, education and income   | 4    | 716.231        | 179.058      | 50.71   | 0.0000      |
| 2. Age, income and education  | 3    | 651.792        | 217.264      | 57.83   | 0.0000      |
| 3. Age at marriage after age, income and education  | 1    | 64.439         | 64.439       | 18.25   | 0.001       |
| 4. Residual   | 269  | 950.006        | 3.532        |         |             |
| Coefficient of regression ( $b \pm SE$ ) = $-0.186 \pm 0.044$ , $t = 4.27$ , $P < 0.0001$ |      |                |              |         |             |

## Educational Level

The mean number of live births per married woman according to educational levels is summarized in Table 4.14. Among the Niam Khasis, the mean number of live births tends to decrease significantly with the increasing level of education of the mothers, ranging from  $6.82 \pm 0.31$  for the illiterates to  $3.89 \pm 0.26$  for the mothers with higher level of education. In the case of Christians, the mean number of live births varies from  $5.56 \pm 0.36$  for the illiterates to  $4.04 \pm 0.17$  for the mothers with higher level of education, whereas in the case of Muslims it varies between  $5.73 \pm 0.32$  to  $4.58 \pm 0.28$  for the mothers with illiteracy and higher level of education, respectively. These differences in live births between educational groups of mothers are statistically significant for all the religious groups (Table 4.14).

Table 4.15 shows the results of the multiple regression analysis on the effect of educational level on the number of live births after controlling for other factors like age, age at marriage, and income. It is found that the coefficient of regression ( $b \pm SE$ ) on the effect of education on the number of live births is negative but not significant in the Christians ( $b = -0.136 \pm 0.098$ ,  $t = 1.39$ ,  $P > 0.05$ ) and Muslims ( $-0.002 \pm 0.124$ ,  $t = 0.02$ ,  $P > 0.05$ ), although it is negatively significant in the Niam Khasis ( $-0.448 \pm 0.127$ ,  $t = 3.52$ ,  $P < 0.0001$ ). Thus, the present findings indicate that the education is not as important as expected in controlling the fertility rates among the Muslim and Christian Khasis, but it is certainly important in the Niam Khasi.

**Table 4.14.** Mean number of live births and surviving children to married women by educational level

| Educational level  | Number of mothers | Live births       |                |
|--------------------|-------------------|-------------------|----------------|
|                    |                   | Mean              | Standard error |
| <i>Christians</i>  |                   |                   |                |
| Illiterate         | 62                | 5.56              | 0.36           |
| Primary            | 64                | 5.61              | 0.29           |
| Secondary          | 66                | 5.03              | 0.29           |
| Higher             | 99                | 4.04              | 0.17           |
| ANOVA-F statistics |                   | 8.87, P < 0.0001  |                |
| <i>Muslims</i>     |                   |                   |                |
| Illiterate         | 59                | 5.73              | 0.32           |
| Primary            | 48                | 5.85              | 0.41           |
| Secondary          | 52                | 4.94              | 0.28           |
| Higher             | 43                | 4.58              | 0.28           |
| ANOVA-F statistics |                   | 3.35, P < 0.02    |                |
| <i>Niam Khasis</i> |                   |                   |                |
| Illiterate         | 68                | 6.82              | 0.31           |
| Primary            | 74                | 5.35              | 0.26           |
| Secondary          | 69                | 4.57              | 0.25           |
| Higher             | 63                | 3.89              | 0.26           |
| ANOVA-F statistics |                   | 21.16, P < 0.0001 |                |

**Table 4.15.** Results of multiple regression analysis of live births on education after allowing for other factors.

| Source of variation   | DF  | Sum of squares | Mean squares | F-value | Probability |
|---|-----|----------------|--------------|---------|-------------|
| <b>Christians:</b>  |     |                |              |         |             |
| 1. Age, age at marriage, education and income   | 4   | 678.997        | 169.749      | 54.26   | 0.0000      |
| 4. Age, age at marriage and income  | 3   | 672.961        | 224.321      | 71.47   | 0.0000      |
| 5. Education after age, age at marriage and income  | 1   | 6.036          | 6.036        | 1.93    | NS          |
| 4. Residual   | 286 | 894.763        | 3.129        |         |             |
| Coefficient of regression ( $b \pm SE$ ) = $-0.136 \pm 0.098$ , $t = 1.39$ , $P > 0.05$   |     |                |              |         |             |
| <b>Muslims:</b>   |     |                |              |         |             |
| 1. Age, age at marriage, education and income   | 4   | 433.572        | 108.393      | 30.97   | 0.0000      |
| 2. Age, age at marriage and income  | 3   | 433.570        | 144.524      | 41.51   | 0.0000      |
| 3. Education after age, age at marriage and income  | 1   | 0.002          | 0.002        | 0.00    | NS          |
| 4. Residual   | 197 | 689.398        | 3.499        |         |             |
| Coefficient of regression ( $b \pm SE$ ) = $-0.002 \pm 0.124$ , $t = 0.02$ , $P > 0.05$   |     |                |              |         |             |
| <b>Niam Khasis:</b>   |     |                |              |         |             |
| 1. Age, age at marriage, education and income   | 4   | 716.231        | 179.058      | 50.71   | 0.0000      |
| 2. Age, age at marriage and income  | 3   | 672.488        | 224.163      | 60.90   | 0.0000      |
| 3. Education after age, age at marriage and income  | 1   | 43.743         | 43.743       | 12.39   | 0.001       |
| 4. Residual   | 269 | 950.006        | 3.532        |         |             |
| Coefficient of regression ( $b \pm SE$ ) = $-0.448 \pm 0.127$ , $t = 3.52$ , $P < 0.0001$ |     |                |              |         |             |

NS = Not significant

**Table 4.16.** Mean number of live births to married women by income group

| Income group       | Number of mothers | Live births        |                |
|--------------------|-------------------|--------------------|----------------|
|                    |                   | Mean               | Standard error |
| <b>Christians:</b> |                   |                    |                |
| LIG                | 86                | 6.27               | 0.25           |
| MIG                | 118               | 5.03               | 0.21           |
| HIG                | 86                | 3.47               | 0.16           |
| ANOVA-F statistics |                   | 39.64, P < 0.00001 |                |
| <b>Muslims:</b>    |                   |                    |                |
| LIG                | 81                | 6.40               | 0.29           |
| MIG                | 83                | 4.82               | 0.22           |
| HIG                | 38                | 4.05               | 0.22           |
| ANOVA-F statistics |                   | 18.42, P < 0.0001  |                |
| <b>Niam Khasis</b> |                   |                    |                |
| LIG                | 101               | 6.41               | 0.26           |
| MIG                | 121               | 4.73               | 0.19           |
| HIG                | 52                | 3.85               | 0.29           |
| ANOVA-F statistics |                   | 39.63, P < 0.0001  |                |

**Table 4.17.** Results of multiple regression analysis of live births on income level after allowing for other factors.

| Source of variation   | DF  | Sum of squares | Mean squares | F-value | Probability |
|---|-----|----------------|--------------|---------|-------------|
| <b>Christians:</b>  |     |                |              |         |             |
| 1. Age, age at marriage, education and income                             | 4   | 678.997        | 169.749      | 54.26   | 0.0000      |
| 2. Age, age at marriage and education                                     | 3   | 583.797        | 194.599      | 56.42   | 0.0000      |
| 3. Income after age, age at marriage and education                        | 1   | 95.200         | 95.200       | 30.43   | 0.0000      |
| 4. Residual   | 286 | 894.763        | 3.129        |         |             |
| Coefficient of regression (b ± SE) = -0.832 ± 0.151, t = 5.52, P < 0.0001 |     |                |              |         |             |
| <b>Muslims:</b>   |     |                |              |         |             |
| 1. Age, age at marriage, education and income                             | 4   | 433.572        | 108.393      | 30.97   | 0.0000      |
| 2. Age, age at marriage and education                                     | 3   | 379.902        | 126.634      | 33.74   | 0.0000      |
| 3. Income after age, age at marriage and education                        | 1   | 53.67          | 53.67        | 15.34   | 0.001       |
| 4. Residual   | 197 | 689.398        | 3.499        |         |             |
| Coefficient of regression (b ± SE) = -0.739 ± 0.189, t = 3.92, P < 0.001  |     |                |              |         |             |
| <b>Niam Khasis:</b>   |     |                |              |         |             |
| 1. Age, age at marriage, education and income                             | 4   | 716.231        | 179.058      | 50.71   | 0.0000      |
| 4. Age, age at marriage and education                                     | 3   | 583.899        | 194.633      | 48.55   | 0.0000      |
| 5. Income after age, age at marriage and education                        | 1   | 132            | 132.332      | 37.47   | 0.0000      |
| 4. Residual   | 269 | 950.006        | 3.532        |         |             |
| Coefficient of regression (b ± SE) = -0.987 ± 0.161, t = 6.12, P < 0.0001 |     |                |              |         |             |

**Income Level**

The mean live births per married woman according to income levels are given in Table 4.16. It is seen that the mean number of live births tends to decrease significantly with the increasing level of the income of household for all the religious groups. Among the Christians, the mean number of live births per mother varies from  $6.27 \pm 0.25$  for the LIG to  $3.47 \pm 0.16$  for HIG, while in the case of Muslims it varies from  $6.40 \pm 0.29$  to  $4.05 \pm 0.22$  in the LIG and MIG respectively. Among the Niam Khasis, on the other hand, it varies between  $6.41 \pm 0.26$  and  $3.85 \pm 0.29$  for the mothers belonging to the LIG and HIG, respectively. These differences in live births between income groups of households are found to be statistically significant for all the religious groups (Table 4.16).

Table 4.17 shows the results of the multiple regression analysis on the effect of income level on the number of live births after controlling for other factors like age, age at marriage, and educational level. It is found that the coefficient of regression on the effect of income on the number of live births is negatively significant for all the religious groups (Christians:  $b = -0.832 \pm 0.151$ ,  $t = 5.52$ ,  $P < 0.0001$ , Muslims:  $b = -0.739 \pm 0.189$ ,  $t = 3.92$ ,  $P < 0.001$ , and Niam Khasis:  $b = -0.987 \pm 0.161$ ,  $t = 6.12$ ,  $P < 0.0001$ ). Thus, the present findings indicate that income of the household is a very important factor in controlling the fertility rates in the present population, irrespective of religious groups.

In view of all the socio-economic factors, it is observed that the fertility rate in the present population is negatively associated with the age at marriage and income levels of mothers. The effect of education, on the other hand, is not clearly perceptible in the present study, except among the Niam Khasi mothers, which indicates that educational level of the mothers is also very important in regulating the fertility rate. The effect of religion on fertility rate is also perceptible. It is observed that the total fertility rate is more or less same among the Muslims and Niam Khasis, but it is lower in the Christians.

### **Infant Mortality and Socio-economic conditions**

Table 4.18 shows the summary of logistic regression analysis on the effects of maternal age, education, religion and income on infant mortality. It is found that the regression coefficient ( $\beta \pm$  standard error) of infant mortality (dependent variable) on maternal age was positively significant ( $0.021 \pm 0.008$ ,  $P < 0.011$ ), and it was negatively significant with respect to educational level ( $-0.150 \pm 0.074$ ,  $P < 0.043$ ) and income level ( $-1.283 \pm 0.125$ ,  $P < 0.000$ ). As has been shown in Table 4.18, the effect of religion on infant mortality is not statistically significant ( $0.051 \pm 0.101$ ,  $P > 0.05$ ). Thus, it indicates that maternal age, education and income are very important in influencing infant mortality in the present population. It is obvious that infant mortality rate increases with the increasing age of the mothers. This may be due to the fact that mothers of higher age groups have higher fertility rate, which is theoretically correlated with higher infant mortality rate. The inverse relationship between infant mortality and educational as well as income level is according to the general observation in other populations, which

indicate that mothers belonging to the higher educational and income levels are more conscious of the health of their children, and they have more access to modern medical aids, etc.

**Table 4.18.** Summary of logistic regression analysis on the effects of maternal age, education, religion and income on infant mortality

| Parameters  | Coefficient ( $\beta$ ) | Standard error | Wald test | Probability level |
|---|-------------------------|----------------|-----------|-------------------|
| Age (in absolute number of maternal age)                                    | 0.021                   | 0.008          | 6.402     | 0.011             |
| Educational level (Illiterate=0, Primary =1, Secondary=2, Higher level = 3) | -0.150                  | 0.074          | 4.109     | 0.043             |
| Income level (LIG = 1, MIG = 2, HIG = 3)                                    | -1.283                  | 0.125          | 106.000   | 0.000             |
| Religion (Muslims =1, Christians =2, Niam Khasis = 3)                       | 0.051                   | 0.101          | 0.254     | 0.614             |
| Constant  | 1.167                   | 0.505          | 5.345     | 0.021             |

Deviance (likelihood ratio) = 172.394, DF = 4, P < 0.000.

## CHAPTER V

### GROWTH PATTERN

In this chapter, we shall describe the growth pattern of the Khasi both boys and girls taking into consideration the body weight, height, sitting height, biacromial diameter, bi-iliac diameter, head circumference, arm circumference and chest circumference.

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#### Weight

Table 5.1 shows the mean and standard deviation of the body weight for both boys and girls. The mean values are plotted against age in Figure 5.1. The distance curve shows that there is a gradual increase in average weight for both boys and girls from 3 years onwards, although there is a decrease in weight for ~~girls~~ from 17 to 18 years of age. It is further observed that the girls are slightly heavier than boys at 3, 6, 7 and 10 years of age. Both boys and girls are more or less same in weight at the age of 11, but girls are significantly heavier than boys at 12 years of age ( $t = 3.80$ ,  $P < 0.000$ ), and thereafter the latter are heavier than the former. This may be associated with the adolescent growth spurt in girls at 12 years of age. In fact, the t-test indicates that the boys are significantly heavier than the girls from 12 to 13 and 17 to 18 years, while the girls are significantly taller than the boys from 11 to 12 years of age (Table 5.1).

The annual increment or growth rate in weight is plotted against age in Figure 5.2. It is seen that the velocity is higher in boys than in girls in many age groups, although it is higher in girls from 5 to 6, 9 to 10, 11 to 12, 13 to 14 and 15 to 16 years. The maximum gain (4.19 kg) in girls occurs at 14 years of age, though the distance curve shows that they are lighter than boys at that age. In the case of boys, the maximum velocity of 5.14 kg takes place at 13 years, which may be associated with their adolescent growth spurt. From 17 to 18 years of age, there is a decline to below zero in weight for girls, while the annual increment in boys is about 1.25 kg.

**Table 5.1.** Statistical constants of weight (kg) for boys and girls

| Age (yrs) | Boys  |      |           | Girls |      |           | t-value |
|-----------|-------|------|-----------|-------|------|-----------|---------|
|           | Mean  | SD   | Increment | Mean  | SD   | Increment |         |
| 3         | 11.93 | 1.81 | -         | 12.13 | 1.87 | -         | 0.73    |
| 4         | 13.95 | 2.07 | 2.02      | 13.88 | 2.04 | 1.75      | 0.22    |
| 5         | 16.13 | 1.85 | 2.18      | 15.70 | 1.84 | 1.82      | 1.53    |
| 6         | 17.10 | 2.17 | 0.97      | 17.74 | 2.41 | 2.04      | 1.86    |
| 7         | 18.11 | 2.25 | 1.01      | 18.69 | 2.36 | 0.86      | 1.69    |
| 8         | 20.65 | 2.78 | 2.54      | 20.41 | 2.46 | 1.72      | 0.59    |
| 9         | 23.04 | 2.85 | 2.39      | 22.68 | 3.23 | 2.27      | 0.79    |
| 10        | 24.59 | 2.47 | 1.55      | 24.72 | 3.57 | 2.04      | 0.24    |
| 11        | 26.98 | 3.71 | 2.39      | 26.99 | 2.96 | 2.27      | 0.02    |
| 12        | 28.86 | 3.24 | 1.88      | 30.87 | 3.65 | 3.88      | 3.80**  |
| 13        | 34.00 | 3.10 | 5.14      | 33.08 | 2.63 | 2.21      | 2.11*   |
| 14        | 37.30 | 3.99 | 3.30      | 37.27 | 5.08 | 4.19      | 0.04    |
| 15        | 41.67 | 4.33 | 4.37      | 41.12 | 3.97 | 3.85      | 0.87    |
| 16        | 43.29 | 4.68 | 1.62      | 43.17 | 3.85 | 2.05      | 0.26    |
| 17        | 47.63 | 3.66 | 4.34      | 44.67 | 4.34 | 1.30      | 4.78**  |
| 18        | 48.88 | 4.05 | 1.25      | 44.38 | 5.06 | -0.09     | 6.14**  |

\*P &lt; 0.05, \*\*P &lt; 0.000

**Height**

Table 5.2 shows the statistical constants for the height of both boys and girls. The smooth curve (Fig. 5.1A and 5.1B) in the figure indicates the fitting of the present data according to fourth degree polynomial model by which the height is equal to  $64.19 + 8.59(\text{Age}) - 0.47(\text{Age})^2 + 0.03(\text{Age})^3 - 5.46(\text{Age})^4$  cm for boys and to  $65.53 + 7.79(\text{Age}) - 0.43(\text{Age})^2 + 0.04(\text{Age})^3 - 0.001(\text{Age})^4$  cm for girls. The estimated values for adult height is found to be 154.20 cm for males and 146.83 cm for females. This indicates that the girls have reached their adult height by the age of 18, while the boys still continue to grow. The present observation seems to confirm that observed among the girls of Assamese Muslims in Assam, though it is not so in the case of boys (Begum and Choudhury, 1999).

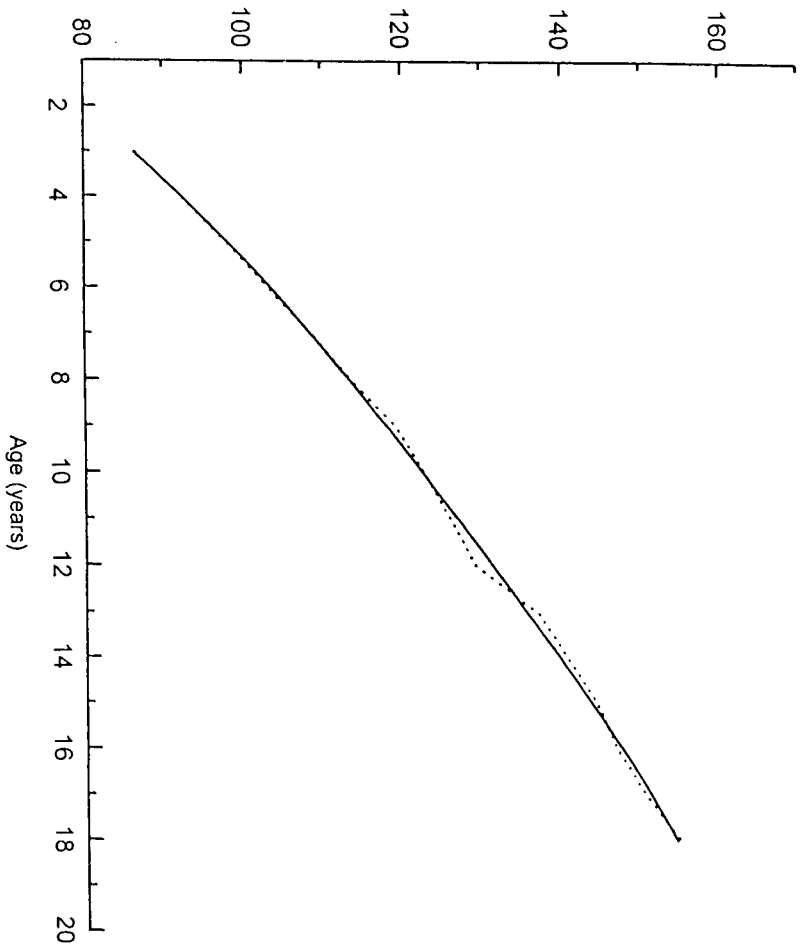


Figure 5.1A. Distance curve for height of boys (smooth curve is 4th degree polynomial model)

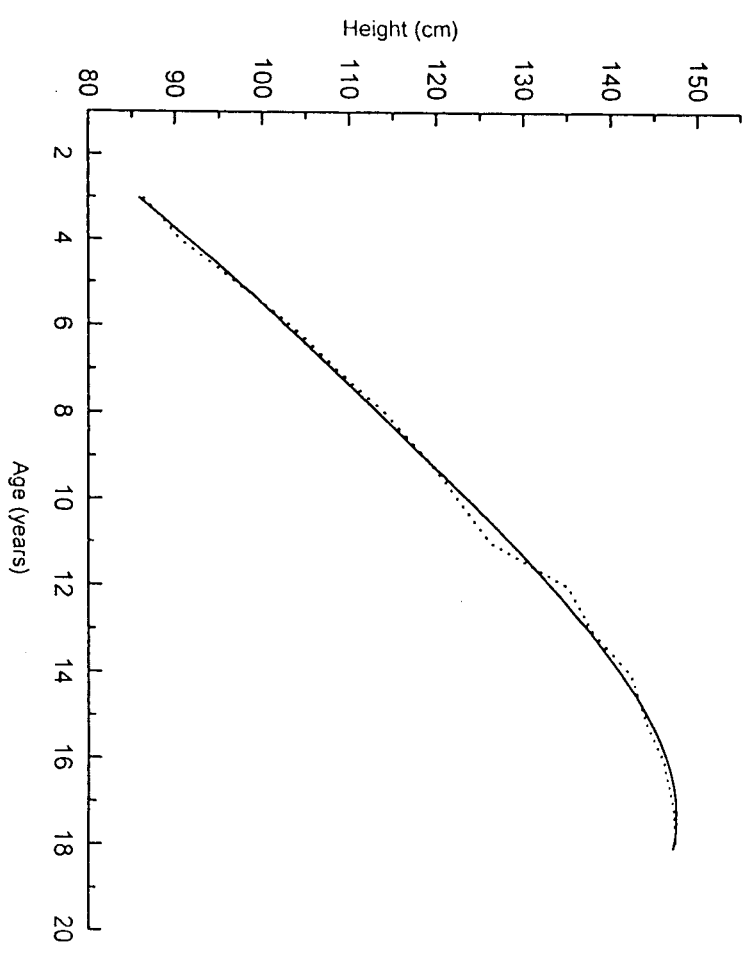


Figure 5.1B. Distance curve for height to girls (smooth curve is 4th degree polynomial model)

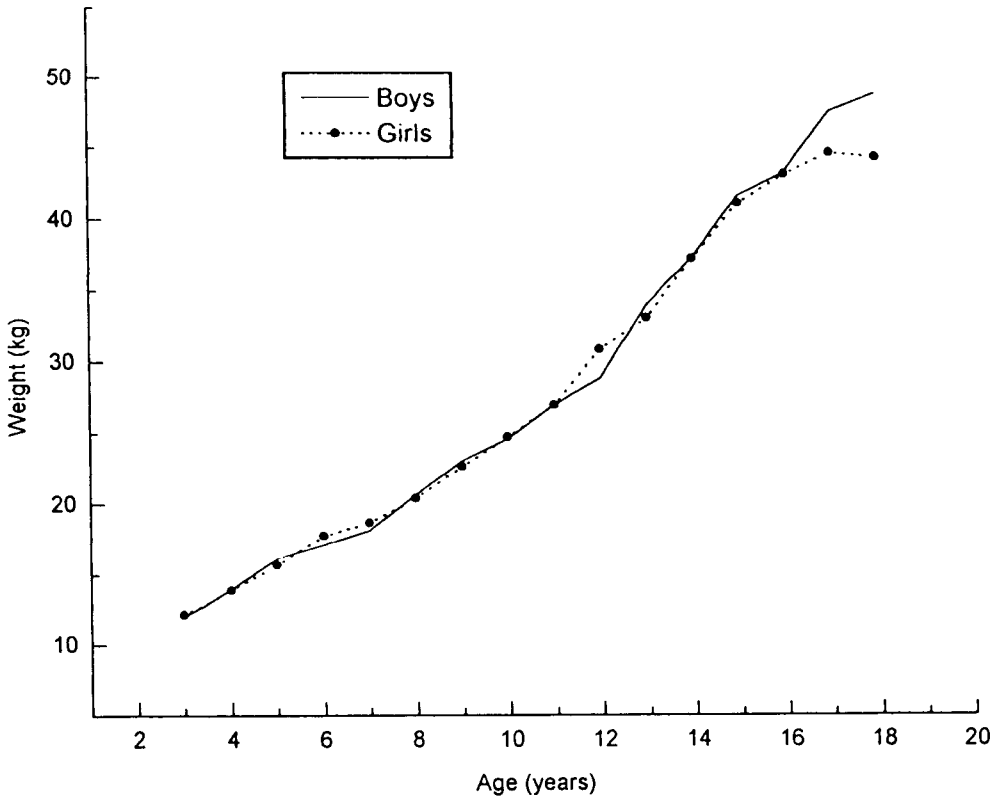


Fig.5.1. Distance curve for weight of boys and girls

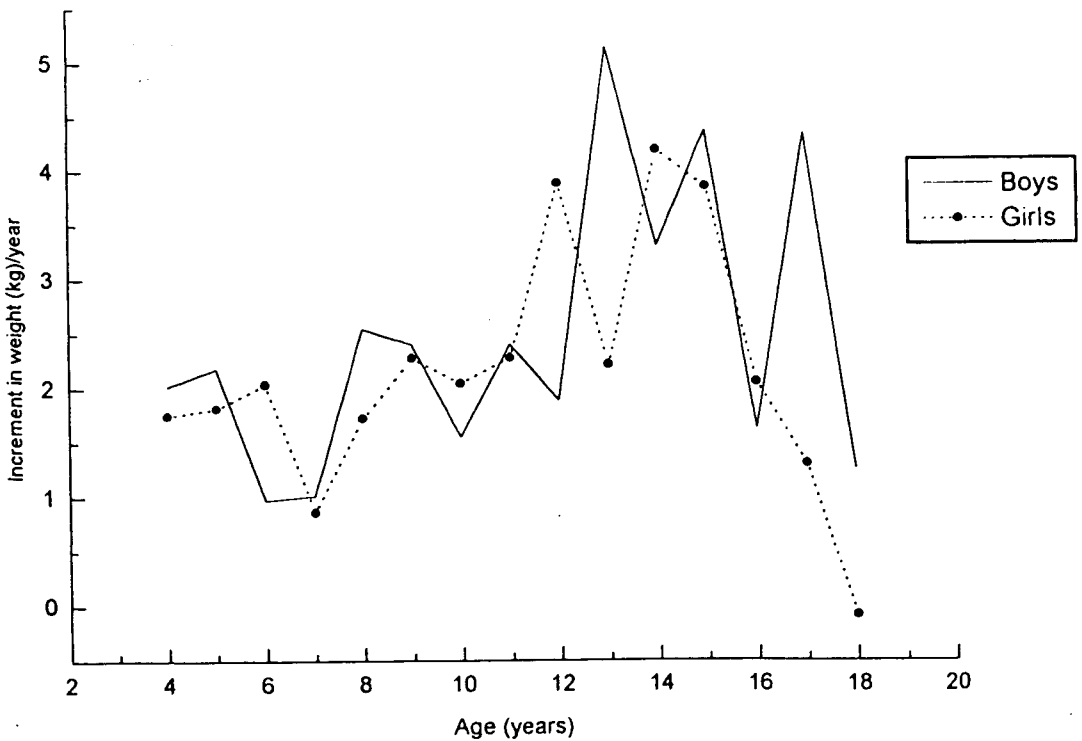


Fig.5.2. Velocity curve for weight of boys and girls

The distance curve (Figure 5.3) shows that boys are taller than girls at ages 3 to 5, 8 to 9 and 15 years onwards, whereas the latter are taller than the former from 12 to 14 years. From 6 to 7 and 10 to 11 years of age, the distance curve shows a similar pattern for both boys and girls. The differences between boys and girls in height are found to be statistically significant at the age of 4, 12, 14, 17 and 18 years. It is seen that the boys are significantly taller than the girls at about 4, 17 and 18 years of age, while the girls are taller than the boys at about 12 and 14 years of age (Table 5.2).

The velocity curve (figure 5.4), which indicates the growth rate per year, shows that both the sexes gained their height from 3 to 18 years in a moderate and continuous manner. It is observed that the velocity rate is higher in boys than in girls in many age groups, although it is higher in the latter than in the former at 5, 6, 8, 12, and 14 years of age. On the other hand, the growth rate is more or less similar for both boys and girls at 9, 10 and 11 years of age. It is found that the maximum increase in height occurs between 12 and 13 years for boys (7.72 cm) and 11 and 12 years for girls (8.85 cm). Thus, like in the case of weight, it indicates that the adolescent growth spurt occurs earlier in girls (12 years) than in boys (13 years).

**Table 5.2.** Statistical constants of height (cm) for boys and girls

| Age (yrs) | Boys   |      |           | Girls  |      |           | t-value |
|-----------|--------|------|-----------|--------|------|-----------|---------|
|           | Mean   | SD   | Increment | Mean   | SD   | Increment |         |
| 3         | 86.50  | 5.33 | -         | 86.41  | 4.70 | -         | 0.12    |
| 4         | 92.47  | 5.07 | 5.97      | 90.97  | 5.53 | 4.35      | 2.11*   |
| 5         | 98.07  | 6.28 | 5.60      | 97.08  | 5.78 | 6.32      | 1.08    |
| 6         | 103.21 | 7.37 | 5.14      | 103.43 | 6.21 | 6.35      | 0.21    |
| 7         | 108.69 | 6.38 | 5.48      | 108.65 | 6.96 | 5.22      | 0.04    |
| 8         | 113.61 | 7.35 | 4.92      | 114.19 | 5.94 | 5.54      | 0.56    |
| 9         | 119.20 | 6.46 | 5.59      | 118.87 | 6.91 | 4.68      | 0.33    |
| 10        | 122.76 | 7.22 | 3.56      | 122.63 | 7.00 | 3.76      | 0.12    |
| 11        | 126.13 | 6.34 | 3.37      | 126.24 | 5.95 | 3.61      | 0.12    |
| 12        | 129.22 | 6.36 | 3.09      | 135.09 | 4.41 | 8.85      | 6.99**  |
| 13        | 136.94 | 5.09 | 7.72      | 137.80 | 4.79 | 2.71      | 1.14    |
| 14        | 140.64 | 5.64 | 3.70      | 142.22 | 4.22 | 4.42      | 2.08*   |
| 15        | 144.25 | 6.54 | 3.61      | 143.72 | 3.55 | 1.50      | 0.67    |
| 16        | 146.78 | 6.43 | 2.53      | 145.84 | 3.33 | 2.12      | 1.19    |
| 17        | 150.27 | 5.74 | 3.49      | 146.89 | 4.04 | 1.05      | 4.16**  |
| 18        | 154.65 | 5.98 | 4.38      | 147.20 | 3.57 | 0.31      | 9.65**  |

\*P < 0.05; \*\*P < 0.000

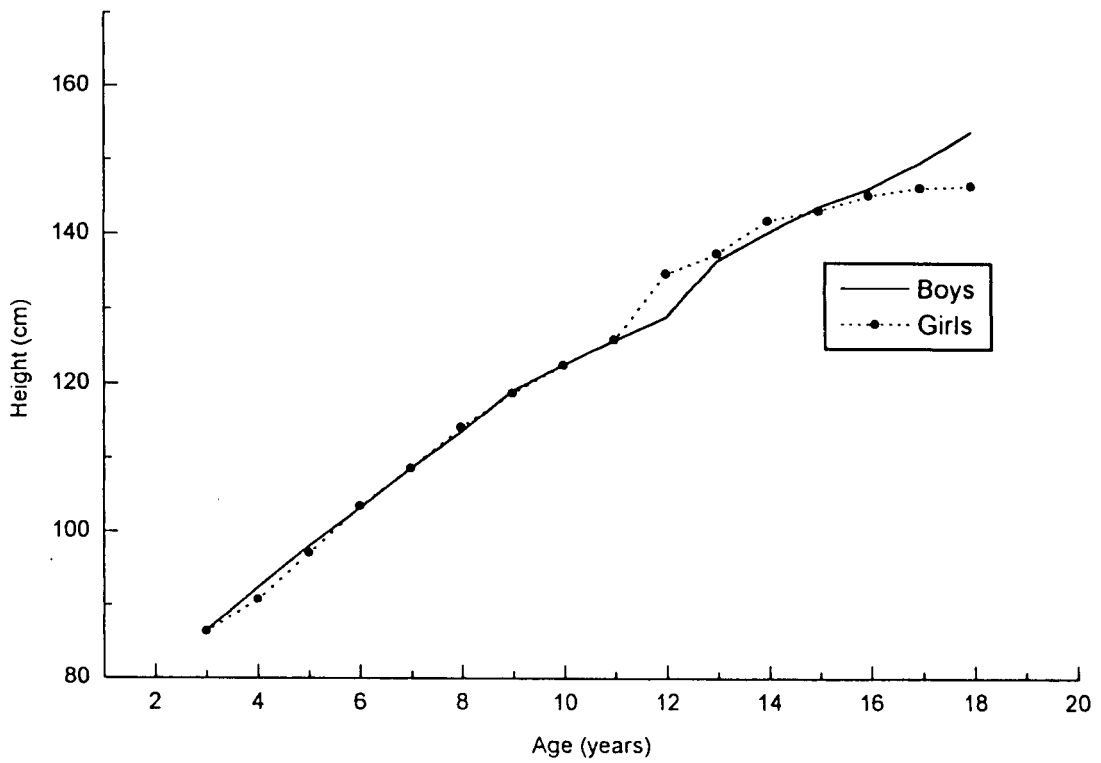


Fig. 5.3. Distance curve for height of boys and girls

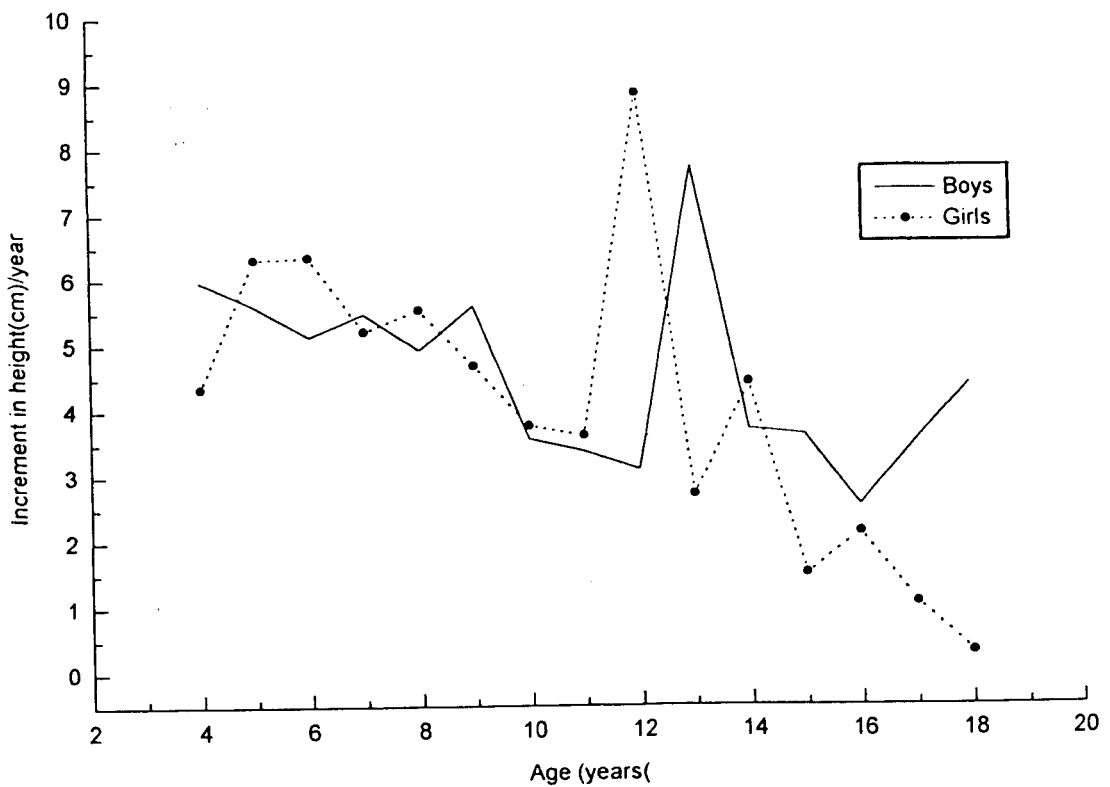


Fig.5.4. Velocity curve for height of boys and girls

### **Sitting Height**

The statistical constants for sitting height of both boys and girls are given in Table 5.3. The distance curve (Figure 5.5) shows that both boys and girls have a similar growth pattern at 6, 10, 13 and 16 years of age, but the sitting height is higher in girls for many age groups, and it is statistically significant at 3, 5, 7 and 12 years of age. The higher mean value of sitting height in boys is perceptible at 4, 8 and 17 to 18 years, but it is significant only at age 18.

The velocity curve (Figure 5.6) shows that both the sexes gained their sitting height continuously from 3 to 18 years of age. It is observed that the velocity rate is higher in boys than in girls in many age groups, although it is higher in the latter than in the former at 5, 7, 9, 12, and 14 years of age. On the other hand, the growth rate is more or less similar for both boys and girls at 10, 11 and 16 years of age. It is found that the maximum increase in sitting height occurs between 12 and 13 years for boys (4.40 cm) and between 11 and 12 years for girls (4.57 cm). Thus, like in the case of weight and height, it indicates that the adolescent growth spurt occurs at about 12 and 13 years in girls and boys, respectively.

### **Biacromial Diameter**

The means and standard deviations of biacromial diameter are presented in Table 5.4. The mean values are plotted against age as shown in Figure 5.7. It indicates that there is a gradual increase in biacromial diameter as age advances. It is true for both boys and girls. However, the distance curve shows that both boys and girls have a similar growth pattern from 7 to 15 years of age, although the girls are significantly broader in shoulder at about 12 years of age, which is associated with their adolescent growth spurt. On the other hand, the boys have a broader shoulder from 3 to 6 and 16 years onwards, although the difference is statistically significant only at the age of 18.

**Table 5.3.** Statistical constants of sitting height (cm) for boys and girls

| Age<br>(yrs) | Boys  |      |           | Girls |      |           | t-value |
|--------------|-------|------|-----------|-------|------|-----------|---------|
|              | Mean  | SD   | Increment | Mean  | SD   | Increment |         |
| 3            | 45.76 | 3.92 | -         | 46.83 | 3.04 | -         | 2.06*   |
| 4            | 49.01 | 4.29 | 3.25      | 48.81 | 4.14 | 1.18      | 0.28    |
| 5            | 51.28 | 4.95 | 2.27      | 52.79 | 4.28 | 3.98      | 2.15*   |
| 6            | 54.97 | 5.82 | 3.69      | 54.58 | 5.26 | 1.79      | 0.47    |
| 7            | 55.51 | 4.49 | 0.54      | 56.91 | 4.32 | 2.33      | 2.13*   |
| 8            | 59.14 | 4.41 | 3.63      | 58.90 | 5.02 | 1.99      | 0.33    |
| 9            | 61.76 | 5.09 | 2.62      | 62.08 | 4.01 | 3.18      | 0.46    |
| 10           | 63.31 | 4.35 | 1.55      | 63.81 | 4.91 | 1.73      | 0.70    |
| 11           | 64.64 | 5.18 | 1.33      | 65.49 | 4.67 | 1.68      | 1.10    |
| 12           | 66.81 | 4.77 | 2.17      | 70.06 | 4.41 | 4.57      | 4.61**  |
| 13           | 71.21 | 4.22 | 4.40      | 71.21 | 4.79 | 1.15      | 0.00    |
| 14           | 73.37 | 3.87 | 2.16      | 74.22 | 4.22 | 3.01      | 1.38    |
| 15           | 76.13 | 4.42 | 2.76      | 76.34 | 3.55 | 2.12      | 0.35    |
| 16           | 77.12 | 3.96 | 0.99      | 77.18 | 3.33 | 0.84      | 0.11    |
| 17           | 79.31 | 3.74 | 2.19      | 78.36 | 4.04 | 1.18      | 1.48    |
| 18           | 80.53 | 3.93 | 1.22      | 78.62 | 3.57 | 0.26      | 3.13**  |

\*P < 0.05; \*\*P < 0.001

The velocity curve (Figure 5.8) for biacromial diameter shows that the growth rate is higher in boys than in girls at 10, 11, 13, and 17 years onwards, and it is higher in the latter than in the former at 5, 6, 7, 9 and 12 years of age. In boys, the maximum gain of 1.93 cm occurs from 12 to 13 years of age, whereas in girls the maximum acceleration rate of 2.27 cm takes place from about 11 to 12 years of age. Thus, like in the case of other measurements, the girls show their adolescent spurt at about 12 years of age, and the boys at about the age of 13. The pre-adolescent spurt is also observed at age 10 in boys, and 9 years in girls during which the growth rates are 1.17 and 1.35 cm, respectively.

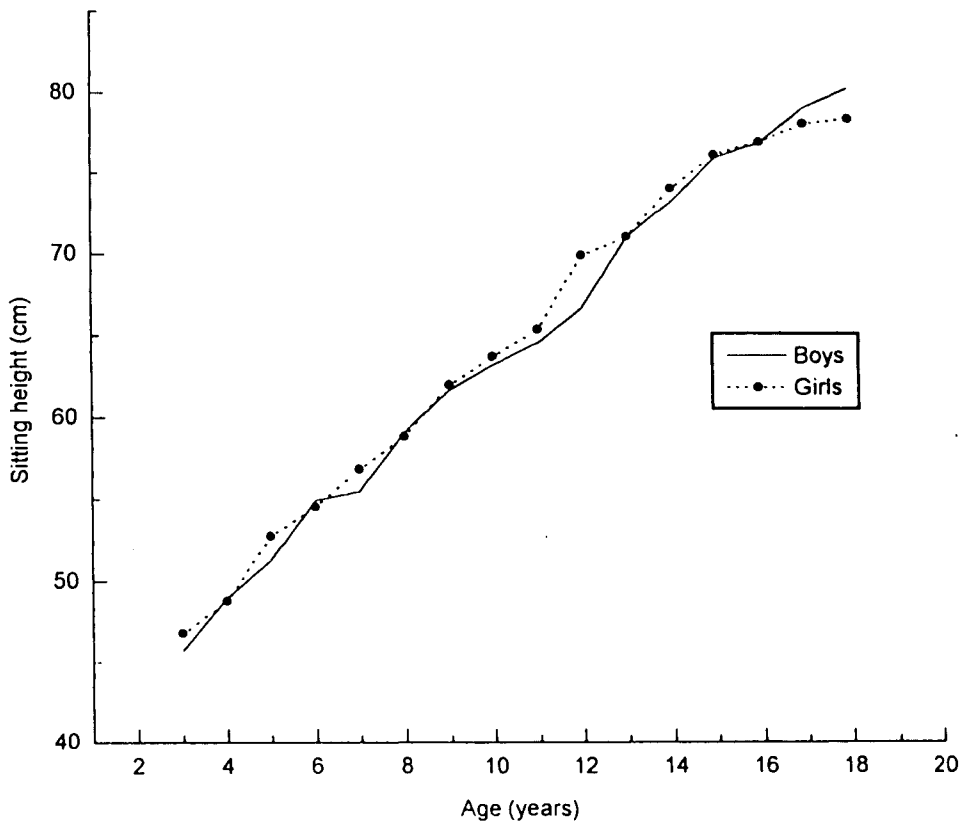


Fig.5.5. Distance curve for sitting height of boys and girls

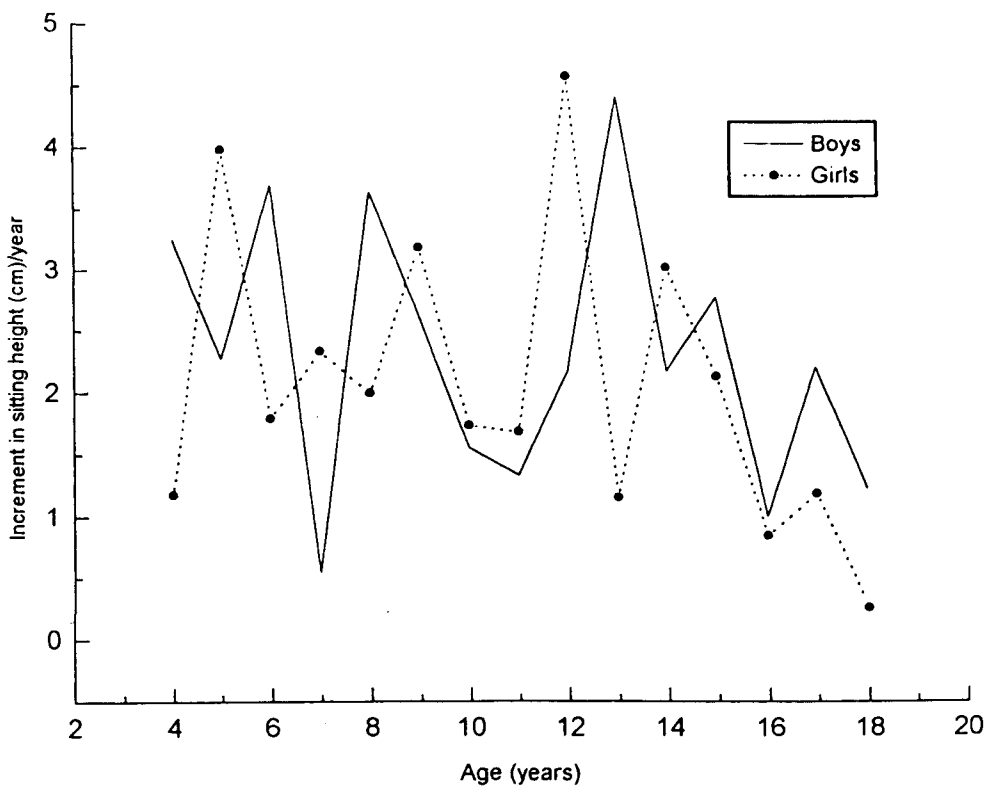


Fig.5.6. Velocity curve for sitting height of boys and girls

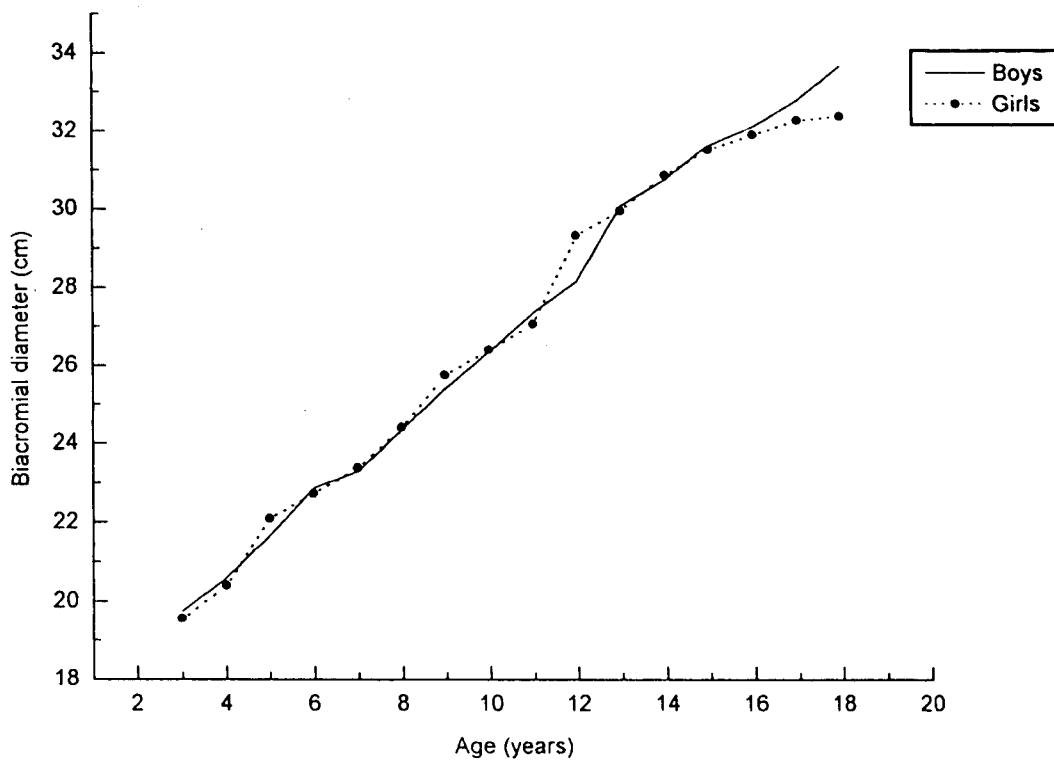


Fig.5.7. Distance curve for biacromial diameter of boys and girls

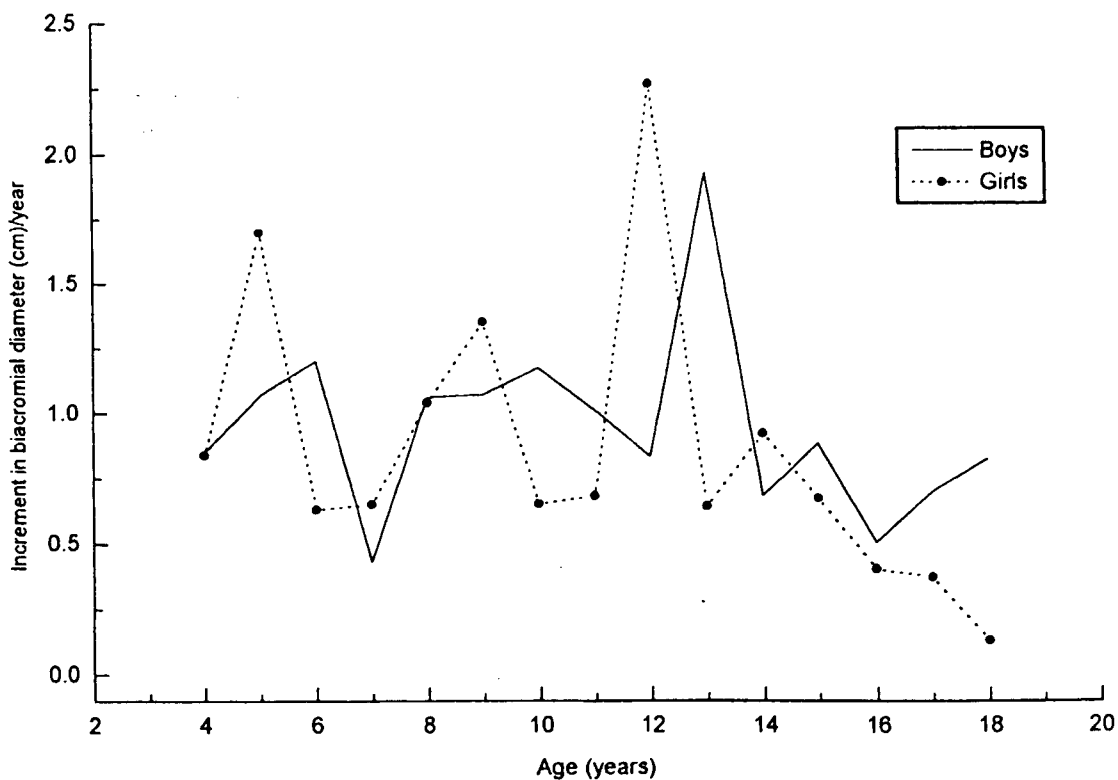


Fig.5.8. Velocity curve for biacromial diameter of boys and girls

In view of the present data on biacromial diameter, it can be concluded that both boys and girls show a similar growth pattern, except during the adolescent period. Like in the case of other measurements, the mean values and growth rates are higher in girls than in boys from 11 to 12 years of age. However, the boys do not show much higher mean values of measurements, although they show a higher growth rate during their adolescent period (i.e., at about 13 years).

**Table 5.4** Statistical constants of biacromial diameter (cm) for boys and girls

| Age (yrs) | Boys  |      |           | Girls |      |           | t-value |
|-----------|-------|------|-----------|-------|------|-----------|---------|
|           | Mean  | SD   | Increment | Mean  | SD   | Increment |         |
| 3         | 19.74 | 1.20 | -         | 19.56 | 1.29 | -         | 0.97    |
| 4         | 20.59 | 1.58 | 0.85      | 20.40 | 1.81 | 0.84      | 0.73    |
| 5         | 21.66 | 1.56 | 1.07      | 22.10 | 1.52 | 1.70      | 1.88    |
| 6         | 22.86 | 1.46 | 1.20      | 22.73 | 1.94 | 0.63      | 0.50    |
| 7         | 23.29 | 1.50 | 0.43      | 23.38 | 1.81 | 0.65      | 0.36    |
| 8         | 24.35 | 1.70 | 1.06      | 24.42 | 1.86 | 1.04      | 0.25    |
| 9         | 25.42 | 1.81 | 1.07      | 25.77 | 1.70 | 1.35      | 1.33    |
| 10        | 26.37 | 2.42 | 1.17      | 26.42 | 2.16 | 0.65      | 0.14    |
| 11        | 27.38 | 2.46 | 1.01      | 27.10 | 1.96 | 0.68      | 0.81    |
| 12        | 28.20 | 1.76 | 0.83      | 29.37 | 2.05 | 2.27      | 3.96*   |
| 13        | 30.14 | 1.93 | 1.93      | 30.01 | 1.83 | 0.64      | 0.45    |
| 14        | 30.82 | 1.56 | 0.68      | 30.93 | 1.91 | 0.92      | 0.41    |
| 15        | 31.70 | 1.73 | 0.88      | 31.60 | 1.39 | 0.67      | 0.42    |
| 16        | 32.20 | 1.58 | 0.50      | 32.00 | 1.48 | 0.40      | 0.54    |
| 17        | 32.89 | 1.69 | 0.69      | 32.37 | 1.63 | 0.37      | 1.91    |
| 18        | 33.79 | 1.85 | 0.82      | 32.50 | 1.33 | 0.13      | 4.77**  |

\*P < 0.05; \*\*P < 0.001

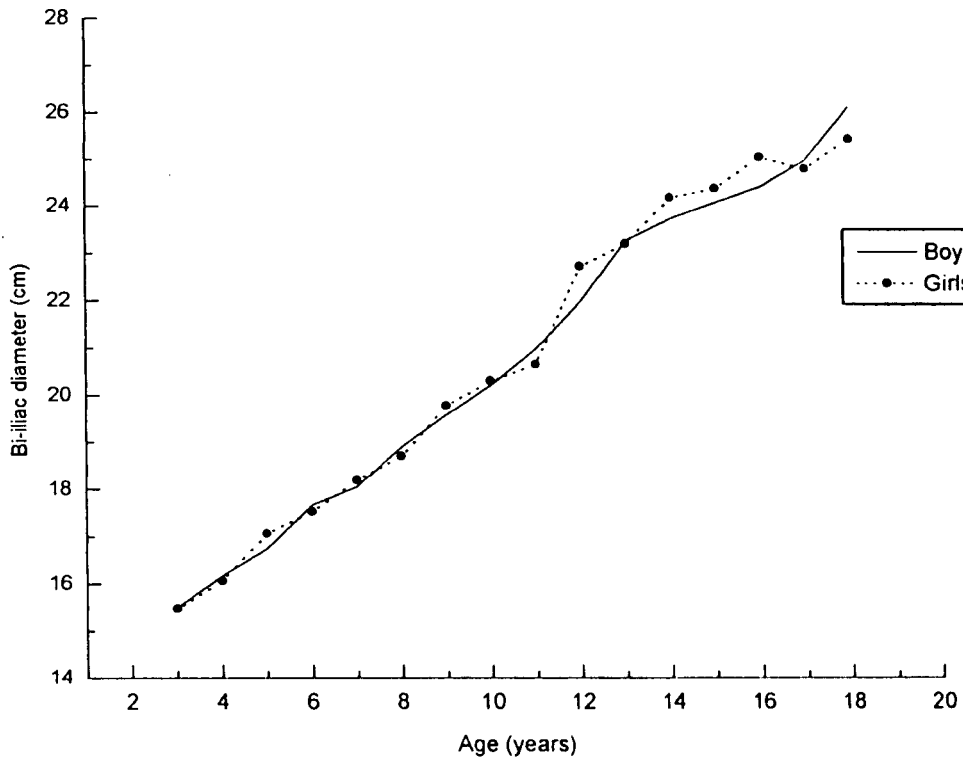


Fig.5.9. Distance curve for bi-iliac diameter of boys and girls

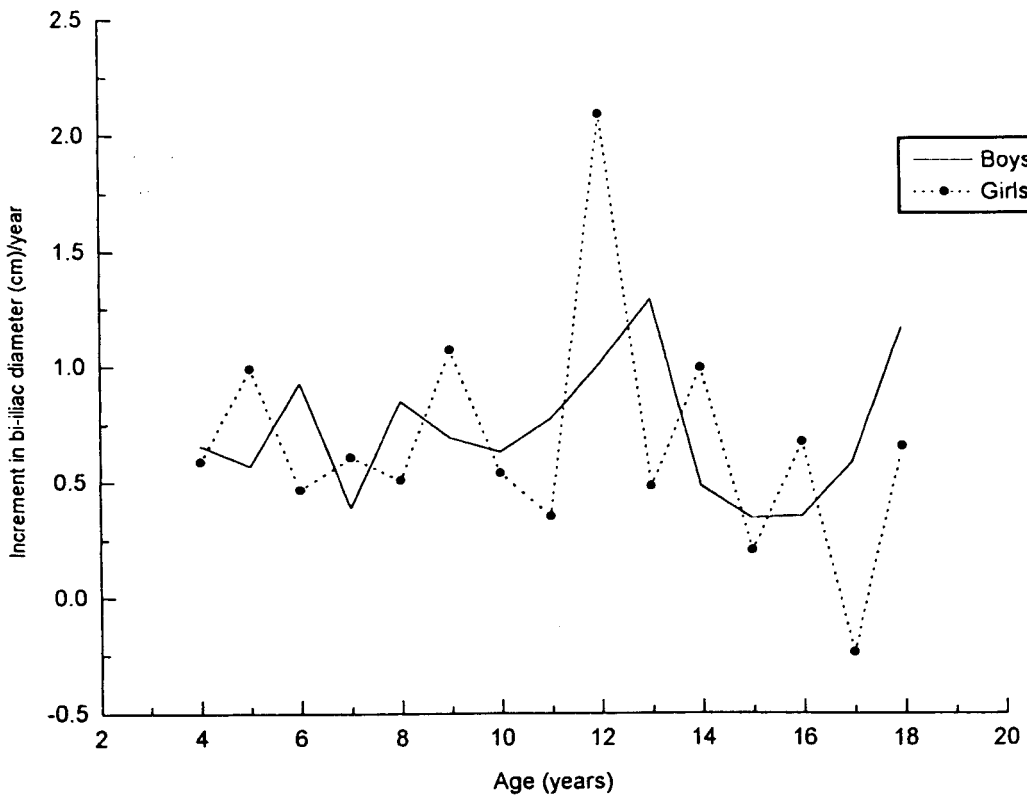


Fig. 5.10. Velocity curve for bi-iliac diameter of boys and girls

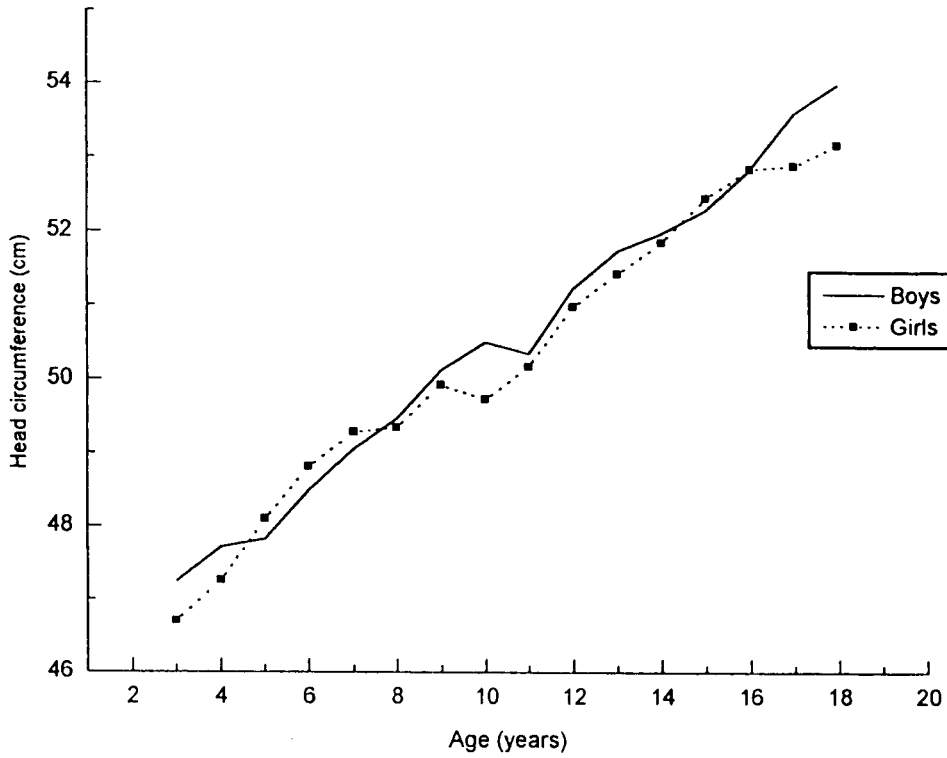


Fig.5.11. Distance curve for head circumference of boys and girls

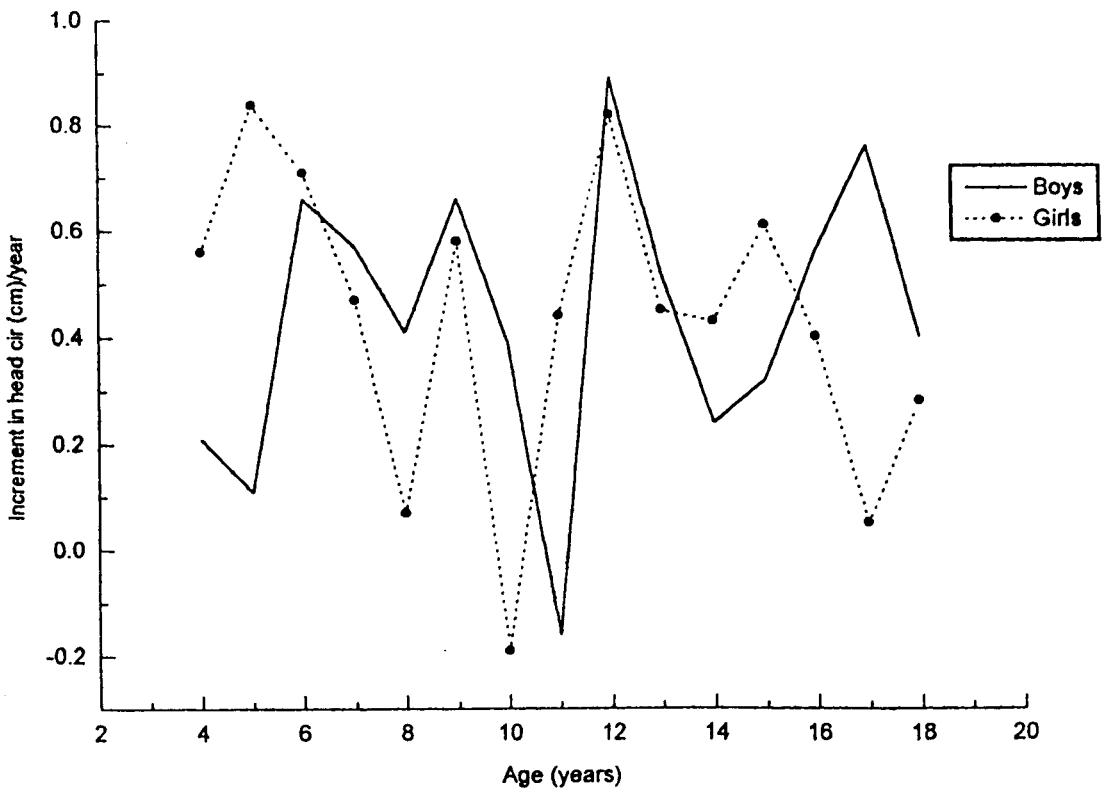


Fig.5.12. Velocity curve for head circumference of boys and girls

### Bi-iliac Diameter

Table 5.5 shows the means and standard deviations of bi-iliac diameter for both boys and girls. The distance curve based on the means against age is shown in Figure 5.9. Like in the case of biacromial diameter, both boys and girls by and large show similar mean values of bi-iliac diameter in many age groups. However, the girls have a broader hip than the boys at 5, 12, 14, 15 and 16 years, while the latter have a higher value than the former from 17 years to the last terminal age group. The t-values (Table 5.5) indicate that the differences between the sexes are significant at 5, 12, 16, and 18 years of age. That is, the bi-iliac diameter is significantly higher in girls than in boys at the age of 5 and 12 and 16, while the boys surpass the girls significantly at the age of 18.

**Table 5.5.** Statistical constants of biiliac diameter (cm) for boys and girls

| Age (yrs) | Boys  |      |           | Girls |      |           | t-value |
|-----------|-------|------|-----------|-------|------|-----------|---------|
|           | Mean  | SD   | Increment | Mean  | SD   | Increment |         |
| 3         | 15.50 | 1.11 | -         | 15.48 | 0.93 | -         | 0.13    |
| 4         | 16.16 | 1.23 | 0.66      | 16.07 | 1.22 | 0.59      | 0.46    |
| 5         | 16.73 | 1.07 | 0.57      | 17.06 | 1.15 | 0.99      | 1.96*   |
| 6         | 17.66 | 1.20 | 0.93      | 17.53 | 1.51 | 0.47      | 0.63    |
| 7         | 18.05 | 1.34 | 0.39      | 18.20 | 1.47 | 0.61      | 0.71    |
| 8         | 18.90 | 1.26 | 0.85      | 18.71 | 1.63 | 0.51      | 0.83    |
| 9         | 19.59 | 1.51 | 0.69      | 19.78 | 1.48 | 1.07      | 0.85    |
| 10        | 20.22 | 1.85 | 0.63      | 20.32 | 1.64 | 0.54      | 0.37    |
| 11        | 20.99 | 1.85 | 0.77      | 20.67 | 1.58 | 0.35      | 1.19    |
| 12        | 22.00 | 1.90 | 1.01      | 22.76 | 2.18 | 2.09      | 2.42*   |
| 13        | 23.29 | 2.26 | 1.29      | 23.24 | 1.17 | 0.48      | 0.15    |
| 14        | 23.77 | 2.16 | 0.48      | 24.23 | 2.21 | 0.99      | 1.38    |
| 15        | 24.11 | 2.01 | 0.34      | 24.43 | 1.98 | 0.20      | 1.05    |
| 16        | 24.46 | 1.82 | 0.35      | 25.10 | 1.99 | 0.67      | 2.16*   |
| 17        | 25.04 | 1.63 | 0.58      | 24.86 | 1.82 | -0.24     | 0.63    |
| 18        | 26.20 | 1.75 | 1.16      | 25.51 | 1.90 | 0.65      | 2.37*   |

\*P < 0.05

The growth rate per annum is plotted against age in Figure 5.10. It is seen that the velocity rate is different between sexes, although it is similar at 4, 10 and 15 years of age. The boys accelerate more than the girls from 5 to 6, 7 to 8, 10 to 11, 12 to 13 and 17 years onwards, while the latter grow faster at 5, 7, 9, 12, 14 and 16 years of age. The acceleration or velocity in boys reaches its peak of 1.29 cm at about 13 years, while the peak velocity of 2.09 cm in girls is observed at the age of about 12 years. In the case of girls, there is also a deceleration of growth in bi-iliac diameter from 16 to 17 years, which is followed by a caught-up at 18 years of age. Nevertheless, data on bi-iliac diameter also show that adolescent growth spurt occurs at 12 and 13 years in girls and boys, respectively.

### **Head Circumference**

The statistical constants of the head circumference for both boys and girls are given in Table 5.6, and the means plotted against age is shown in Figure 5.11. It is observed that the boys are higher in head circumference than the girls from 3 to 4, 8 to 14 and 17 to 18 years, while the girls surpass the boys from 5 to 8 years of age. Both boys and girls are more or less similar in growth pattern from 14 to 16 years of age. However, the t-values given in Table 5.6 show that the differences between the sexes are significant only at 10, 17 and 18 years of age.

As far as the velocity curve is concerned (Figure 5.12), it indicates that the acceleration rate is higher in girls than in boys from 3 to 6 and 14 to 15 years of age with the peak velocity (0.82 cm) at the age of 12 as in the case of other measurements. On the other hand, the boys have higher head circumference than the girls from 6 to 9 and 16 years onwards with the peak velocity (0.89 cm) at 12 years of age as in the case of girls. Thus, unlike other measurements mentioned above, both boys and girls experience a high growth spurt at the age of 12, which may be associated with their adolescent growth spurt. Further, it is observed from Figure 5.12 that both boys and girls have a deceleration of growth rate, which occurs at 11 years in boys and 10 years in girls. Thereafter, the growth rate tends to increase with the increasing age of both the sexes.

### Upper Arm Circumference

Table 5.7 shows the means and standard deviations of the upper arm circumference for both boys and girls, and the distance and velocity curves are shown in Figures 5.13 and 5.14, respectively. The distance curve shows that mean values of arm circumference are more or less similar for both sexes in all age groups, except at 12, 17, and 18 years of age. It is seen that the girls have a higher mean arm circumference than that of boys at 12 years of age. On the other hand, the arm circumference is higher in boys than in girls from 17 to 18 years of age. It is also found that these sex differences in mean arm circumference are statistically significant (Table 5.7).

**Table 5.6.** Statistical constants of head circumference (cm) for boys and girls

| Age (yrs) | Boys  |      |           | Girls |      |           | t-value |
|-----------|-------|------|-----------|-------|------|-----------|---------|
|           | Mean  | SD   | Increment | Mean  | SD   | Increment |         |
| 3         | 47.25 | 1.34 | -         | 46.70 | 2.17 | -         | 1.92    |
| 4         | 47.72 | 1.85 | 0.21      | 47.26 | 1.70 | 0.56      | 1.69    |
| 5         | 47.83 | 1.61 | 0.11      | 48.10 | 1.65 | 0.84      | 1.09    |
| 6         | 48.49 | 1.46 | 0.66      | 48.81 | 1.64 | 0.71      | 1.37    |
| 7         | 49.06 | 1.66 | 0.57      | 49.28 | 1.17 | 0.47      | 1.03    |
| 8         | 49.47 | 1.55 | 0.41      | 49.35 | 1.37 | 0.07      | 0.53    |
| 9         | 50.13 | 1.48 | 0.66      | 49.93 | 1.30 | 0.58      | 0.96    |
| 10        | 50.52 | 1.42 | 0.39      | 49.74 | 1.55 | -0.19     | 3.39*   |
| 11        | 50.36 | 1.76 | -0.16     | 50.18 | 1.39 | 0.44      | 0.73    |
| 12        | 51.25 | 1.67 | 0.89      | 51.00 | 1.91 | 0.82      | 0.91    |
| 13        | 51.77 | 1.48 | 0.52      | 51.45 | 1.11 | 0.45      | 1.61    |
| 14        | 52.01 | 1.34 | 0.24      | 51.88 | 1.37 | 0.43      | 0.63    |
| 15        | 52.33 | 1.38 | 0.32      | 52.49 | 1.28 | 0.61      | 0.79    |
| 16        | 52.89 | 1.51 | 0.56      | 52.89 | 1.34 | 0.40      | 0.00    |
| 17        | 53.65 | 1.38 | 0.76      | 52.94 | 1.70 | 0.05      | 2.78*   |
| 18        | 54.05 | 1.55 | 0.40      | 53.22 | 1.64 | 0.28      | 3.27*   |

\*P < 0.01

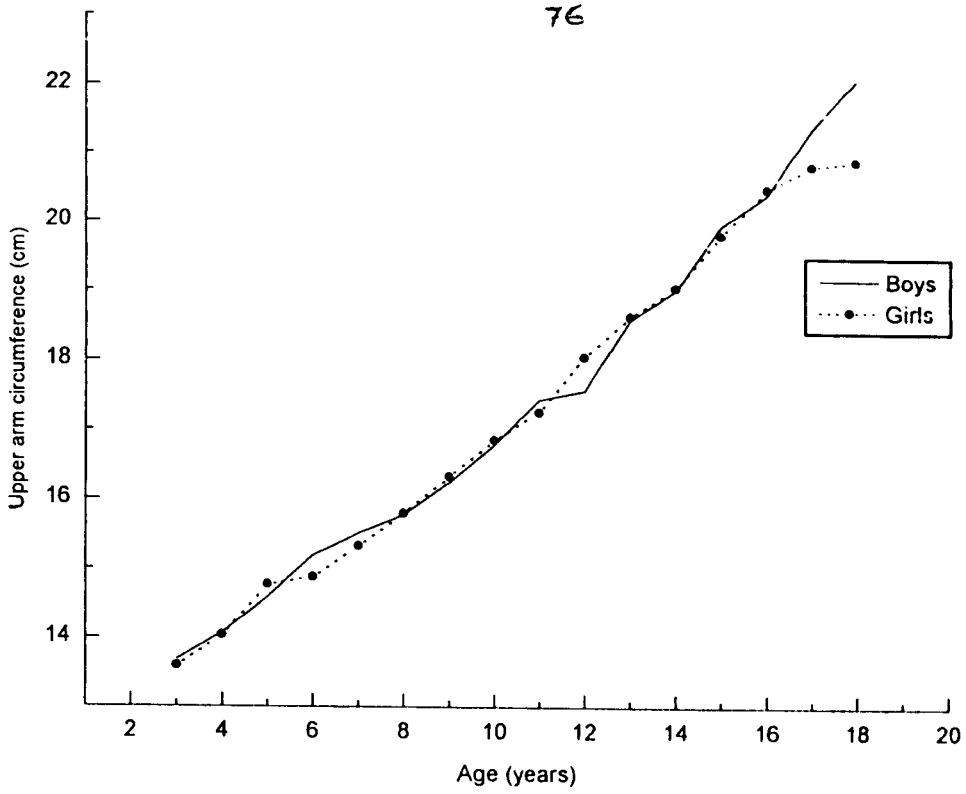


Fig. 5.13. Distance curve for upper arm circumference of boys and girls

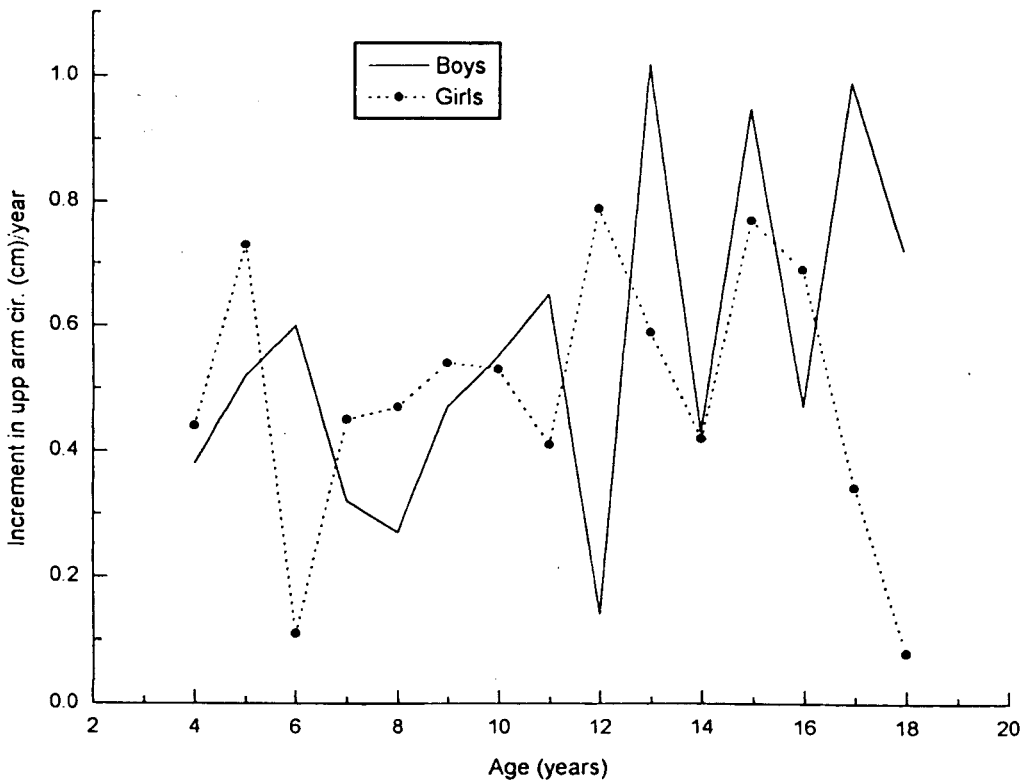


Fig. 5.14. Velocity curve for upper arm circumference of boys and girls

**Table 5.7.** Statistical constants of upper arm circumference (cm) for boys and girls

| Age (yrs) | Boys  |      |           | Girls |      |           | t-value |
|-----------|-------|------|-----------|-------|------|-----------|---------|
|           | Mean  | SD   | Increment | Mean  | SD   | Increment |         |
| 3         | 13.69 | 1.09 | -         | 13.60 | 0.94 | -         | 0.60    |
| 4         | 14.07 | 1.02 | 0.38      | 14.04 | 1.20 | 0.44      | 0.18    |
| 5         | 14.59 | 1.26 | 0.52      | 14.77 | 1.07 | 0.73      | 1.01    |
| 6         | 15.19 | 1.22 | 0.60      | 14.88 | 1.23 | 0.11      | 1.68    |
| 7         | 15.51 | 1.11 | 0.32      | 15.33 | 1.28 | 0.45      | 1.00    |
| 8         | 15.78 | 1.20 | 0.27      | 15.80 | 1.14 | 0.47      | 0.11    |
| 9         | 16.25 | 1.21 | 0.47      | 16.34 | 1.36 | 0.54      | 0.47    |
| 10        | 16.80 | 1.39 | 0.55      | 16.87 | 1.24 | 0.53      | 0.34    |
| 11        | 17.45 | 1.36 | 0.65      | 17.28 | 1.42 | 0.41      | 0.80    |
| 12        | 17.59 | 1.11 | 0.14      | 18.07 | 1.33 | 0.79      | 2.55*   |
| 13        | 18.61 | 1.25 | 1.02      | 18.66 | 1.26 | 0.59      | 0.31    |
| 14        | 19.04 | 1.27 | 0.43      | 19.08 | 1.51 | 0.42      | 0.19    |
| 15        | 19.99 | 1.35 | 0.95      | 19.85 | 1.48 | 0.77      | 0.65    |
| 16        | 20.46 | 1.47 | 0.47      | 20.54 | 1.42 | 0.69      | 0.36    |
| 17        | 21.45 | 1.62 | 0.99      | 20.88 | 1.60 | 0.34      | 2.15*   |
| 18        | 22.17 | 1.38 | 0.72      | 20.96 | 1.32 | 0.08      | 5.74**  |

\*P &lt; 0.05, \*\*P &lt; 0.000

As for the annual growth rate, Figure 5.14 shows that the velocity rate is more or less similar in both boys and girls from 3 to 4, 8 to 10, and 12 to 14 years of age. The boys have a higher growth rate than the girls at 6, 11, 15 and 17 years onwards, while the latter are higher in velocity rate at the age of 5, 7, 8, 12 and 16. The total gain in arm circumference is more in boys (8.48 cm) than in girls (7.36 cm). In boys, the maximum gain occurs at 13 years, while in girls it takes place at the age of 12 years, accounting to about 12% and 11% of the total gain from 3 to 18 years for boys and girls, respectively. Thus, it is obvious that adolescent spurt occurs at 12 and 13 years in girls and boys, respectively. The pre-adolescent growth spurt in boys takes place at the age of 11 with the annual increment of 0.65 cm, while in girls it occurs during the period between 9 and 10 years of age.

Table 5.8. Statistical constants of chest circumference (cm) for boys and girls

| Age (Yrs) | Boys  |      |           | Girls |      |           | t-value |
|-----------|-------|------|-----------|-------|------|-----------|---------|
|           | Mean  | SD   | Increment | Mean  | SD   | Increment |         |
| 3         | 51.61 | 4.09 | -         | 51.23 | 4.51 | -         | 0.59    |
| 4         | 54.54 | 4.66 | 2.93      | 53.38 | 4.40 | 2.51      | 1.67    |
| 5         | 55.33 | 3.70 | 0.79      | 55.18 | 4.21 | 1.80      | 0.25    |
| 6         | 56.75 | 4.58 | 1.42      | 57.94 | 5.10 | 2.76      | 1.63    |
| 7         | 58.65 | 4.80 | 1.90      | 59.01 | 4.78 | 1.07      | 0.50    |
| 8         | 60.59 | 5.29 | 1.94      | 59.37 | 5.67 | 0.36      | 1.43    |
| 9         | 62.48 | 4.43 | 1.89      | 62.83 | 5.69 | 3.46      | 0.46    |
| 10        | 64.34 | 5.96 | 1.86      | 64.13 | 5.50 | 2.00      | 0.24    |
| 11        | 67.17 | 4.99 | 1.83      | 65.90 | 5.33 | 1.77      | 1.58    |
| 12        | 68.53 | 4.99 | 1.36      | 69.76 | 5.87 | 3.86      | 1.47    |
| 13        | 73.43 | 5.63 | 4.90      | 71.20 | 4.78 | 1.44      | 2.81*   |
| 14        | 75.52 | 5.57 | 2.09      | 74.37 | 5.22 | 3.17      | 1.40    |
| 15        | 78.00 | 4.59 | 2.48      | 76.30 | 5.15 | 1.93      | 2.29*   |
| 16        | 79.50 | 4.93 | 1.50      | 78.40 | 4.76 | 2.10      | 1.46    |
| 17        | 83.43 | 4.90 | 3.93      | 79.55 | 4.20 | 1.15      | 5.18**  |
| 18        | 85.94 | 5.67 | 2.51      | 79.98 | 4.90 | 0.43      | 7.11**  |

\*P &lt; 0.05, \*\*P &lt; 0.000

### Chest Circumference

The statistical constants for chest girth of both boys and girls are given in Table 5.8. The mean values are plotted against age as shown in Figure 5.15. It is observed that there is a gradual increase in chest girth from 3 to 18 years of age for both boys and girls. The distance curve shows that the chest girth is higher in boys than in girls from 3 to 5, 7 to 8 and 10 to 11 years of age. On the other hand, the girls are higher in mean values from 6 to 7, 10 to 11 and after 12 years of age. However, these differences between boys and girls in respect of chest girth are significant only at 13, 15, 17 and 18 years. Nevertheless, it indicates that the boys have higher chest girth in many age groups, except in some age groups like adolescent period when the girls surpass the boys.

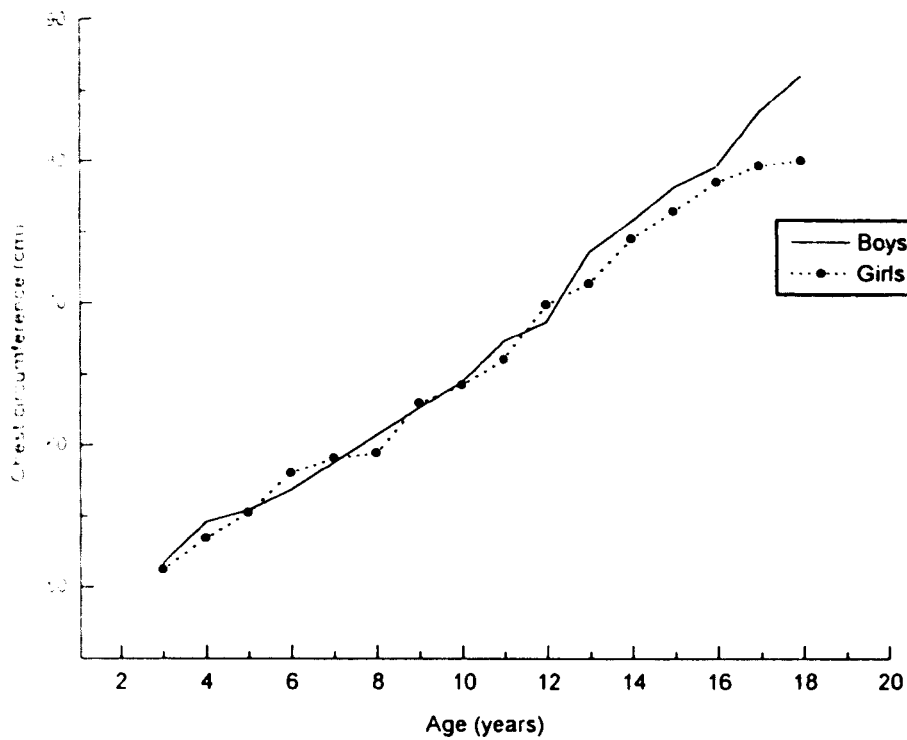


Fig. 5.15. Distance curve for chest circumference of boys and girls

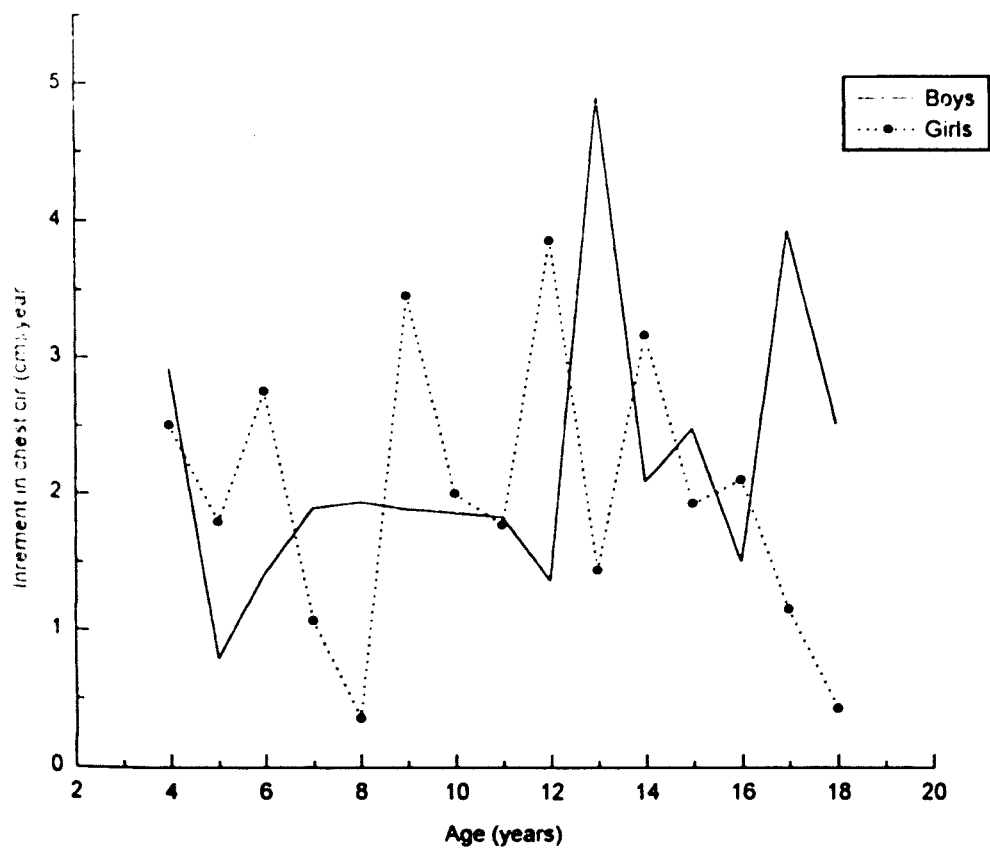


Fig. 5.16. Velocity curve for chest circumference of boys and girls

Figure 5.16 shows that the velocity rates vary between sexes. It is observed that the growth rate is higher in girls than in boys at 5,6,9,10,12,14 and 16 years of age. On the other hand, the acceleration rate is higher in boys than in girls at the age of 4,7,8,11,13,15,17 and 18 years. It is found that the total gain from 3 to 18 years is 34.33 cm in boys and 28.55 cm in girls. The maximum gain or peak velocity of 4.90 cm in boys occurs at the age of 13 (i.e., 14.27% of the total gain) while it is 3.86 cm, (i.e., 13.52% of the total gain) in girls at the age of 12 years.

## **GROWTH BY SOCIOECONOMIC CONDITION**

In this section, we shall deal with the relationship between growth of children and the socio-economic condition of the households. In this connection, we shall take into consideration the income of household and religion as described in Chapter III.

### **INCOME OF HOUSEHOLD**

#### **Weight**

The means and standard deviations of weight according to income groups for boys and girls are given in Tables 5.9 and 5.10, respectively. It is observed that both boys and girls in the HIG are heavier than those belonging to the LIG and MIG, although the MIG boys are heavier than the HIG boys from 3 to 4 years of age. The one way analysis of covariance (ANCOVA) indicates that the differences between income groups after adjusting for the effect of religion are highly significant for many age groups of boys and girls. This clearly shows that the income of household is very important in controlling the growth in weight for the children of the present population.

Table 5.9. Mean weight of boys according to income groups

| Age (yrs) | Low Income Group (LIG) |      | Middle Income Group (MIG) |      | High Income Group (HIG) |      | ANCOVA-Statistics |         |
|-----------|------------------------|------|---------------------------|------|-------------------------|------|-------------------|---------|
|           | Mean                   | SD   | Mean                      | SD   | Mean                    | SD   | F-ratio           | p-level |
| 3         | 11.33                  | 1.95 | 12.68                     | 1.27 | 12.14                   | 1.88 | 5.19              | 0.007*  |
| 4         | 13.50                  | 2.17 | 14.54                     | 1.82 | 14.14                   | 2.09 | 1.84              | 0.170   |
| 5         | 15.43                  | 1.70 | 16.46                     | 1.86 | 17.07                   | 1.67 | 5.84              | 0.004*  |
| 6         | 16.51                  | 2.31 | 17.61                     | 1.95 | 17.73                   | 1.87 | 3.83              | 0.003*  |
| 7         | 17.97                  | 2.00 | 18.03                     | 2.21 | 18.56                   | 2.79 | 2.13              | 0.130   |
| 8         | 19.92                  | 2.63 | 20.41                     | 2.67 | 22.37                   | 2.64 | 7.92              | 0.001*  |
| 9         | 21.93                  | 2.75 | 23.29                     | 3.04 | 24.23                   | 2.28 | 8.00              | 0.001*  |
| 10        | 23.40                  | 3.77 | 25.19                     | 2.84 | 25.98                   | 3.04 | 4.40              | 0.020*  |
| 11        | 25.33                  | 4.08 | 27.23                     | 2.53 | 29.13                   | 3.11 | 9.37              | 0.000*  |
| 12        | 27.69                  | 3.42 | 29.92                     | 2.62 | 30.83                   | 2.00 | 6.91              | 0.002*  |
| 13        | 32.35                  | 3.66 | 35.09                     | 3.91 | 34.98                   | 4.29 | 4.43              | 0.020*  |
| 14        | 35.24                  | 3.60 | 37.95                     | 3.41 | 39.74                   | 3.99 | 11.41             | 0.000*  |
| 15        | 40.04                  | 4.41 | 42.52                     | 3.64 | 43.87                   | 4.22 | 5.72              | 0.005*  |
| 16        | 41.46                  | 3.70 | 44.44                     | 4.98 | 44.96                   | 4.80 | 5.30              | 0.007*  |
| 17        | 46.80                  | 2.58 | 47.90                     | 3.84 | 48.09                   | 4.65 | 1.06              | 0.350   |
| 18        | 48.04                  | 4.57 | 48.90                     | 4.01 | 50.13                   | 3.11 | 1.17              | 0.320   |

\*Significant

Table 5.10. Mean weight of girls according to income groups

| Age (yrs) | Low Income Group (LIG) |      | Middle Income Group (MIG) |      | High Income Group (HIG) |      | ANCOVA-Statistics |         |
|-----------|------------------------|------|---------------------------|------|-------------------------|------|-------------------|---------|
|           | Mean                   | SD   | Mean                      | SD   | Mean                    | SD   | F-ratio           | p-level |
| 3         | 11.27                  | 1.53 | 12.24                     | 1.73 | 13.25                   | 1.99 | 10.59             | 0.000*  |
| 4         | 13.10                  | 2.47 | 14.05                     | 1.47 | 14.64                   | 1.82 | 5.60              | 0.005*  |
| 5         | 15.07                  | 1.79 | 15.94                     | 1.57 | 16.71                   | 2.14 | 5.21              | 0.007*  |
| 6         | 17.15                  | 2.07 | 17.78                     | 2.81 | 18.66                   | 2.35 | 4.87              | 0.010*  |
| 7         | 18.18                  | 2.20 | 18.78                     | 2.05 | 19.38                   | 2.79 | 3.19              | 0.050*  |
| 8         | 20.54                  | 2.46 | 19.74                     | 2.35 | 21.55                   | 2.33 | 5.20              | 0.010*  |
| 9         | 21.74                  | 3.31 | 22.74                     | 2.86 | 24.39                   | 3.15 | 5.01              | 0.010*  |
| 10        | 23.46                  | 3.61 | 24.57                     | 3.11 | 26.53                   | 3.68 | 4.70              | 0.010*  |
| 11        | 26.72                  | 2.97 | 27.04                     | 2.82 | 27.58                   | 3.40 | 1.02              | 0.370   |
| 12        | 30.31                  | 3.72 | 30.64                     | 3.49 | 31.69                   | 3.80 | 0.77              | 0.380   |
| 13        | 32.28                  | 3.26 | 33.36                     | 4.82 | 33.72                   | 5.87 | 1.11              | 0.340   |
| 14        | 35.84                  | 4.64 | 38.08                     | 5.54 | 38.40                   | 4.60 | 2.16              | 0.120   |
| 15        | 39.17                  | 3.48 | 41.78                     | 4.26 | 42.76                   | 2.61 | 5.78              | 0.004*  |
| 16        | 42.27                  | 3.68 | 42.80                     | 4.12 | 45.08                   | 2.85 | 3.30              | 0.040*  |
| 17        | 43.27                  | 4.01 | 44.51                     | 4.56 | 46.92                   | 3.50 | 3.02              | 0.050*  |
| 18        | 42.72                  | 4.50 | 45.31                     | 5.43 | 47.55                   | 3.55 | 5.12              | 0.010*  |

\*Significant

Table 5.11. Mean height of boys according to income groups

| Age (yrs) | Low Income Group (LIG) |      | Middle Income Group (MIG) |      | High Income Group (HIG) |      | ANCOVA-Statistics |         |
|-----------|------------------------|------|---------------------------|------|-------------------------|------|-------------------|---------|
|           | Mean                   | SD   | Mean                      | SD   | Mean                    | SD   | F-ratio           | p-level |
| 3         | 84.71                  | 4.33 | 87.66                     | 4.94 | 89.54                   | 7.05 | 7.24              | 0.001*  |
| 4         | 91.26                  | 5.11 | 93.96                     | 5.22 | 93.15                   | 3.84 | 2.08              | 0.070   |
| 5         | 95.00                  | 5.91 | 98.37                     | 5.85 | 102.47                  | 6.09 | 6.41              | 0.003*  |
| 6         | 99.88                  | 6.79 | 104.57                    | 6.00 | 108.68                  | 6.50 | 3.53              | 0.030*  |
| 7         | 107.62                 | 5.85 | 107.74                    | 5.75 | 112.54                  | 7.34 | 7.46              | 0.001*  |
| 8         | 110.22                 | 7.74 | 114.03                    | 5.40 | 119.43                  | 5.05 | 15.16             | 0.000*  |
| 9         | 116.39                 | 6.39 | 118.21                    | 6.38 | 123.81                  | 3.69 | 19.30             | 0.000*  |
| 10        | 119.83                 | 8.01 | 123.11                    | 5.29 | 127.55                  | 5.01 | 9.17              | 0.000*  |
| 11        | 123.53                 | 6.81 | 126.17                    | 5.11 | 129.88                  | 4.98 | 9.70              | 0.000*  |
| 12        | 127.82                 | 5.94 | 130.87                    | 5.72 | 130.23                  | 9.26 | 2.31              | 0.020*  |
| 13        | 135.12                 | 5.59 | 137.18                    | 4.33 | 139.06                  | 4.44 | 4.47              | 0.010*  |
| 14        | 138.13                 | 5.52 | 140.81                    | 4.64 | 144.69                  | 5.18 | 9.37              | 0.000*  |
| 15        | 142.62                 | 5.42 | 145.04                    | 6.58 | 146.58                  | 8.25 | 2.29              | 0.110   |
| 16        | 144.38                 | 5.76 | 147.57                    | 5.86 | 150.97                  | 7.32 | 6.88              | 0.002*  |
| 17        | 148.79                 | 5.17 | 149.52                    | 4.19 | 155.76                  | 8.54 | 6.38              | 0.003*  |
| 18        | 153.08                 | 6.11 | 154.41                    | 5.90 | 157.57                  | 5.18 | 2.60              | 0.080   |

\*Significant

Table 5.12. Mean height of girls according to income groups

| Age (yrs) | Low Income Group (LIG) |      | Middle Income Group (MIG) |      | High Income Group (HIG) |      | ANCOVA-Statistics |         |
|-----------|------------------------|------|---------------------------|------|-------------------------|------|-------------------|---------|
|           | Mean                   | SD   | Mean                      | SD   | Mean                    | SD   | F-ratio           | p-level |
| 3         | 85.16                  | 5.03 | 86.13                     | 3.89 | 88.76                   | 4.82 | 4.17              | 0.020*  |
| 4         | 89.30                  | 5.34 | 90.84                     | 5.61 | 92.46                   | 5.38 | 2.54              | 0.090   |
| 5         | 95.41                  | 5.29 | 98.41                     | 6.20 | 97.95                   | 5.13 | 3.30              | 0.040*  |
| 6         | 102.43                 | 5.69 | 102.77                    | 6.05 | 105.68                  | 6.85 | 2.91              | 0.060   |
| 7         | 106.53                 | 7.10 | 108.82                    | 7.52 | 111.74                  | 4.77 | 5.57              | 0.050*  |
| 8         | 113.47                 | 6.21 | 113.04                    | 5.64 | 117.15                  | 5.45 | 4.74              | 0.010*  |
| 9         | 117.06                 | 7.59 | 118.33                    | 6.35 | 123.37                  | 4.33 | 5.71              | 0.010*  |
| 10        | 121.59                 | 6.88 | 121.32                    | 7.38 | 126.15                  | 5.46 | 3.67              | 0.030*  |
| 11        | 124.44                 | 6.90 | 126.26                    | 4.81 | 130.91                  | 2.74 | 8.05              | 0.001*  |
| 12        | 132.76                 | 5.61 | 134.28                    | 7.11 | 138.35                  | 6.34 | 5.10              | 0.010*  |
| 13        | 136.89                 | 5.89 | 138.05                    | 5.92 | 138.65                  | 5.35 | 0.92              | 0.400   |
| 14        | 139.68                 | 5.64 | 143.28                    | 5.54 | 144.87                  | 7.46 | 5.41              | 0.010*  |
| 15        | 141.29                 | 5.58 | 144.06                    | 5.13 | 147.02                  | 2.95 | 6.83              | 0.002*  |
| 16        | 145.19                 | 5.28 | 144.29                    | 5.04 | 150.00                  | 3.50 | 9.00              | 0.000*  |
| 17        | 144.35                 | 5.85 | 146.75                    | 6.10 | 152.83                  | 5.75 | 8.20              | 0.001*  |
| 18        | 145.46                 | 5.96 | 147.16                    | 6.38 | 154.10                  | 5.56 | 7.96              | 0.001*  |

\*Significant

Table 5.13. Mean sitting height of boys according to income groups

| Age (yrs) | Low Income Group (LIG) |      | Middle Income Group (MIG) |      | High Income Group (HIG) |      | ANCOVA-Statistics |         |
|-----------|------------------------|------|---------------------------|------|-------------------------|------|-------------------|---------|
|           | Mean                   | SD   | Mean                      | SD   | Mean                    | SD   | F-ratio           | p-level |
| 3         | 45.47                  | 3.80 | 46.20                     | 2.92 | 45.69                   | 5.96 | 0.31              | 0.740   |
| 4         | 48.66                  | 4.34 | 49.57                     | 3.92 | 48.95                   | 4.99 | 0.27              | 0.070   |
| 5         | 50.62                  | 4.61 | 51.65                     | 4.94 | 52.05                   | 5.91 | 0.51              | 0.600   |
| 6         | 53.78                  | 6.00 | 54.75                     | 4.55 | 57.80                   | 3.47 | 4.54              | 0.001*  |
| 7         | 55.18                  | 4.65 | 55.79                     | 4.54 | 55.51                   | 4.33 | 1.96              | 0.150   |
| 8         | 58.18                  | 4.19 | 58.39                     | 3.78 | 61.27                   | 5.16 | 5.41              | 0.010*  |
| 9         | 59.66                  | 5.65 | 62.16                     | 4.89 | 64.07                   | 3.24 | 9.85              | 0.000*  |
| 10        | 62.29                  | 4.41 | 63.18                     | 3.76 | 65.28                   | 4.42 | 3.07              | 0.050*  |
| 11        | 62.63                  | 5.93 | 65.32                     | 4.16 | 66.85                   | 3.90 | 6.59              | 0.002*  |
| 12        | 66.17                  | 4.70 | 67.42                     | 3.90 | 67.80                   | 7.56 | 0.78              | 0.460   |
| 13        | 69.71                  | 3.74 | 70.46                     | 4.72 | 74.04                   | 2.71 | 9.74              | 0.000*  |
| 14        | 71.87                  | 4.43 | 73.74                     | 2.89 | 75.31                   | 3.45 | 5.94              | 0.004*  |
| 15        | 74.64                  | 4.12 | 76.70                     | 4.81 | 78.59                   | 2.83 | 5.26              | 0.007*  |
| 16        | 75.47                  | 4.11 | 78.14                     | 3.02 | 78.71                   | 4.44 | 6.95              | 0.002*  |
| 17        | 77.84                  | 4.15 | 79.12                     | 3.29 | 82.67                   | 2.51 | 7.41              | 0.001*  |
| 18        | 78.92                  | 4.42 | 80.80                     | 3.58 | 82.37                   | 3.02 | 4.72              | 0.010*  |

\*Significant

Table 5.14. Mean sitting height of girls according to income groups

| Age (yrs) | Low Income Group (LIG) |      | Middle Income Group (MIG) |      | High Income Group (HIG) |      | ANCOVA-Statistics |         |
|-----------|------------------------|------|---------------------------|------|-------------------------|------|-------------------|---------|
|           | Mean                   | SD   | Mean                      | SD   | Mean                    | SD   | F-ratio           | p-level |
| 3         | 46.52                  | 2.54 | 46.49                     | 3.67 | 47.88                   | 2.28 | 1.73              | 0.25    |
| 4         | 47.41                  | 4.35 | 48.35                     | 3.80 | 48.33                   | 4.36 | 1.42              | 0.25    |
| 5         | 52.60                  | 3.79 | 52.40                     | 5.12 | 54.27                   | 2.73 | 1.39              | 0.26    |
| 6         | 54.62                  | 4.03 | 51.97                     | 6.34 | 56.91                   | 5.01 | 7.43              | 0.01*   |
| 7         | 55.93                  | 4.90 | 57.31                     | 3.84 | 57.96                   | 4.61 | 2.51              | 0.09    |
| 8         | 59.02                  | 4.80 | 58.53                     | 5.20 | 59.49                   | 5.07 | 0.34              | 0.71    |
| 9         | 62.18                  | 3.56 | 61.19                     | 4.37 | 63.51                   | 3.94 | 1.51              | 0.23    |
| 10        | 63.76                  | 5.10 | 63.21                     | 4.97 | 64.91                   | 4.61 | 0.58              | 0.56    |
| 11        | 64.84                  | 5.65 | 64.77                     | 3.45 | 69.00                   | 2.84 | 6.36              | 0.00*   |
| 12        | 69.63                  | 3.88 | 69.21                     | 4.66 | 71.58                   | 4.28 | 1.83              | 0.17    |
| 13        | 69.98                  | 5.16 | 71.97                     | 4.58 | 71.68                   | 4.48 | 2.55              | 0.08    |
| 14        | 72.90                  | 5.06 | 75.07                     | 3.39 | 75.05                   | 3.42 | 2.57              | 0.08    |
| 15        | 74.76                  | 3.70 | 76.69                     | 3.37 | 78.18                   | 2.63 | 5.53              | 0.01*   |
| 16        | 76.90                  | 3.18 | 76.64                     | 3.46 | 78.72                   | 2.89 | 2.40              | 0.10    |
| 17        | 77.44                  | 3.96 | 78.21                     | 4.20 | 80.81                   | 2.81 | 2.99              | 0.06    |
| 18        | 77.24                  | 3.42 | 79.43                     | 3.38 | 81.19                   | 2.60 | 7.69              | 0.00*   |

\*Significant

### **Height and Sitting Height**

Like in the case of weight, Tables 5.11 and 5.12 show that boys and girls belonging to the HIG are taller than their counterparts in the LIG and MIG. The ANCOVA test indicates that the differences between income groups are highly significant in many age groups for both boys and girls. Likewise, the mean sitting height in boys varies significantly between income groups except in the lower age groups (, i.e., from 3 to 5 years of age) and at ages 7 and 12 (Table 5.13). On the other hand, Table 5.14 shows that sitting height does not vary significantly in most of the age groups for girls, except at 6, 11, 15 and 18 years of age. Nevertheless, it indicates that income of the household is important in controlling height and sitting height in the present population especially in the case of boys.

### **Biacromial and Biiliac Diameters**

Tables 5.15 and 5.16 show the means and standard deviations of biacromial diameter according to income groups for boys and girls, respectively. With the exception of few cases, the mean biacromial diameter in boys is higher in HIG when compared with the LIG and MIG, and it is statistically significant in many age groups. On the other hand, the ANCOVA test indicates that the differences between income groups for girls after adjusting for the effect of religion are significant only at 3, 5, 14 and 16 years of age. This indicates that income of the household does not play significant role in patterning the growth of biacromial diameter in girls, although it is to a certain extent important in the case of boys. A similar trend is observed with respect to biiliac diameter (Tables 5.17 and 5.18). The Tables show that there is not much difference between income groups for girls, but the differences are significant in many age groups for boys.

Table 5.15. Biaromial diameter of boys according to income groups

| Age (yrs) | Low Income Group (LIG) |      | Middle Income Group (MIG) |      | High Income Group (HIG) |      | ANCOVA-Statistics |         |
|-----------|------------------------|------|---------------------------|------|-------------------------|------|-------------------|---------|
|           | Mean                   | SD   | Mean                      | SD   | Mean                    | SD   | F-ratio           | p-level |
| 3         | 19.48                  | 1.27 | 19.97                     | 0.96 | 20.06                   | 1.36 | 2.52              | 0.090   |
| 4         | 20.60                  | 1.47 | 20.49                     | 1.56 | 20.75                   | 1.98 | 0.19              | 0.830   |
| 5         | 21.13                  | 0.95 | 21.94                     | 2.02 | 22.29                   | 1.11 | 4.15              | 0.002*  |
| 6         | 22.20                  | 1.37 | 23.19                     | 1.22 | 23.86                   | 1.24 | 12.03             | 0.000*  |
| 7         | 23.01                  | 1.32 | 23.46                     | 1.65 | 23.41                   | 1.49 | 1.89              | 0.160   |
| 8         | 24.07                  | 1.30 | 24.34                     | 1.76 | 24.89                   | 2.19 | 1.30              | 0.280   |
| 9         | 24.41                  | 1.65 | 25.16                     | 1.49 | 26.97                   | 1.17 | 25.19             | 0.000*  |
| 10        | 25.68                  | 2.46 | 26.35                     | 2.26 | 27.62                   | 2.12 | 4.43              | 0.020*  |
| 11        | 26.48                  | 2.36 | 27.31                     | 2.28 | 28.78                   | 2.21 | 7.31              | 0.001*  |
| 12        | 27.95                  | 1.55 | 28.24                     | 1.94 | 29.37                   | 1.76 | 1.97              | 0.150   |
| 13        | 29.31                  | 2.07 | 30.51                     | 1.79 | 30.82                   | 1.52 | 5.74              | 0.005*  |
| 14        | 30.29                  | 1.89 | 31.18                     | 1.11 | 31.11                   | 1.40 | 5.15              | 0.008*  |
| 15        | 31.37                  | 1.65 | 31.68                     | 1.36 | 32.61                   | 2.33 | 2.19              | 0.120   |
| 16        | 31.75                  | 1.22 | 32.22                     | 1.37 | 33.28                   | 2.49 | 4.87              | 0.010*  |
| 17        | 32.71                  | 1.83 | 32.93                     | 1.55 | 33.09                   | 2.04 | 0.66              | 0.520   |
| 18        | 33.45                  | 1.66 | 33.48                     | 1.95 | 34.62                   | 1.70 | 2.21              | 0.120   |

\*Significant

Table 5.16. Biaromial diameter of girls according to income groups

| Age (yrs) | Low Income Group (LIG) |      | Middle Income Group (MIG) |      | High Income Group (HIG) |      | ANCOVA-Statistics |         |
|-----------|------------------------|------|---------------------------|------|-------------------------|------|-------------------|---------|
|           | Mean                   | SD   | Mean                      | SD   | Mean                    | SD   | F-ratio           | p-level |
| 3         | 19.41                  | 1.15 | 19.67                     | 1.67 | 19.60                   | 1.66 | 0.53              | 0.05*   |
| 4         | 20.34                  | 1.76 | 20.10                     | 1.78 | 20.86                   | 1.90 | 1.18              | 0.31    |
| 5         | 21.64                  | 1.11 | 22.31                     | 1.72 | 22.72                   | 1.65 | 3.35              | 0.04*   |
| 6         | 22.66                  | 1.85 | 21.96                     | 1.65 | 23.55                   | 2.07 | 4.35              | 0.02*   |
| 7         | 23.20                  | 1.84 | 23.47                     | 1.65 | 23.56                   | 1.99 | 0.36              | 0.70    |
| 8         | 23.97                  | 1.73 | 24.43                     | 1.76 | 24.88                   | 2.15 | 1.38              | 0.26    |
| 9         | 25.76                  | 1.61 | 25.47                     | 1.86 | 26.34                   | 1.50 | 1.21              | 0.31    |
| 10        | 26.16                  | 2.02 | 26.03                     | 2.43 | 27.13                   | 1.60 | 2.29              | 0.11    |
| 11        | 26.87                  | 1.91 | 27.02                     | 1.91 | 27.68                   | 2.22 | 1.23              | 0.30    |
| 12        | 29.44                  | 2.24 | 29.08                     | 1.91 | 29.69                   | 2.08 | 0.30              | 0.74    |
| 13        | 29.96                  | 1.74 | 30.31                     | 1.62 | 29.56                   | 2.23 | 1.24              | 0.30    |
| 14        | 30.05                  | 2.03 | 31.30                     | 1.48 | 31.85                   | 1.81 | 7.23              | 0.00*   |
| 15        | 31.30                  | 1.61 | 31.77                     | 1.29 | 31.66                   | 1.21 | 0.92              | 0.40    |
| 16        | 31.83                  | 1.25 | 31.71                     | 1.55 | 32.82                   | 1.33 | 3.86              | 0.03*   |
| 17        | 32.40                  | 1.75 | 32.10                     | 1.65 | 33.17                   | 1.00 | 1.64              | 0.21    |
| 18        | 32.38                  | 1.30 | 32.42                     | 1.33 | 33.23                   | 1.34 | 1.74              | 0.18    |

\*Significant

**Table 5.17.** Biiliac diameter of boys according to income groups

| Age (yrs) | Low Income Group (LIG) |      | Middle Income Group (MIG) |      | High Income Group (HIG) |      | ANCOVA-Statistics |         |
|-----------|------------------------|------|---------------------------|------|-------------------------|------|-------------------|---------|
|           | Mean                   | SD   | Mean                      | SD   | Mean                    | SD   | F-ratio           | p-level |
| 3         | 15.25                  | 1.23 | 15.57                     | 0.94 | 16.11                   | 0.89 | 3.40              | 0.040*  |
| 4         | 16.00                  | 1.06 | 16.15                     | 1.23 | 16.68                   | 1.58 | 1.67              | 0.190   |
| 5         | 16.54                  | 0.94 | 16.75                     | 1.22 | 17.10                   | 0.93 | 1.44              | 0.240   |
| 6         | 17.36                  | 1.23 | 17.58                     | 1.08 | 18.42                   | 0.99 | 5.98              | 0.004*  |
| 7         | 17.93                  | 1.23 | 18.00                     | 1.54 | 18.39                   | 1.08 | 2.49              | 0.090   |
| 8         | 18.71                  | 1.01 | 18.95                     | 1.20 | 19.17                   | 1.61 | 0.98              | 0.410   |
| 9         | 18.75                  | 1.19 | 19.56                     | 1.54 | 20.68                   | 1.16 | 17.38             | 0.000*  |
| 10        | 19.67                  | 2.13 | 20.31                     | 1.33 | 21.07                   | 1.57 | 4.12              | 0.020*  |
| 11        | 20.40                  | 1.62 | 20.75                     | 1.52 | 22.10                   | 2.06 | 7.26              | 0.000*  |
| 12        | 21.90                  | 1.63 | 21.76                     | 1.97 | 23.36                   | 2.48 | 2.30              | 0.190   |
| 13        | 22.85                  | 2.25 | 23.28                     | 1.99 | 23.89                   | 2.51 | 1.62              | 0.200   |
| 14        | 23.40                  | 2.22 | 23.63                     | 2.01 | 24.65                   | 2.17 | 1.77              | 0.180   |
| 15        | 23.91                  | 2.01 | 24.16                     | 2.18 | 24.49                   | 1.66 | 0.33              | 0.720   |
| 16        | 24.11                  | 1.74 | 24.36                     | 1.58 | 25.65                   | 2.26 | 3.51              | 0.040*  |
| 17        | 25.04                  | 1.63 | 24.90                     | 1.64 | 25.63                   | 1.58 | 0.46              | 0.630   |
| 18        | 26.35                  | 1.71 | 25.71                     | 1.55 | 27.04                   | 1.95 | 2.97              | 0.050*  |

\*Significant

**Table 5.18.** Biiliac diameter of girls according to income groups

| Age (yrs) | Low Income Group (LIG) |      | Middle Income Group (MIG) |      | High Income Group (HIG) |      | ANCOVA-Statistics |         |
|-----------|------------------------|------|---------------------------|------|-------------------------|------|-------------------|---------|
|           | Mean                   | SD   | Mean                      | SD   | Mean                    | SD   | F-ratio           | p-level |
| 3         | 15.25                  | 0.96 | 15.57                     | 0.95 | 15.68                   | 0.84 | 1.99              | 0.08    |
| 4         | 15.85                  | 1.05 | 16.05                     | 1.50 | 16.38                   | 1.01 | 1.35              | 0.27    |
| 5         | 16.98                  | 1.18 | 17.09                     | 1.22 | 17.20                   | 0.92 | 0.26              | 0.77    |
| 6         | 17.47                  | 1.15 | 17.05                     | 1.32 | 18.06                   | 2.01 | 2.82              | 0.07    |
| 7         | 18.21                  | 1.62 | 18.07                     | 1.07 | 18.32                   | 1.67 | 0.15              | 0.86    |
| 8         | 18.74                  | 1.33 | 18.32                     | 1.58 | 19.44                   | 1.81 | 3.61              | 0.03*   |
| 9         | 19.86                  | 1.55 | 19.37                     | 1.42 | 20.38                   | 1.31 | 2.23              | 0.11    |
| 10        | 20.12                  | 1.80 | 20.11                     | 1.55 | 20.91                   | 1.54 | 1.68              | 0.19    |
| 11        | 20.72                  | 1.91 | 20.57                     | 1.89 | 20.81                   | 1.59 | 0.30              | 0.75    |
| 12        | 22.97                  | 2.52 | 22.42                     | 2.23 | 23.03                   | 1.73 | 0.32              | 0.73    |
| 13        | 23.35                  | 2.35 | 23.14                     | 1.87 | 23.25                   | 2.46 | 0.24              | 0.78    |
| 14        | 23.54                  | 2.31 | 24.54                     | 1.98 | 24.93                   | 2.22 | 3.03              | 0.05*   |
| 15        | 24.17                  | 2.08 | 24.57                     | 1.94 | 24.54                   | 1.98 | 0.34              | 0.72    |
| 16        | 24.68                  | 1.83 | 24.76                     | 1.67 | 26.35                   | 2.35 | 5.44              | 0.01*   |
| 17        | 24.59                  | 1.92 | 24.62                     | 1.64 | 26.23                   | 1.66 | 4.17              | 0.02*   |
| 18        | 25.62                  | 1.75 | 25.17                     | 2.19 | 26.29                   | 1.07 | 1.40              | 0.25    |

\*Significant

### Head, Arm and Chest Circumferences

Tables 5.19 and 5.20 show the means and standard deviations of head circumference according to income groups for boys and girls, respectively. The ANCOVA test indicates that the differences between income groups are significant only at the ages of 3, 5, 9, 10 and 16 years of age in boys and at 6, 10, 14 and 17 in girls.

The means and standard deviations of mid upper arm circumference according to income groups for boys and girls are shown in Tables 5.21 and 5.22, respectively. It is observed that the mean upper arm circumferences are higher in the HIG when compared with the LIG and MIG, and the differences are significant in many age groups for boys. In the case of girls, the ANCOVA test indicates that the differences are significant only at the age of 10,12 and 14 years of age. Nevertheless, it indicates that income of the household is an important factor influencing the arm circumferences of children in this population, especially in boys.

With respect to chest circumference, Tables 5.23 and 5.24 show that the differences between income groups are significant in many age groups for boys. In the case of girls, the differences are found to be significant only in six age groups, i.e., at 6, 8,10,14, 16 and 17 years of age. Like in the case of mid upper arm circumference, the influence of income seems to be more important in boys as compared to girls.

**Table 5.19.** Head circumference of boys according to income groups

| Age (yrs) | Low Income Group (LIG) |      | Middle Income Group (MIG) |      | High Income Group (HIG) |      | ANCOVA-Statistics |         |
|-----------|------------------------|------|---------------------------|------|-------------------------|------|-------------------|---------|
|           | Mean                   | SD   | Mean                      | SD   | Mean                    | SD   | F-ratio           | p-level |
| 3         | 46.88                  | 1.74 | 47.88                     | 1.13 | 47.01                   | 1.95 | 3.44              | 0.040*  |
| 4         | 47.53                  | 1.78 | 47.65                     | 2.06 | 48.44                   | 1.51 | 1.63              | 0.200   |
| 5         | 47.33                  | 1.58 | 48.16                     | 1.70 | 48.16                   | 1.13 | 3.19              | 0.040*  |
| 6         | 48.20                  | 1.60 | 48.67                     | 1.28 | 48.67                   | 1.25 | 2.20              | 0.120   |
| 7         | 48.97                  | 1.69 | 49.06                     | 1.68 | 49.24                   | 1.64 | 0.67              | 0.510   |
| 8         | 49.27                  | 1.72 | 49.63                     | 1.49 | 49.61                   | 1.28 | 0.62              | 0.540   |
| 9         | 49.88                  | 1.59 | 49.88                     | 1.57 | 50.69                   | 1.06 | 3.12              | 0.050*  |
| 10        | 49.91                  | 1.39 | 50.96                     | 1.13 | 51.05                   | 1.43 | 6.79              | 0.002*  |
| 11        | 50.03                  | 2.04 | 50.20                     | 1.43 | 51.00                   | 1.53 | 2.49              | 0.090   |
| 12        | 51.03                  | 1.37 | 51.50                     | 2.16 | 51.08                   | 0.61 | 1.12              | 0.330   |
| 13        | 51.57                  | 1.48 | 51.88                     | 1.47 | 51.92                   | 1.54 | 0.46              | 0.630   |
| 14        | 51.69                  | 1.44 | 52.09                     | 1.15 | 52.45                   | 1.40 | 2.01              | 0.140   |
| 15        | 51.97                  | 1.35 | 52.57                     | 1.27 | 52.73                   | 1.54 | 2.41              | 0.100   |
| 16        | 52.26                  | 1.62 | 53.18                     | 1.25 | 53.76                   | 1.20 | 6.84              | 0.002*  |
| 17        | 53.54                  | 1.47 | 53.52                     | 1.28 | 54.36                   | 1.53 | 1.43              | 0.250   |
| 18        | 53.63                  | 1.61 | 54.16                     | 1.51 | 54.44                   | 1.39 | 1.45              | 0.240   |

\*Significant

**Table 5.20.** Head circumference of girls according to income groups

| Age (yrs) | Low Income Group (LIG) |      | Middle Income Group (MIG) |      | High Income Group (HIG) |      | ANCOVA-Statistics |         |
|-----------|------------------------|------|---------------------------|------|-------------------------|------|-------------------|---------|
|           | Mean                   | SD   | Mean                      | SD   | Mean                    | SD   | F-ratio           | p-level |
| 3         | 46.79                  | 1.57 | 46.25                     | 2.89 | 47.31                   | 1.23 | 1.72              | 0.29    |
| 4         | 47.32                  | 1.76 | 47.13                     | 1.55 | 47.37                   | 1.85 | 0.11              | 0.90    |
| 5         | 47.87                  | 1.75 | 48.37                     | 1.59 | 48.01                   | 1.51 | 1.16              | 0.32    |
| 6         | 48.78                  | 1.31 | 48.23                     | 2.21 | 49.42                   | 1.34 | 3.40              | 0.04*   |
| 7         | 49.20                  | 1.22 | 49.40                     | 1.16 | 49.28                   | 1.21 | 0.31              | 0.73    |
| 8         | 49.47                  | 1.26 | 49.11                     | 1.46 | 49.69                   | 1.26 | 1.37              | 0.26    |
| 9         | 49.82                  | 1.22 | 49.91                     | 1.44 | 50.16                   | 1.21 | 0.39              | 0.68    |
| 10        | 49.54                  | 1.64 | 49.44                     | 1.58 | 50.53                   | 1.13 | 3.53              | 0.03*   |
| 11        | 49.93                  | 1.45 | 50.32                     | 1.36 | 50.46                   | 1.32 | 1.10              | 0.34    |
| 12        | 51.49                  | 2.46 | 50.47                     | 1.59 | 51.27                   | 1.58 | 1.95              | 0.15    |
| 13        | 51.22                  | 0.93 | 51.46                     | 1.14 | 51.80                   | 1.24 | 2.07              | 0.13    |
| 14        | 51.44                  | 1.49 | 52.02                     | 1.23 | 52.44                   | 1.17 | 3.76              | 0.03*   |
| 15        | 52.31                  | 1.28 | 52.64                     | 1.17 | 52.59                   | 1.57 | 0.60              | 0.55    |
| 16        | 52.81                  | 1.29 | 52.84                     | 1.48 | 53.00                   | 1.07 | 0.27              | 0.76    |
| 17        | 52.40                  | 1.56 | 52.98                     | 1.79 | 53.93                   | 1.27 | 3.63              | 0.03*   |
| 18        | 52.87                  | 1.46 | 53.46                     | 1.46 | 53.72                   | 1.92 | 1.56              | 0.22    |

\*Significant

**Table 5.21.** Upper arm circumference of boys according to income groups

| Age (yrs) | Low Income Group (LIG) |      | Middle Income Group (MIG) |      | High Income Group (HIG) |      | ANCOVA-Statistics |         |
|-----------|------------------------|------|---------------------------|------|-------------------------|------|-------------------|---------|
|           | Mean                   | SD   | Mean                      | SD   | Mean                    | SD   | F-ratio           | p-level |
| 3         | 13.39                  | 1.06 | 13.96                     | 0.93 | 14.04                   | 1.29 | 3.11              | 0.050*  |
| 4         | 14.05                  | 0.96 | 14.07                     | 1.02 | 14.13                   | 1.26 | 0.22              | 0.800   |
| 5         | 14.20                  | 1.24 | 14.80                     | 1.30 | 15.07                   | 0.92 | 3.46              | 0.040*  |
| 6         | 14.96                  | 1.35 | 15.34                     | 1.08 | 15.49                   | 1.03 | 1.94              | 0.150   |
| 7         | 15.54                  | 1.22 | 15.40                     | 1.00 | 15.66                   | 1.14 | 1.83              | 0.170   |
| 8         | 15.70                  | 1.35 | 15.87                     | 1.06 | 15.79                   | 1.12 | 0.15              | 0.860   |
| 9         | 15.86                  | 1.01 | 16.24                     | 1.25 | 16.78                   | 1.23 | 5.44              | 0.006*  |
| 10        | 16.38                  | 1.50 | 17.06                     | 1.06 | 17.23                   | 1.41 | 2.92              | 0.050*  |
| 11        | 16.71                  | 1.39 | 17.64                     | 0.87 | 18.31                   | 1.21 | 14.68             | 0.000*  |
| 12        | 17.10                  | 1.20 | 17.60                     | 1.01 | 18.03                   | 0.50 | 3.50              | 0.040*  |
| 13        | 18.27                  | 1.15 | 18.66                     | 1.31 | 19.00                   | 1.22 | 2.28              | 0.110   |
| 14        | 18.66                  | 1.25 | 19.22                     | 1.26 | 19.38                   | 1.21 | 4.03              | 0.020*  |
| 15        | 19.65                  | 1.39 | 20.20                     | 1.34 | 20.40                   | 1.11 | 2.42              | 0.100   |
| 16        | 20.05                  | 1.53 | 20.61                     | 1.40 | 21.11                   | 1.27 | 3.51              | 0.040*  |
| 17        | 21.24                  | 1.24 | 21.36                     | 1.67 | 22.18                   | 1.96 | 1.09              | 0.340   |
| 18        | 21.80                  | 1.58 | 22.16                     | 1.14 | 22.76                   | 1.44 | 2.23              | 0.120   |

\*Significant

Table 5.22. Upper arm circumference of girls according to income groups

| Age (yrs) | Low Income Group (LIG) |      | Middle Income Group (MIG) |      | High Income Group (HIG) |      | ANCOVA-Statistics |         |
|-----------|------------------------|------|---------------------------|------|-------------------------|------|-------------------|---------|
|           | Mean                   | SD   | Mean                      | SD   | Mean                    | SD   | F-ratio           | p-level |
| 3         | 13.38                  | 0.96 | 13.70                     | 0.85 | 13.76                   | 1.02 | 1.68              | 0.23    |
| 4         | 14.15                  | 1.32 | 13.86                     | 0.97 | 14.10                   | 1.31 | 1.66              | 0.20    |
| 5         | 14.50                  | 1.09 | 14.82                     | 1.02 | 15.31                   | 0.95 | 1.20              | 0.31    |
| 6         | 14.94                  | 1.28 | 14.79                     | 1.18 | 14.85                   | 1.24 | 0.01              | 0.99    |
| 7         | 15.41                  | 1.38 | 15.19                     | 1.19 | 15.37                   | 1.26 | 0.30              | 0.74    |
| 8         | 15.99                  | 1.28 | 15.66                     | 1.03 | 15.88                   | 1.21 | 0.47              | 0.58    |
| 9         | 16.34                  | 1.27 | 16.18                     | 1.31 | 16.62                   | 1.63 | 0.37              | 0.69    |
| 10        | 16.37                  | 1.11 | 17.00                     | 1.08 | 17.29                   | 1.48 | 4.36              | 0.02*   |
| 11        | 16.97                  | 1.59 | 17.45                     | 1.35 | 17.66                   | 0.95 | 2.01              | 0.14    |
| 12        | 16.53                  | 1.01 | 17.55                     | 1.59 | 18.32                   | 0.97 | 3.94              | 0.02*   |
| 13        | 18.52                  | 1.35 | 18.63                     | 1.35 | 18.85                   | 1.00 | 0.72              | 0.49    |
| 14        | 18.35                  | 1.39 | 19.70                     | 1.50 | 19.28                   | 1.21 | 7.89              | 0.01*   |
| 15        | 19.43                  | 1.57 | 19.99                     | 1.44 | 20.18                   | 1.35 | 1.50              | 0.23    |
| 16        | 20.56                  | 1.18 | 20.27                     | 1.57 | 21.07                   | 1.26 | 1.41              | 0.25    |
| 17        | 20.66                  | 1.81 | 20.85                     | 1.51 | 21.47                   | 1.33 | 1.04              | 0.36    |
| 18        | 20.70                  | 1.31 | 21.11                     | 1.23 | 21.48                   | 1.51 | 1.87              | 0.16    |

\*Significant

Table 5.23. Chest circumference of boys according to income groups

| Age (yrs) | Low Income Group (LIG) |      | Middle Income Group (MIG) |      | High Income Group (HIG) |      | ANCOVA-Statistics |         |
|-----------|------------------------|------|---------------------------|------|-------------------------|------|-------------------|---------|
|           | Mean                   | SD   | Mean                      | SD   | Mean                    | SD   | F-ratio           | p-level |
| 3         | 51.00                  | 4.40 | 51.94                     | 3.26 | 52.78                   | 4.66 | 0.86              | 0.430   |
| 4         | 54.16                  | 4.20 | 55.95                     | 5.30 | 56.88                   | 4.15 | 1.61              | 0.190   |
| 5         | 54.57                  | 3.25 | 55.48                     | 4.16 | 56.87                   | 3.30 | 2.12              | 0.130   |
| 6         | 56.36                  | 4.75 | 57.52                     | 5.24 | 56.62                   | 3.20 | 0.62              | 0.540   |
| 7         | 58.71                  | 4.69 | 59.10                     | 4.43 | 57.62                   | 5.74 | 0.27              | 0.770   |
| 8         | 59.16                  | 4.51 | 61.29                     | 5.03 | 62.29                   | 6.46 | 3.64              | 0.030*  |
| 9         | 60.40                  | 3.98 | 63.09                     | 4.71 | 64.56                   | 3.98 | 8.86              | 0.000*  |
| 10        | 62.57                  | 5.57 | 64.31                     | 5.36 | 67.53                   | 6.26 | 4.85              | 0.010*  |
| 11        | 65.42                  | 5.33 | 67.23                     | 2.97 | 69.68                   | 5.29 | 6.70              | 0.002*  |
| 12        | 67.34                  | 4.35 | 68.78                     | 4.92 | 73.47                   | 5.51 | 5.44              | 0.006*  |
| 13        | 71.73                  | 5.14 | 72.98                     | 6.50 | 76.19                   | 4.17 | 4.77              | 0.010*  |
| 14        | 74.94                  | 5.92 | 74.76                     | 4.80 | 77.85                   | 5.12 | 1.28              | 0.280   |
| 15        | 76.39                  | 4.25 | 78.98                     | 5.05 | 79.89                   | 3.02 | 4.71              | 0.010*  |
| 16        | 77.56                  | 4.26 | 80.20                     | 4.60 | 82.66                   | 5.56 | 6.58              | 0.002*  |
| 17        | 82.93                  | 5.09 | 83.67                     | 4.83 | 83.40                   | 5.21 | 0.41              | 0.670   |
| 18        | 84.95                  | 6.00 | 85.34                     | 5.38 | 88.74                   | 5.18 | 2.21              | 0.120   |

\*Significant

**Table 5.24.** Chest circumference of girls according to income groups

| Age (yrs) | Low Income Group (LIG) |      | Middle Income Group (MIG) |      | High Income Group (HIG) |      | ANCOVA-Statistics |         |
|-----------|------------------------|------|---------------------------|------|-------------------------|------|-------------------|---------|
|           | Mean                   | SD   | Mean                      | SD   | Mean                    | SD   | F-ratio           | p-level |
| 3         | 50.53                  | 4.55 | 51.06                     | 4.85 | 52.58                   | 3.71 | 1.68              | 0.32    |
| 4         | 53.35                  | 4.80 | 52.24                     | 3.92 | 54.60                   | 4.24 | 1.66              | 0.32    |
| 5         | 54.49                  | 4.01 | 55.50                     | 4.46 | 56.14                   | 4.06 | 1.20              | 0.31    |
| 6         | 56.70                  | 3.94 | 57.46                     | 5.80 | 60.40                   | 5.44 | 4.87              | 0.01*   |
| 7         | 57.90                  | 4.09 | 59.37                     | 5.00 | 60.32                   | 5.28 | 2.70              | 0.07    |
| 8         | 58.97                  | 3.94 | 58.07                     | 6.23 | 62.28                   | 5.31 | 4.57              | 0.01*   |
| 9         | 63.56                  | 6.22 | 61.48                     | 5.74 | 63.86                   | 4.10 | 1.01              | 0.37    |
| 10        | 62.04                  | 5.00 | 64.22                     | 5.41 | 66.58                   | 5.44 | 4.42              | 0.02*   |
| 11        | 65.42                  | 5.90 | 65.48                     | 4.71 | 68.21                   | 5.00 | 2.20              | 0.12    |
| 12        | 70.33                  | 6.79 | 69.36                     | 5.95 | 69.77                   | 4.96 | 0.08              | 0.92    |
| 13        | 70.14                  | 3.64 | 71.73                     | 5.68 | 71.81                   | 4.49 | 1.30              | 0.27    |
| 14        | 72.04                  | 5.08 | 75.38                     | 4.98 | 76.74                   | 4.38 | 6.53              | 0.01*   |
| 15        | 75.19                  | 5.67 | 76.03                     | 4.80 | 78.86                   | 4.44 | 2.55              | 0.08    |
| 16        | 78.65                  | 4.03 | 77.07                     | 4.88 | 80.97                   | 4.48 | 3.80              | 0.03*   |
| 17        | 78.07                  | 3.58 | 79.48                     | 4.24 | 83.00                   | 3.50 | 6.48              | 0.01*   |
| 18        | 78.83                  | 4.17 | 80.80                     | 5.45 | 81.57                   | 4.95 | 2.44              | 0.09    |

\*Significant

**RELIGION**

The effect of religion on growth pattern of the children in the present study may be briefly described as follows:

**Weight:** Tables 5.25 and 5.26 shows the means and standard deviations of body weight for boys and girls, respectively. The Tables show that with the exception of few cases, the Muslim boys and girls are heavier than their counterparts belonging to the other religious groups, viz., the Niam Khasis and Christians. The ANCOVA test also indicates that the differences between religious groups after adjusting for income of the household are significant in many age groups.

**Height and Sitting Height:** Like in the case of body weight, the Khasi Muslim children are taller than the Christian and Niam Khasi children (Tables 5.27 and 5.28). The ANCOVA test indicates that the differences between religious groups are significant in many age groups. Thus, it indicates that religion also plays an important role in influencing body weight and height of the children in the present study. With respect to sitting height, Tables 5.29 and 5.30 show that, like in the case of height, the Muslim boys and girls are also higher in mean values of sitting height as compared with the Christian and Niam Khasi boys and girls across ages. It is found that the differences between religious groups after allowing for income are significant for many age groups.

**Table 5.25.** Mean weight of boys according to religious groups

| Age (yrs) | Muslims |      | Christians |      | Niam Khasis |      | ANCOVA-Statistics |         |
|-----------|---------|------|------------|------|-------------|------|-------------------|---------|
|           | Mean    | SD   | Mean       | SD   | Mean        | SD   | F-ratio           | p-level |
| 3         | 12.12   | 1.89 | 12.35      | 1.64 | 11.38       | 1.85 | 2.02              | 0.140   |
| 4         | 14.58   | 1.93 | 13.98      | 2.36 | 13.56       | 1.84 | 1.69              | 0.190   |
| 5         | 17.13   | 1.57 | 16.11      | 2.10 | 15.50       | 1.56 | 7.18              | 0.001*  |
| 6         | 17.87   | 0.92 | 16.73      | 2.60 | 16.92       | 1.26 | 3.52              | 0.030*  |
| 7         | 19.17   | 2.12 | 17.92      | 2.03 | 17.53       | 2.33 | 6.22              | 0.003*  |
| 8         | 22.28   | 3.33 | 20.55      | 2.54 | 19.89       | 2.37 | 8.02              | 0.001*  |
| 9         | 25.39   | 3.21 | 22.47      | 2.25 | 22.10       | 2.27 | 19.65             | 0.000*  |
| 10        | 26.79   | 3.24 | 25.02      | 2.58 | 22.66       | 3.33 | 12.47             | 0.000*  |
| 11        | 28.57   | 3.57 | 26.63      | 3.70 | 26.17       | 3.62 | 5.78              | 0.008*  |
| 12        | 30.43   | 2.83 | 28.17      | 3.20 | 28.51       | 3.27 | 3.07              | 0.050*  |
| 13        | 35.38   | 4.49 | 33.45      | 3.18 | 33.66       | 4.45 | 1.78              | 0.180   |
| 14        | 39.32   | 3.31 | 37.05      | 3.72 | 36.23       | 4.22 | 4.88              | 0.010*  |
| 15        | 44.33   | 3.92 | 40.74      | 4.09 | 40.81       | 4.19 | 7.51              | 0.001*  |
| 16        | 44.41   | 4.34 | 43.04      | 3.65 | 42.76       | 5.48 | 1.39              | 0.260   |
| 17        | 49.56   | 2.24 | 46.69      | 3.35 | 47.36       | 4.15 | 3.33              | 0.040*  |
| 18        | 50.21   | 2.92 | 48.36      | 3.32 | 48.63       | 5.02 | 1.32              | 0.270   |

\* Significant

**Table 5.26.** Mean weight of girls according to religious groups

| Age (yrs) | Muslims |      | Christians |      | Niam Khasis |      | ANCOVA-Statistics |         |
|-----------|---------|------|------------|------|-------------|------|-------------------|---------|
|           | Mean    | SD   | Mean       | SD   | Mean        | SD   | F-ratio           | p-level |
| 3         | 11.96   | 1.74 | 12.89      | 2.20 | 11.50       | 1.38 | 3.81              | 0.030*  |
| 4         | 14.13   | 2.16 | 14.12      | 2.08 | 13.51       | 1.93 | 1.56              | 0.220   |
| 5         | 16.04   | 1.96 | 15.38      | 1.91 | 15.76       | 1.68 | 1.73              | 0.180   |
| 6         | 19.17   | 2.40 | 17.45      | 2.30 | 16.84       | 2.03 | 11.00             | 0.000*  |
| 7         | 19.68   | 2.25 | 18.69      | 2.46 | 18.01       | 1.15 | 5.46              | 0.006*  |
| 8         | 22.34   | 2.58 | 19.47      | 2.02 | 19.95       | 2.04 | 14.85             | 0.000*  |
| 9         | 25.06   | 2.89 | 21.18      | 2.90 | 22.12       | 2.67 | 18.20             | 0.000*  |
| 10        | 26.05   | 3.21 | 24.14      | 3.45 | 24.32       | 3.80 | 3.72              | 0.030*  |
| 11        | 29.11   | 2.39 | 27.22      | 2.61 | 25.42       | 2.77 | 12.21             | 0.000*  |
| 12        | 32.48   | 2.73 | 30.97      | 3.64 | 29.71       | 3.28 | 4.41              | 0.020*  |
| 13        | 34.38   | 4.31 | 33.96      | 4.66 | 31.66       | 4.38 | 3.96              | 0.020*  |
| 14        | 38.12   | 5.34 | 37.53      | 4.32 | 36.47       | 5.45 | 0.67              | 0.510   |
| 15        | 42.40   | 4.03 | 40.93      | 2.82 | 40.29       | 4.56 | 2.10              | 0.130   |
| 16        | 44.80   | 3.18 | 42.77      | 2.86 | 42.44       | 4.66 | 4.01              | 0.020*  |
| 17        | 44.32   | 5.13 | 44.88      | 3.16 | 44.21       | 4.80 | 0.04              | 0.960   |
| 18        | 44.20   | 4.70 | 44.81      | 4.25 | 44.17       | 5.86 | 0.08              | 0.920   |

\* Significant

**Table 5.27.** Mean height of boys according to religious groups

| Age (yrs) | Muslims |      | Christians |      | Niam Khasis |      | ANCOVA-Statistics |         |
|-----------|---------|------|------------|------|-------------|------|-------------------|---------|
|           | Mean    | SD   | Mean       | SD   | Mean        | SD   | F-ratio           | p-level |
| 3         | 84.72   | 3.52 | 86.65      | 5.80 | 87.44       | 5.62 | 2.57              | 0.080   |
| 4         | 92.72   | 6.28 | 91.70      | 5.00 | 92.99       | 4.37 | 1.14              | 0.330   |
| 5         | 99.96   | 5.20 | 96.47      | 7.02 | 98.11       | 6.13 | 4.12              | 0.002*  |
| 6         | 105.20  | 6.29 | 101.00     | 7.47 | 103.97      | 7.62 | 8.43              | 0.000*  |
| 7         | 110.30  | 6.91 | 108.49     | 6.37 | 107.71      | 5.95 | 3.85              | 0.030*  |
| 8         | 116.44  | 7.07 | 113.31     | 7.51 | 112.40      | 7.17 | 5.54              | 0.006*  |
| 9         | 122.74  | 4.25 | 119.02     | 6.42 | 117.26      | 6.83 | 9.99              | 0.000*  |
| 10        | 125.57  | 6.71 | 124.13     | 5.66 | 119.58      | 7.75 | 5.63              | 0.005*  |
| 11        | 129.02  | 5.07 | 126.85     | 5.48 | 123.38      | 6.94 | 7.35              | 0.001*  |
| 12        | 130.00  | 7.70 | 130.03     | 4.50 | 128.04      | 6.85 | 0.85              | 0.430   |
| 13        | 137.12  | 5.51 | 137.41     | 4.82 | 136.39      | 5.17 | 0.50              | 0.950   |
| 14        | 142.74  | 5.72 | 139.97     | 5.15 | 139.85      | 5.77 | 2.47              | 0.090   |
| 15        | 148.69  | 8.70 | 142.21     | 4.97 | 143.25      | 4.86 | 8.99              | 0.000*  |
| 16        | 149.99  | 7.10 | 145.00     | 7.22 | 146.05      | 4.60 | 6.45              | 0.003*  |
| 17        | 154.44  | 6.39 | 149.40     | 6.58 | 148.84      | 3.44 | 7.21              | 0.000*  |
| 18        | 157.48  | 6.32 | 154.05     | 6.73 | 153.64      | 4.66 | 2.76              | 0.070   |

\* Significant

**Table 5.28.** Mean height of girls according to religious groups

| Age (yrs) | Muslims |      | Christians |      | Niam Khasis |      | ANCOVA-Statistics |         |
|-----------|---------|------|------------|------|-------------|------|-------------------|---------|
|           | Mean    | SD   | Mean       | SD   | Mean        | SD   | F-ratio           | p-level |
| 3         | 86.18   | 4.89 | 86.43      | 4.96 | 86.56       | 4.84 | 0.33              | 0.720   |
| 4         | 91.84   | 4.71 | 89.62      | 6.46 | 90.99       | 5.18 | 2.27              | 0.110   |
| 5         | 99.61   | 4.55 | 95.27      | 7.14 | 96.96       | 4.54 | 5.18              | 0.008*  |
| 6         | 106.19  | 7.04 | 102.61     | 5.35 | 101.98      | 5.74 | 5.26              | 0.007*  |
| 7         | 110.66  | 8.64 | 108.07     | 5.31 | 107.77      | 6.84 | 3.24              | 0.040*  |
| 8         | 117.23  | 6.93 | 112.62     | 5.73 | 113.53      | 7.72 | 6.47              | 0.002*  |
| 9         | 121.56  | 6.32 | 117.82     | 5.47 | 117.58      | 8.15 | 3.88              | 0.030*  |
| 10        | 126.09  | 6.39 | 122.99     | 6.30 | 119.86      | 7.09 | 6.23              | 0.003*  |
| 11        | 128.37  | 3.63 | 126.97     | 6.18 | 124.14      | 6.36 | 4.66              | 0.010*  |
| 12        | 137.10  | 6.53 | 136.47     | 6.94 | 132.51      | 6.17 | 4.34              | 0.020*  |
| 13        | 139.81  | 5.87 | 137.86     | 5.04 | 136.46      | 6.12 | 2.62              | 0.080   |
| 14        | 144.50  | 5.87 | 141.24     | 6.63 | 141.35      | 6.19 | 2.60              | 0.080   |
| 15        | 145.79  | 4.72 | 142.71     | 4.54 | 143.00      | 5.98 | 3.63              | 0.030*  |
| 16        | 146.99  | 3.41 | 145.24     | 5.09 | 145.59      | 6.35 | 1.69              | 0.190   |
| 17        | 147.96  | 6.99 | 146.76     | 6.44 | 146.44      | 6.48 | 1.02              | 0.370   |
| 18        | 148.19  | 5.72 | 146.82     | 7.61 | 146.87      | 6.42 | 0.75              | 0.480   |

\* Significant

**Table 5.29.** Mean sitting height of boys according to religious groups

| Age (yrs) | Muslims |      | Christians |      | Niam Khasis |      | ANCOVA-Statistics |         |
|-----------|---------|------|------------|------|-------------|------|-------------------|---------|
|           | Mean    | SD   | Mean       | SD   | Mean        | SD   | F-ratio           | p-level |
| 3         | 45.51   | 3.45 | 46.08      | 5.37 | 45.60       | 2.16 | 0.15              | 0.860   |
| 4         | 50.54   | 3.47 | 47.87      | 4.94 | 49.12       | 3.90 | 2.79              | 0.070   |
| 5         | 53.77   | 5.09 | 49.84      | 5.36 | 50.31       | 3.98 | 5.25              | 0.007*  |
| 6         | 58.75   | 6.86 | 54.33      | 4.15 | 52.96       | 5.30 | 10.98             | 0.000*  |
| 7         | 58.66   | 3.91 | 54.92      | 4.34 | 53.75       | 3.89 | 13.95             | 0.000*  |
| 8         | 61.99   | 4.09 | 59.04      | 3.86 | 57.76       | 4.42 | 8.17              | 0.001*  |
| 9         | 65.24   | 3.76 | 62.12      | 3.72 | 59.44       | 5.51 | 15.39             | 0.000*  |
| 10        | 65.29   | 3.68 | 64.18      | 3.53 | 61.14       | 4.70 | 7.79              | 0.001*  |
| 11        | 66.90   | 3.60 | 66.21      | 4.31 | 61.56       | 5.48 | 11.52             | 0.000*  |
| 12        | 68.58   | 5.76 | 67.58      | 3.20 | 65.04       | 4.81 | 4.23              | 0.020*  |
| 13        | 70.77   | 4.55 | 72.06      | 3.53 | 70.70       | 4.58 | 0.51              | 0.610   |
| 14        | 75.13   | 2.94 | 73.35      | 3.52 | 72.27       | 4.31 | 3.88              | 0.030*  |
| 15        | 78.92   | 4.73 | 76.52      | 2.90 | 74.06       | 4.35 | 9.54              | 0.000*  |
| 16        | 78.83   | 4.17 | 77.01      | 3.79 | 76.13       | 3.67 | 4.34              | 0.020*  |
| 17        | 81.51   | 2.19 | 79.82      | 3.50 | 77.83       | 3.96 | 7.57              | 0.001*  |
| 18        | 83.17   | 2.67 | 80.99      | 3.47 | 78.69       | 4.02 | 9.22              | 0.000*  |

\* Significant

**Table 5.30.** Mean sitting height of girls according to religious groups

| Age (yrs) | Muslims |      | Christians |      | Niam Khasis |      | ANCOVA-Statistics |         |
|-----------|---------|------|------------|------|-------------|------|-------------------|---------|
|           | Mean    | SD   | Mean       | SD   | Mean        | SD   | F-ratio           | p-level |
| 3         | 46.68   | 2.68 | 47.03      | 3.82 | 46.77       | 2.45 | 0.03              | 0.970   |
| 4         | 49.91   | 3.80 | 47.40      | 4.47 | 47.27       | 3.77 | 1.09              | 0.340   |
| 5         | 55.57   | 3.00 | 51.56      | 4.88 | 51.96       | 3.62 | 8.85              | 0.000*  |
| 6         | 58.67   | 4.64 | 53.52      | 4.78 | 52.28       | 4.28 | 17.84             | 0.000*  |
| 7         | 58.51   | 4.30 | 56.46      | 3.83 | 56.21       | 4.55 | 3.79              | 0.030*  |
| 8         | 61.14   | 6.03 | 57.72      | 3.84 | 58.46       | 4.86 | 3.56              | 0.030*  |
| 9         | 64.18   | 3.27 | 61.69      | 3.27 | 60.65       | 4.59 | 6.42              | 0.003*  |
| 10        | 66.67   | 2.94 | 64.48      | 3.74 | 61.19       | 5.69 | 9.95              | 0.000*  |
| 11        | 65.79   | 3.42 | 67.75      | 4.62 | 62.97       | 4.24 | 9.87              | 0.000*  |
| 12        | 72.53   | 3.29 | 70.45      | 4.19 | 68.05       | 4.42 | 8.32              | 0.001*  |
| 13        | 73.02   | 4.26 | 72.41      | 3.83 | 68.86       | 5.14 | 7.54              | 0.001*  |
| 14        | 74.98   | 3.91 | 75.04      | 3.14 | 73.06       | 4.94 | 2.00              | 0.140   |
| 15        | 77.38   | 3.15 | 77.41      | 2.06 | 74.64       | 4.14 | 6.13              | 0.003*  |
| 16        | 78.98   | 2.69 | 77.71      | 2.65 | 75.59       | 3.55 | 9.27              | 0.000*  |
| 17        | 78.59   | 4.62 | 79.21      | 3.67 | 77.56       | 4.29 | 0.95              | 0.390   |
| 18        | 78.78   | 3.38 | 79.21      | 3.74 | 78.10       | 3.57 | 0.85              | 0.430   |

\* Significant

**Biacromial and bi-iliac diameter:** The means and standard deviations of biacromial diameter according to religious groups are given in Tables 5.31 and 5.32 for boys and girls, respectively, while those for bi-iliac diameter are presented in Tables 5.33 and 5.34, respectively. It is seen from Table 5.31 the Muslim boys have broader shoulder than the Christian and Niam Khasi boys, especially from 14 years onwards. In the case of girls, Table 5.32 also shows the higher mean values in the Muslims, although they are surpassed by the Christian girls especially from 7 to 8 and 12 to 13 years of age.

With respect to bi-iliac diameter, Tables 5.33 and 5.34 show that, like in the case of other measurements, the Muslim children have a significant broader hip when compared to the Christian and Niam Khasi children.

**Table 5.31.** Biacromial diameter of boys according to religious groups

| Age (yrs) | Muslims |      | Christians |      | Niam Khasis |      | ANCOVA-Statistics |         |
|-----------|---------|------|------------|------|-------------|------|-------------------|---------|
|           | Mean    | SD   | Mean       | SD   | Mean        | SD   | F-ratio           | p-level |
| 3         | 19.38   | 1.31 | 19.88      | 1.21 | 19.82       | 1.10 | 1.32              | 0.270   |
| 4         | 20.72   | 1.29 | 20.63      | 1.72 | 20.47       | 1.63 | 0.16              | 0.850   |
| 5         | 21.70   | 1.74 | 21.94      | 1.34 | 21.41       | 1.58 | 0.47              | 0.630   |
| 6         | 22.67   | 1.33 | 22.97      | 1.39 | 22.88       | 1.63 | 0.15              | 0.870   |
| 7         | 23.61   | 1.69 | 23.49      | 1.09 | 22.87       | 1.63 | 3.16              | 0.050*  |
| 8         | 23.67   | 2.08 | 24.85      | 1.43 | 24.29       | 1.61 | 2.13              | 0.130   |
| 9         | 25.28   | 1.19 | 25.96      | 1.84 | 25.09       | 2.02 | 1.06              | 0.350   |
| 10        | 26.69   | 2.79 | 27.12      | 1.91 | 25.48       | 2.32 | 3.52              | 0.030*  |
| 11        | 27.83   | 1.79 | 27.68      | 2.46 | 26.78       | 2.80 | 1.47              | 0.240   |
| 12        | 28.93   | 1.70 | 28.12      | 1.63 | 27.83       | 1.81 | 2.30              | 0.110   |
| 13        | 29.86   | 1.82 | 30.53      | 1.56 | 29.96       | 2.27 | 0.65              | 0.520   |
| 14        | 31.32   | 1.35 | 31.10      | 1.33 | 30.27       | 1.71 | 3.65              | 0.030*  |
| 15        | 33.00   | 1.89 | 31.41      | 1.44 | 31.14       | 1.46 | 10.48             | 0.000*  |
| 16        | 32.82   | 1.98 | 32.10      | 1.24 | 31.87       | 1.44 | 3.51              | 0.040*  |
| 17        | 34.31   | 2.05 | 32.43      | 1.41 | 32.53       | 1.30 | 8.83              | 0.000*  |
| 18        | 34.57   | 1.73 | 33.28      | 1.37 | 33.62       | 2.15 | 3.08              | 0.050*  |

\* Significant

**Table 5.32.** Biacromial diameter of girls according to religious groups

| Age (yrs) | Muslims |      | Christians |      | Niam Khasis |      | ANCOVA-Statistics |         |
|-----------|---------|------|------------|------|-------------|------|-------------------|---------|
|           | Mean    | SD   | Mean       | SD   | Mean        | SD   | F-ratio           | p-level |
| 3         | 19.44   | 1.24 | 19.88      | 0.95 | 19.35       | 1.54 | 1.42              | 0.250   |
| 4         | 20.76   | 1.85 | 20.18      | 2.03 | 20.35       | 1.61 | 1.09              | 0.340   |
| 5         | 22.08   | 1.35 | 22.15      | 1.74 | 22.06       | 1.48 | 0.06              | 0.940   |
| 6         | 22.78   | 1.68 | 22.91      | 1.61 | 22.51       | 2.41 | 0.31              | 0.740   |
| 7         | 22.96   | 1.86 | 24.07      | 1.94 | 23.09       | 1.53 | 3.25              | 0.040*  |
| 8         | 24.14   | 2.06 | 24.88      | 1.49 | 24.20       | 2.00 | 1.26              | 0.290   |
| 9         | 26.23   | 1.28 | 26.02      | 1.67 | 25.12       | 1.89 | 3.66              | 0.030*  |
| 10        | 26.84   | 1.99 | 26.17      | 2.01 | 26.35       | 2.42 | 1.06              | 0.350   |
| 11        | 27.72   | 1.88 | 27.30      | 2.16 | 26.41       | 1.62 | 3.29              | 0.040*  |
| 12        | 29.77   | 1.45 | 30.01      | 1.90 | 28.53       | 2.27 | 4.96              | 0.009*  |
| 13        | 30.23   | 1.22 | 30.46      | 1.69 | 29.42       | 2.14 | 3.22              | 0.050*  |
| 14        | 30.97   | 1.81 | 31.21      | 1.94 | 30.68       | 1.99 | 0.31              | 0.740   |
| 15        | 31.90   | 1.35 | 31.64      | 1.29 | 31.34       | 1.49 | 1.08              | 0.340   |
| 16        | 32.07   | 1.55 | 32.28      | 0.97 | 31.72       | 1.74 | 0.86              | 0.430   |
| 17        | 33.04   | 1.92 | 32.50      | 1.12 | 31.93       | 1.72 | 2.94              | 0.060   |
| 18        | 32.31   | 1.08 | 32.85      | 1.38 | 32.36       | 1.42 | 1.16              | 0.320   |

\* Significant

**Table 5.33.** Biiliac diameter of boys according to religious groups

| Age (yrs) | Muslims |      | Christians |      | Niam Khasis |      | ANCOVA-Statistics |         |
|-----------|---------|------|------------|------|-------------|------|-------------------|---------|
|           | Mean    | SD   | Mean       | SD   | Mean        | SD   | F-ratio           | p-level |
| 3         | 15.23   | 1.42 | 15.84      | 0.88 | 15.32       | 1.07 | 2.15              | 0.120   |
| 4         | 16.21   | 1.03 | 16.25      | 1.35 | 16.06       | 1.25 | 1.11              | 0.890   |
| 5         | 16.90   | 1.21 | 16.64      | 0.76 | 16.68       | 1.19 | 0.65              | 0.520   |
| 6         | 17.74   | 0.81 | 17.65      | 1.23 | 17.62       | 1.41 | 0.54              | 0.590   |
| 7         | 18.63   | 1.54 | 17.90      | 1.24 | 17.78       | 1.18 | 5.47              | 0.006*  |
| 8         | 18.69   | 1.35 | 19.20      | 1.24 | 18.75       | 1.23 | 1.02              | 0.370   |
| 9         | 19.71   | 1.44 | 19.64      | 1.39 | 19.48       | 1.67 | 0.84              | 0.440   |
| 10        | 20.22   | 1.96 | 20.66      | 1.76 | 19.82       | 1.81 | 1.21              | 0.300   |
| 11        | 21.09   | 1.65 | 21.19      | 1.75 | 20.72       | 2.08 | 0.33              | 0.720   |
| 12        | 22.49   | 2.14 | 21.78      | 1.69 | 21.89       | 1.93 | 0.78              | 0.460   |
| 13        | 23.21   | 2.07 | 23.16      | 2.08 | 23.46       | 2.57 | 0.40              | 0.670   |
| 14        | 24.30   | 2.09 | 23.73      | 2.17 | 23.46       | 2.19 | 0.93              | 0.400   |
| 15        | 25.07   | 2.03 | 23.76      | 1.77 | 23.81       | 2.05 | 3.47              | 0.040*  |
| 16        | 25.41   | 1.95 | 23.42      | 2.16 | 24.60       | 1.73 | 12.00             | 0.000*  |
| 17        | 25.97   | 2.04 | 24.78      | 1.16 | 24.78       | 1.58 | 3.53              | 0.040*  |
| 18        | 27.15   | 1.55 | 25.75      | 1.79 | 26.07       | 1.66 | 3.89              | 0.030*  |

\* Significant

**Table 5.34.** Biiliac diameter of girls according to religious groups

| Age (yrs) | Muslims |      | Christians |      | Niam Khasis |      | ANCOVA-Statistics |         |
|-----------|---------|------|------------|------|-------------|------|-------------------|---------|
|           | Mean    | SD   | Mean       | SD   | Mean        | SD   | F-ratio           | p-level |
| 3         | 15.37   | 1.00 | 15.73      | 0.85 | 15.33       | 1.07 | 1.18              | 0.310   |
| 4         | 16.14   | 1.17 | 16.03      | 1.21 | 16.07       | 1.30 | 0.29              | 0.750   |
| 5         | 17.43   | 1.05 | 16.72      | 1.34 | 17.11       | 0.94 | 2.88              | 0.060   |
| 6         | 17.76   | 1.45 | 17.52      | 1.45 | 17.35       | 1.64 | 0.69              | 0.510   |
| 7         | 17.84   | 1.45 | 18.56      | 1.66 | 18.14       | 1.29 | 1.73              | 0.180   |
| 8         | 18.17   | 1.98 | 18.95      | 1.50 | 18.47       | 1.48 | 0.87              | 0.430   |
| 9         | 20.75   | 1.24 | 19.69      | 1.28 | 19.04       | 1.45 | 11.85             | 0.000*  |
| 10        | 21.00   | 1.50 | 19.93      | 1.50 | 20.20       | 1.77 | 3.77              | 0.030*  |
| 11        | 21.42   | 1.54 | 20.63      | 1.40 | 20.19       | 1.63 | 3.79              | 0.030*  |
| 12        | 23.23   | 1.60 | 23.31      | 2.20 | 21.96       | 2.29 | 3.89              | 0.020*  |
| 13        | 23.89   | 2.31 | 23.49      | 2.06 | 22.57       | 2.07 | 2.80              | 0.070   |
| 14        | 24.12   | 2.02 | 24.36      | 2.38 | 24.21       | 2.27 | 0.05              | 0.950   |
| 15        | 24.91   | 2.01 | 24.05      | 2.08 | 24.39       | 1.85 | 1.38              | 0.260   |
| 16        | 25.00   | 2.08 | 25.22      | 2.02 | 25.06       | 1.95 | 0.01              | 0.990   |
| 17        | 25.27   | 2.37 | 24.93      | 1.65 | 24.60       | 1.64 | 1.01              | 0.370   |
| 18        | 25.68   | 1.92 | 25.40      | 1.81 | 25.49       | 2.00 | 0.15              | 0.860   |

• Significant

**Head, Arm and Chest circumferences:** The means and standard deviations of head circumference according to religious groups for boys and girls are shown in Tables 5.35 and 5.36, respectively. It is seen that in the case of boys there is no significant difference between religious groups in respect of head circumference, except at the ages of 6 and 10 years, which is significantly higher in the Muslim and Christian boys, respectively. In the case of girls, the Christians are significantly higher than the other two religious groups at 6, 7, 13, 17 and 18 years of age. Thus, unlike in the case of other measurements, the Christian girls seem to be higher in head circumference when compared with the Muslim and Niam Khasi girls.

With respect to mid upper arm circumference, Table 5.37 shows that with the exception of few cases, the Muslim boys are significantly higher than the Christian and Niam Khasi boys in many age groups. The same is true in the case of girls (Table 5.38). Thus, it indicates that there are significant differences between religious groups in respect of mid upper arm circumference. However, it may be noted that such differences are mainly due to the differences between the Muslim and other religious groups.

The same trend is observed with respect to chest circumference, which indicates that the Muslim boys and girls are significantly higher in mean values for many age groups (Tables 5.39 and 5.40).

Table 5.35. Head circumference of boys according to religious groups

| Age (yrs) | Muslims |      | Christians |      | Niam Khasis |      | ANCOVA-Statistics |         |
|-----------|---------|------|------------|------|-------------|------|-------------------|---------|
|           | Mean    | SD   | Mean       | SD   | Mean        | SD   | F-ratio           | p-level |
| 3         | 47.29   | 1.64 | 47.80      | 1.27 | 46.68       | 1.81 | 3.78              | 0.130   |
| 4         | 47.99   | 1.54 | 48.04      | 2.05 | 47.29       | 1.78 | 1.37              | 0.260   |
| 5         | 48.13   | 0.96 | 47.80      | 1.90 | 47.66       | 1.70 | 0.82              | 0.440   |
| 6         | 49.10   | 0.99 | 48.47      | 1.49 | 48.08       | 1.58 | 4.24              | 0.001*  |
| 7         | 49.42   | 1.16 | 49.11      | 1.97 | 48.76       | 1.64 | 1.64              | 0.200   |
| 8         | 49.47   | 1.54 | 49.91      | 1.56 | 49.10       | 1.48 | 2.08              | 0.130   |
| 9         | 49.93   | 1.26 | 50.46      | 1.57 | 49.98       | 1.52 | 0.69              | 0.500   |
| 10        | 50.59   | 1.28 | 51.06      | 1.21 | 50.05       | 1.54 | 3.75              | 0.030*  |
| 11        | 50.62   | 1.40 | 50.70      | 1.42 | 49.85       | 2.17 | 1.84              | 0.170   |
| 12        | 51.31   | 1.02 | 51.30      | 1.40 | 51.17       | 2.18 | 0.44              | 0.960   |
| 13        | 51.65   | 1.64 | 52.09      | 1.71 | 51.56       | 1.11 | 0.94              | 0.390   |
| 14        | 51.97   | 1.08 | 52.30      | 1.33 | 51.81       | 1.49 | 0.78              | 0.460   |
| 15        | 52.67   | 1.27 | 52.51      | 1.51 | 51.97       | 1.29 | 1.61              | 0.210   |
| 16        | 52.93   | 0.90 | 53.30      | 1.60 | 52.58       | 1.69 | 1.18              | 0.310   |
| 17        | 53.73   | 1.29 | 54.02      | 1.52 | 53.34       | 1.29 | 1.74              | 0.180   |
| 18        | 53.94   | 1.40 | 54.49      | 1.48 | 53.72       | 1.64 | 1.55              | 0.220   |

\*Significant

Table 5.36. Head circumference of girls according to religious groups

| Age (yrs) | Muslims |      | Christians |      | Niam Khasis |      | ANCOVA-Statistics |         |
|-----------|---------|------|------------|------|-------------|------|-------------------|---------|
|           | Mean    | SD   | Mean       | SD   | Mean        | SD   | F-ratio           | p-level |
| 3         | 46.36   | 2.57 | 47.25      | 1.65 | 46.44       | 2.24 | 1.41              | 0.250   |
| 4         | 47.86   | 1.45 | 47.37      | 1.80 | 46.78       | 1.66 | 2.08              | 0.050*  |
| 5         | 48.57   | 1.86 | 48.10      | 1.68 | 47.77       | 1.41 | 1.83              | 0.170   |
| 6         | 48.93   | 1.15 | 49.35      | 1.44 | 48.20       | 1.97 | 4.07              | 0.020*  |
| 7         | 49.41   | 1.07 | 49.67      | 0.96 | 48.87       | 1.28 | 4.34              | 0.020*  |
| 8         | 49.48   | 1.22 | 49.56      | 1.52 | 49.09       | 1.31 | 1.09              | 0.340   |
| 9         | 49.85   | 0.84 | 50.31      | 1.32 | 49.61       | 1.53 | 2.24              | 0.120   |
| 10        | 50.20   | 1.16 | 49.67      | 1.88 | 49.49       | 1.43 | 1.90              | 0.160   |
| 11        | 50.59   | 1.21 | 50.10      | 1.56 | 49.99       | 1.29 | 1.46              | 0.240   |
| 12        | 51.34   | 2.44 | 51.24      | 1.73 | 50.56       | 1.61 | 1.49              | 0.230   |
| 13        | 51.54   | 1.24 | 51.78      | 1.18 | 51.08       | 0.83 | 3.11              | 0.050*  |
| 14        | 51.66   | 1.29 | 52.34      | 1.32 | 51.69       | 1.41 | 1.96              | 0.150   |
| 15        | 52.31   | 1.23 | 52.71      | 1.22 | 52.43       | 1.38 | 0.67              | 0.520   |
| 16        | 52.75   | 1.08 | 53.36      | 1.40 | 52.60       | 1.37 | 2.52              | 0.090   |
| 17        | 51.93   | 1.57 | 53.74      | 1.39 | 52.82       | 1.71 | 5.51              | 0.006*  |
| 18        | 52.30   | 1.38 | 54.10      | 1.54 | 53.15       | 1.56 | 7.90              | 0.001*  |

\*Significant

**Table 5.37.** Upper arm circumference of boys according to religious groups

| Age (yrs) | Muslims |      | Christians |      | Niam Khasis |      | ANCOVA-Statistics |         |
|-----------|---------|------|------------|------|-------------|------|-------------------|---------|
|           | Mean    | SD   | Mean       | SD   | Mean        | SD   | F-ratio           | p-level |
| 3         | 13.77   | 0.87 | 14.13      | 0.98 | 13.20       | 1.14 | 6.04              | 0.004*  |
| 4         | 14.35   | 1.11 | 14.37      | 0.94 | 13.65       | 0.92 | 5.28              | 0.007*  |
| 5         | 15.07   | 1.48 | 14.53      | 0.95 | 14.34       | 1.26 | 3.09              | 0.050*  |
| 6         | 15.73   | 0.10 | 15.11      | 1.25 | 14.89       | 1.34 | 4.38              | 0.002*  |
| 7         | 16.18   | 1.12 | 15.31      | 1.00 | 15.20       | 1.00 | 8.97              | 0.000*  |
| 8         | 15.67   | 1.75 | 16.00      | 0.85 | 15.65       | 1.11 | 0.69              | 0.510   |
| 9         | 16.42   | 1.41 | 16.48      | 1.15 | 15.99       | 1.09 | 1.52              | 0.220   |
| 10        | 17.48   | 1.24 | 16.86      | 1.13 | 16.26       | 1.50 | 5.42              | 0.006*  |
| 11        | 17.94   | 1.04 | 17.74      | 1.21 | 16.82       | 1.49 | 7.00              | 0.002*  |
| 12        | 18.08   | 0.73 | 17.22      | 1.19 | 17.10       | 1.08 | 5.57              | 0.005*  |
| 13        | 18.86   | 1.04 | 18.66      | 1.13 | 18.40       | 1.45 | 0.64              | 0.530   |
| 14        | 19.62   | 0.73 | 19.20      | 1.06 | 18.55       | 1.50 | 5.38              | 0.006*  |
| 15        | 20.60   | 1.29 | 20.08      | 1.06 | 19.55       | 1.47 | 4.02              | 0.020*  |
| 16        | 21.03   | 1.12 | 20.82      | 0.95 | 19.84       | 1.74 | 6.31              | 0.003*  |
| 17        | 22.41   | 1.29 | 21.28      | 1.36 | 21.09       | 1.78 | 1.74              | 0.180   |
| 18        | 22.73   | 1.28 | 22.03      | 1.10 | 21.99       | 1.60 | 1.98              | 0.150   |

\* Significant

**Table 5.38.** Upper arm circumference of girls according to religious groups

| Age (yrs) | Muslims |      | Christians |      | Niam Khasis |      | ANCOVA-Statistics |         |
|-----------|---------|------|------------|------|-------------|------|-------------------|---------|
|           | Mean    | SD   | Mean       | SD   | Mean        | SD   | F-ratio           | p-level |
| 3         | 13.89   | 0.78 | 13.90      | 0.78 | 13.12       | 0.99 | 9.54              | 0.000*  |
| 4         | 14.57   | 1.30 | 14.14      | 1.04 | 13.60       | 1.11 | 5.05              | 0.009*  |
| 5         | 14.95   | 0.78 | 14.94      | 1.05 | 14.48       | 1.21 | 2.42              | 0.090   |
| 6         | 15.49   | 1.55 | 14.88      | 0.61 | 14.37       | 1.18 | 6.59              | 0.002*  |
| 7         | 15.59   | 1.55 | 15.38      | 1.12 | 15.11       | 1.20 | 1.04              | 0.360   |
| 8         | 16.65   | 1.22 | 15.62      | 1.06 | 15.39       | 0.85 | 10.45             | 0.000*  |
| 9         | 16.89   | 1.38 | 16.41      | 1.27 | 15.78       | 1.25 | 5.13              | 0.008*  |
| 10        | 17.10   | 1.06 | 17.21      | 1.42 | 15.40       | 1.05 | 3.56              | 0.030*  |
| 11        | 17.75   | 1.39 | 17.57      | 1.35 | 16.68       | 1.33 | 5.09              | 0.008*  |
| 12        | 18.35   | 0.99 | 18.36      | 1.00 | 17.60       | 1.65 | 3.48              | 0.040*  |
| 13        | 18.88   | 1.43 | 19.01      | 0.94 | 18.16       | 1.30 | 4.22              | 0.020*  |
| 14        | 19.14   | 1.45 | 19.25      | 1.35 | 18.91       | 1.69 | 0.23              | 0.800   |
| 15        | 20.51   | 1.17 | 20.03      | 1.57 | 19.18       | 1.69 | 6.47              | 0.002*  |
| 16        | 21.20   | 1.07 | 20.85      | 1.13 | 19.85       | 1.56 | 8.28              | 0.001*  |
| 17        | 20.95   | 1.64 | 21.47      | 0.91 | 20.38       | 1.86 | 3.19              | 0.050*  |
| 18        | 20.85   | 1.26 | 21.43      | 0.95 | 20.69       | 1.50 | 2.42              | 0.100   |

\* Significant

**Table 5.39.** Chest circumference of boys according to religious groups

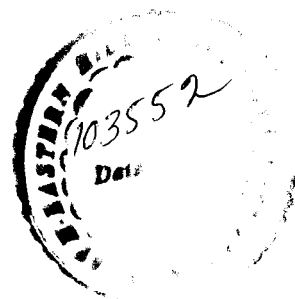
| Age (yrs) | Muslims |      | Christians |      | Niam Khasis |      | ANCOVA-Statistics |         |
|-----------|---------|------|------------|------|-------------|------|-------------------|---------|
|           | Mean    | SD   | Mean       | SD   | Mean        | SD   | F-ratio           | p-level |
| 3         | 52.02   | 3.05 | 53.89      | 4.22 | 49.06       | 3.00 | 14.93             | 0.000*  |
| 4         | 54.69   | 3.83 | 57.00      | 5.20 | 52.29       | 3.42 | 10.59             | 0.000*  |
| 5         | 55.57   | 2.89 | 56.38      | 4.62 | 54.37       | 3.17 | 1.86              | 0.160   |
| 6         | 57.80   | 3.47 | 57.10      | 5.31 | 55.67       | 4.39 | 1.62              | 0.200   |
| 7         | 59.74   | 3.82 | 60.10      | 5.00 | 56.54       | 4.58 | 56.52             | 0.006*  |
| 8         | 62.13   | 4.95 | 61.96      | 5.04 | 58.66       | 5.17 | 4.95              | 0.009*  |
| 9         | 63.81   | 4.51 | 63.53      | 4.84 | 60.90       | 3.87 | 4.83              | 0.010*  |
| 10        | 66.50   | 6.29 | 66.25      | 4.55 | 61.14       | 5.55 | 8.66              | 0.000*  |
| 11        | 69.51   | 3.54 | 67.88      | 5.03 | 64.84       | 4.96 | 7.84              | 0.001*  |
| 12        | 72.33   | 4.36 | 67.86      | 4.98 | 66.78       | 4.15 | 9.75              | 0.000*  |
| 13        | 73.35   | 4.83 | 74.43      | 5.27 | 72.57       | 6.37 | 0.39              | 0.680   |
| 14        | 77.14   | 4.96 | 76.68      | 5.96 | 73.57       | 5.16 | 3.55              | 0.030*  |
| 15        | 79.41   | 3.70 | 78.83      | 5.00 | 76.43       | 4.36 | 2.96              | 0.260   |
| 16        | 80.49   | 5.22 | 79.68      | 4.24 | 78.74       | 5.20 | 1.20              | 0.310   |
| 17        | 84.98   | 2.91 | 83.39      | 5.15 | 82.68       | 5.42 | 1.17              | 0.320   |
| 18        | 88.44   | 5.03 | 85.76      | 5.38 | 84.74       | 5.42 | 2.45              | 0.090   |

• Significant

**Table 5.40.** Chest circumference of girls according to religious groups

| Age (yrs) | Muslims |      | Christians |      | Niam Khasis |      | ANCOVA-Statistics |         |
|-----------|---------|------|------------|------|-------------|------|-------------------|---------|
|           | Mean    | SD   | Mean       | SD   | Mean        | SD   | F-ratio           | p-level |
| 3         | 50.47   | 4.57 | 53.35      | 4.66 | 49.85       | 3.65 | 5.18              | 0.007*  |
| 4         | 54.40   | 3.20 | 54.81      | 4.77 | 51.53       | 4.19 | 5.88              | 0.004*  |
| 5         | 54.65   | 1.85 | 57.30      | 5.45 | 53.62       | 3.31 | 6.95              | 0.002*  |
| 6         | 58.06   | 3.77 | 59.17      | 5.39 | 56.64       | 5.57 | 2.24              | 0.110   |
| 7         | 59.69   | 4.14 | 59.91      | 5.10 | 57.79       | 4.76 | 1.80              | 0.170   |
| 8         | 60.75   | 4.55 | 59.06      | 5.73 | 58.72       | 6.27 | 1.66              | 0.200   |
| 9         | 65.24   | 4.92 | 62.85      | 6.16 | 60.71       | 5.13 | 4.73              | 0.010*  |
| 10        | 64.90   | 4.73 | 65.28      | 5.53 | 62.52       | 5.74 | 1.94              | 0.150   |
| 11        | 67.58   | 5.80 | 67.05      | 5.31 | 63.64       | 4.31 | 4.95              | 0.010*  |
| 12        | 70.48   | 5.27 | 70.81      | 6.60 | 68.32       | 5.40 | 1.69              | 0.190   |
| 13        | 70.69   | 6.32 | 72.93      | 4.30 | 69.81       | 3.58 | 3.34              | 0.040*  |
| 14        | 75.06   | 4.60 | 75.91      | 4.89 | 72.69       | 5.52 | 2.91              | 0.060   |
| 15        | 78.03   | 4.42 | 76.49      | 5.11 | 74.82       | 5.39 | 2.65              | 0.080   |
| 16        | 80.08   | 4.13 | 79.13      | 3.08 | 76.72       | 5.76 | 4.14              | 0.020*  |
| 17        | 79.48   | 4.20 | 80.86      | 4.03 | 78.56       | 4.16 | 1.57              | 0.220   |
| 18        | 79.65   | 4.43 | 82.28      | 4.88 | 78.51       | 4.68 | 4.83              | 0.010*  |

\* Significant



## **CHAPTER -VI**

### **NUTRITIONAL STATUS**

In this chapter, we shall deal with the nutritional status of Khasi children taking into consideration the anthropometric indices like weight for height and body mass index, which are generally used as indicators of nutritional status. We shall also look into the relationship between these anthropometric indices and socioeconomic condition like religion and income of the household.

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#### **NUTRITIONAL STATUS**

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 undernutrition and infections in developing countries are poverty, poor hygienic conditions and little access to preventive and health care (Mitra, 1985; WHO, 1990). Hence, assessment of the nutritional status of population has attracted the attention of not only the nutritionists and other biological scientists, but also the economists and other social scientists with a view to understanding the health and socioeconomic status of the population (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 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 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, skinfold thickness, weight for age, height for age, weight for height, body mass index, indices of upper arm circumference, etc., (Jelliffe, 1966; Frisancho, 1990) are used for assessing the nutritional status of children.

In the present study, we have taken three important anthropometric indices, i.e., weight for age, height for age and body mass index, for assessing the nutritional status of the children in the present study. We shall also take into consideration how these three indices are associated with religion and income of the household. Thus, they may be presented briefly as follows:

### **Weight for age**

Weight for age, expressed as percentage of individual weight to the median or 50<sup>th</sup> percentile of the international population reference (i.e., NCHS reference or standard) is generally considered as one of the indicators of underweight. The means and standard deviations of the weight for age for the children of the present study are given in Table 6.1. It is seen that the mean weight for age is higher in girls than in boys from 3 to 7 years of age, except at the age of 5 when both boys and girls show a similar mean value.

It is also found that the differences between boys and girls in respect of mean weight for age are not statistically significant from 8 to 14 years of age, although the boys are higher in mean value at the age of 13, that is, during the maximum growth spurt of their adolescent period. On the other hand, the Table shows that the mean weight for age is significantly higher in girls than in boys from 14 to 18 years, which indicates the great sex dimorphism during adolescent period.

**Table 6.1.** Statistical constants of weight for age (%) for boys and girls

| Age<br>(yrs) | Boys   |       |       | Girls  |       |       | t-value |
|--------------|--------|-------|-------|--------|-------|-------|---------|
|              | Number | Mean  | SD    | Number | Mean  | SD    |         |
| 3            | 89     | 87.96 | 13.41 | 92     | 93.06 | 14.34 | 2.46*   |
| 4            | 84     | 91.07 | 13.53 | 87     | 93.27 | 13.73 | 1.06    |
| 5            | 87     | 92.78 | 10.67 | 86     | 92.76 | 10.87 | 0.01    |
| 6            | 88     | 87.15 | 11.08 | 89     | 92.57 | 12.60 | 3.04**  |
| 7            | 87     | 82.49 | 10.25 | 93     | 86.64 | 10.92 | 2.62    |
| 8            | 82     | 84.51 | 11.41 | 84     | 84.13 | 10.15 | 0.23    |
| 9            | 92     | 84.84 | 10.50 | 86     | 82.84 | 11.78 | 1.20    |
| 10           | 88     | 81.10 | 11.50 | 79     | 79.62 | 11.51 | 0.83    |
| 11           | 85     | 79.36 | 10.92 | 80     | 76.70 | 8.40  | 1.75    |
| 12           | 85     | 75.36 | 8.45  | 85     | 77.92 | 9.22  | 1.89    |
| 13           | 84     | 78.74 | 9.50  | 87     | 75.23 | 10.52 | 2.29*   |
| 14           | 85     | 76.89 | 8.24  | 87     | 77.91 | 10.62 | 0.70    |
| 15           | 84     | 77.29 | 8.03  | 89     | 80.73 | 7.78  | 2.86**  |
| 16           | 82     | 73.49 | 7.95  | 84     | 81.25 | 7.25  | 6.57*** |
| 17           | 72     | 75.56 | 5.81  | 76     | 81.43 | 7.95  | 5.26*** |
| 18           | 75     | 73.95 | 6.13  | 84     | 79.65 | 9.08  | 4.58*** |

\*P &lt; 0.05; \*\*P &lt; 0.01; \*\*\*P &lt; 0.000

**Table 6.2.** Nutritional status according to weight for age (based on NCHS reference)

| Nutritional status   | Boys (N = 1351) |          | Girls (N = 1368) |          |
|----------------------|-----------------|----------|------------------|----------|
|                      | Number          | Per cent | Number           | Per cent |
| Normal ( $\leq 90$ ) | 311             | 23.02    | 380              | 27.78    |
| Mild (75-89.9)       | 604             | 44.71    | 661              | 48.32    |
| Moderate (60-74.9)   | 411             | 30.42    | 309              | 22.59    |
| Severe (< 60)        | 25              | 1.85     | 18               | 1.32     |

 $\chi^2 = 24.94$ , DF = 3, P < 0.000

Following the cut-off points suggested by Comez *et al.* (1956), Table 6.2 shows the different degrees of the nutritional status according to weight for age of both boys and girls. It can be seen that the frequencies of mild, moderate and severe forms of underweight are 44.71%, 30.42% and 1.85% in boys and 48.32%, 22.59% and 1.32% in girls, respectively. It indicates that most of the underweight children are in the categories of mild and moderate degrees of undernutrition. Overall, it suggests that the prevalence of underweight is higher in boys (76.98%) than in girls (72.24%), and the difference is found to be statistically significant ( $\chi^2 = 24.94$ , DF = 3, P < 0.000).

### Height for age

In the present study, height for age is expressed as percentage of individual weight to the median of the NCHS population reference. It is widely accepted as one of the best indicators of stunting or short stature due to inadequate nutrition or undernutrition. The means and standard deviations for height for age of both boys and girls are given in Table 6.3. The Table shows that, like in the case of weight for age, the differences between boys and girls in height for age are not statistically significant from 3 to 13 years of age, despite the significant difference at the age of 12. But from 14 years onwards, the mean height for age is significantly higher in girls than in boys.

The nutritional status of both boys and girls according to height for age is presented in Table 6.4, following the cut-of points proposed by Visweswara Roa *et al.* (1986). It can be seen that about 95% of boys and girls in the present population are stunting. Whether stunting or short stature of these children should be regarded as growth retardation, thereby indicating of high undernutrition, is a moot question of interest. It has been suggested that the use of national and international population references for assessing the nutritional status of children in terms of height for age may lead to overestimation of undernutrition in children of the short stature population like the Khasis (Khongsdier, 1996). In the present study, an attempt has also been made to show the different levels of growth retardation as per the ICMR reference of height for age in Table 6.5. It shows that about 84.83% of boys and 77.41% of girls have growth retardation, although the frequency is lower than that derived from the NCHS standard. So the present findings seem to confirm those observations made among the War Khasi (Khongsdier, 1996). The same is true in the case weight for age since weight is also correlated with height.

**Table 6.3.** Statistical constants of height for age (%) for boys and girls

| Age<br>(yrs) | Boys   |       |      | Girls  |       |      | t-value |
|--------------|--------|-------|------|--------|-------|------|---------|
|              | Number | Mean  | SD   | Number | Mean  | SD   |         |
| 3            | 89     | 94.71 | 5.83 | 92     | 95.66 | 5.21 | 1.16    |
| 4            | 84     | 93.40 | 5.12 | 87     | 92.94 | 5.66 | 0.56    |
| 5            | 87     | 92.63 | 5.93 | 86     | 92.94 | 5.53 | 0.36    |
| 6            | 88     | 91.80 | 6.55 | 89     | 92.77 | 5.58 | 1.06    |
| 7            | 87     | 91.75 | 5.39 | 93     | 91.73 | 5.88 | 0.02    |
| 8            | 82     | 90.79 | 5.88 | 84     | 91.42 | 4.76 | 0.76    |
| 9            | 92     | 90.99 | 4.93 | 86     | 91.05 | 5.29 | 0.08    |
| 10           | 88     | 90.05 | 5.30 | 79     | 90.41 | 5.17 | 0.44    |
| 11           | 85     | 89.12 | 4.48 | 80     | 89.51 | 4.22 | 0.57    |
| 12           | 85     | 88.29 | 4.39 | 85     | 91.38 | 4.60 | 4.48*** |
| 13           | 84     | 89.70 | 3.34 | 87     | 89.04 | 3.72 | 1.23    |
| 14           | 85     | 87.71 | 3.51 | 87     | 89.33 | 3.98 | 2.83*   |
| 15           | 84     | 86.14 | 3.91 | 89     | 89.09 | 3.29 | 5.38**  |
| 16           | 82     | 85.26 | 3.74 | 84     | 87.47 | 3.66 | 3.85*   |
| 17           | 72     | 86.05 | 3.29 | 76     | 90.24 | 4.00 | 6.94**  |
| 18           | 75     | 87.95 | 3.40 | 84     | 90.29 | 4.04 | 3.93*   |

\*P &lt; 0.01; \*\*P &lt; 0.000

With regard to sex differences in nutritional status, which is to a great extent independent of standard, Table 6.5 shows that like in the case of weight for age, the prevalence of growth retardation, especially those children with moderate and severe forms of undernutrition, is significantly higher in boys than in girls ( $\chi^2 = 58.85$ , DF = 3, P < 0.000). Whether or not these findings are associated with the matrilineal system of the society is a different question because we do not have data on child care of the society. But the results of the present study indicate that girls are better than boys in nutritional status.

**Table 6.4.** Nutritional status according to height for age (based on NCHS reference)

| Nutritional status    | Boys (N =1351) |          | Girls (N = 1368) |          |
|-----------------------|----------------|----------|------------------|----------|
|                       | Number         | Per cent | Number           | Per cent |
| Normal ( $\leq 100$ ) | 58             | 4.29     | 69               | 5.04     |
| Mild (95-99.9)        | 171            | 12.66    | 209              | 15.28    |
| Moderate (90-94.9)    | 401            | 29.68    | 497              | 36.33    |
| Severe ( $< 90$ )     | 721            | 53.37    | 593              | 43.35    |

$\chi^2 = 27.38$ , DF = 3, P < 0.000

**Table 6.5.** Nutritional status according to height for age (based on ICMR reference)

| Nutritional status    | Boys (N =1351) |          | Girls (N = 1368) |          |
|-----------------------|----------------|----------|------------------|----------|
|                       | Number         | Per cent | Number           | Per cent |
| Normal ( $\leq 100$ ) | 205            | 15.17    | 309              | 22.59    |
| Mild (95-99.9)        | 428            | 31.68    | 514              | 37.57    |
| Moderate (90-94.9)    | 475            | 35.16    | 397              | 29.02    |
| Severe ( $< 90$ )     | 243            | 17.99    | 148              | 10.82    |

$\chi^2 = 58.85$ , DF = 3, P < 0.000

**Table 6.6.** Statistical constants of body mass index for boys and girls

| Age<br>(yrs) | Boys   |       |      | Girls  |       |      | t-value |
|--------------|--------|-------|------|--------|-------|------|---------|
|              | Number | Mean  | SD   | Number | Mean  | SD   |         |
| 3            | 89     | 13.80 | 1.99 | 92     | 14.03 | 1.92 | 0.79    |
| 4            | 84     | 15.09 | 2.12 | 87     | 15.31 | 2.17 | 0.67    |
| 5            | 87     | 16.45 | 1.64 | 86     | 16.20 | 1.87 | 0.94    |
| 6            | 88     | 16.58 | 1.95 | 89     | 17.13 | 1.93 | 1.89    |
| 7            | 87     | 16.68 | 1.99 | 93     | 17.22 | 2.03 | 0.94    |
| 8            | 82     | 18.14 | 1.86 | 84     | 17.86 | 1.81 | 0.98    |
| 9            | 92     | 19.31 | 1.95 | 86     | 19.04 | 2.15 | 0.88    |
| 10           | 88     | 19.97 | 2.07 | 79     | 20.13 | 2.47 | 0.46    |
| 11           | 85     | 21.37 | 2.55 | 80     | 21.39 | 2.19 | 0.05    |
| 12           | 85     | 22.34 | 2.35 | 85     | 22.83 | 2.22 | 1.40    |
| 13           | 84     | 24.82 | 2.72 | 87     | 23.98 | 2.97 | 2.22*   |
| 14           | 85     | 26.51 | 2.50 | 87     | 26.18 | 3.10 | 0.77    |
| 15           | 84     | 28.85 | 2.27 | 89     | 28.58 | 2.19 | 0.79    |
| 16           | 82     | 29.47 | 2.75 | 84     | 29.57 | 2.09 | 0.26    |
| 17           | 72     | 31.69 | 2.12 | 76     | 30.25 | 2.34 | 3.91**  |
| 18           | 75     | 31.62 | 2.40 | 84     | 30.13 | 2.99 | 3.44**  |

### Body mass index

Body mass index (BMI) is generally considered as the best indicator of fatness or thinness and wasting due to chronic energy deficiency (Ferro-Luzi *et al.*, 1992). It is obtained as weight (kg) divided by height (cm<sup>2</sup>) of the individual, and it is independent of age. The means and standard deviations of BMI for both boys and girls are shown in Table 6.6. It can be seen that there is not much difference between boys and girls in respect of BMI, although it is significantly higher in boys than in girls at the ages 13, 17 and 18.

The nutritional status of children according to BMI is summarized in Table 6.7. In the case of children aged 3 to 9 years, we have followed the cut-off point of 1.50,

which is equivalent to 5<sup>th</sup> percentile of the NCHS standard (Visweswara Rao et al., 1986), while the cut-off points proposed by Ferro-Luzi *et al.* (1992) has been adopted for assessing the nutritional status of children aged 10 to 18 years. It is observed that the frequencies of mild, moderate and severe forms of chronic energy deficiency in the children aged 3 to 9 years of age are respectively about 12%, 6% and 8% in boys and 18%, 6% and 8% in girls. Thus, the frequency of mild chronic energy deficiency is about 6% higher in girls than in boys, although the difference between sexes is not statistically significant ( $\chi^2 = 6.44$ , DF = 3,  $P > 0.05$ ). In the case of children aged 10 to 18 years, it is seen from Table 6.7 that about 95 % of boys and girls are well nourished in the present population.

**Table 6.7.** Nutritional status according to body mass index

|                                      | Boys (N = 609) |          | Girls (N = 617) |          |
|--------------------------------------|----------------|----------|-----------------|----------|
|                                      | Number         | Per cent | Number          | Per cent |
| 3 - 9 years                          |                |          |                 |          |
| Normal ( $\leq 15.0$ )               | 450            | 73.89    | 472             | 76.50    |
| Mild (14.0-14.9)                     | 70             | 11.49    | 108             | 17.50    |
| Moderate (13.0-13.9)                 | 38             | 6.24     | 37              | 6.00     |
| Severe ( $< 13.0$ )                  | 51             | 8.37     | 47              | 7.62     |
| $\chi^2 = 6.44$ , DF = 3, $P > 0.05$ |                |          |                 |          |
| 10-18 years                          |                |          |                 |          |
| Normal ( $\leq 18.5$ )               | 708            | 95.42    | 713             | 94.94    |
| Mild (17.0-18.4)                     | 22             | 2.96     | 26              | 3.46     |
| Moderate (16.0-16.9)                 | 7              | 0.93     | 11              | 1.46     |
| Severe ( $< 16.0$ )                  | 5              | 0.67     | 1               | 0.13     |
| $\chi^2 = 0.30$ , DF = 3, $P > 0.05$ |                |          |                 |          |

In view of these results, it is obvious that the children in the higher age groups are better in nutritional status than those in the lower age groups, i.e., 3 to 9 years of age. Another important point is that the nutritional status of children according to BMI is much better than that observed with respect to weight for age and height for age. This may be due to the fact that weight for age and height for age are derived as percentage of the median of the international population reference, whereas BMI is directly obtained as

a proportion of weight to the square of height of an individual, thereby it is independent of the so-called standard weight or height. Thus, as also observed in other populations, BMI seems to be the better indicator of nutritional status than any other indices taken for the present study.

### **NUTRITIONAL STATUS AND SOCIO-ECONOMIC CONDITION**

As mentioned earlier, it is generally reported that the widespread of undernutrition in developing countries is associated with poor hygienic conditions and socio-economic condition of the populations (Mitra, 1985; WHO, 1990). Therefore, assessment of the nutritional status of population has attracted the attention of not only the nutritionists and other biological scientists, but also the economists and other social scientists with a view to understanding the health and socioeconomic status of the population. In the present study, we have also been an attempt to show the prevalence of undernutrition according to religious and income groups of the population. This may be described as follows:

#### **Religion**

The means and standard deviations of weight for age, height for age and BMI according to religious groups for both boys and girls are given in Table 6.8. It is seen that the mean values of all these anthropometric indices are higher in the Muslim children than in the Christian and Niam Khasi children. After allowing the effect of economic condition, the one way analysis of covariance (ANCOVA) indicates that the differences in anthropometric indices between religious groups are highly significant for both boys and girls, except BMI in girls. According to Scheffe's multiple range test, the Muslim boys are found to be significantly higher than the Christian boys in weight for age (Difference  $\pm$  standard error:  $5.01 \pm 0.81$ ,  $P < 0.000$ ) and height for age ( $1.70 \pm 0.39$ ,  $P < 0.000$ ). With respect to BMI, there is an absence of significant difference according to Scheffe's test, but it is significant according to Least Square Significance Difference ( $0.94 \pm 0.44$ ,  $P < 0.03$ ). The differences between the Muslim and Niam Khasi boys are also significant in respect of all indices (Weight for age:  $6.88 \pm 0.79$ ,  $P < 0.000$ ; Height for age:  $2.07 \pm 0.38$ ,  $P < 0.000$ ; BMI:  $0.96 \pm 0.43$ ,  $P < 0.03$ ). On the other hand, the differences between Christian and Niam Khasi boys are found to be significant only in respect of weight for age ( $1.87 \pm 0.72$ ,  $P < 0.03$ ). Nevertheless, it is clear that the Muslim boys are heavier than

the Christian and Niam Khasi boys in respect of all anthropometric indices, thereby suggesting that the Muslim boys are better in nutritional status.

**Table 6.8.** Anthropometric indices according to religious groups

| Indices/sex    | Muslims |                   | Christians |                   | Niam Khasis |                   | ANCOVA-F statistics |
|----------------|---------|-------------------|------------|-------------------|-------------|-------------------|---------------------|
|                | N       | Mean $\pm$ SD     | N          | Mean $\pm$ SD     | N           | Mean $\pm$ SD     |                     |
| <b>Boys</b>    |         |                   |            |                   |             |                   |                     |
| Weight for age | 339     | 86.10 $\pm$ 11.61 | 467        | 81.09 $\pm$ 11.61 | 545         | 79.22 $\pm$ 11.06 | 44.55**             |
| Height for age | 339     | 91.28 $\pm$ 5.11  | 467        | 89.58 $\pm$ 5.46  | 545         | 89.21 $\pm$ 5.59  | 22.25*              |
| BMI            | 339     | 22.51 $\pm$ 5.96  | 467        | 21.51 $\pm$ 5.96  | 545         | 21.56 $\pm$ 6.41  | 3.84*               |
| <b>Girls</b>   |         |                   |            |                   |             |                   |                     |
| Weight for age | 365     | 87.29 $\pm$ 12.22 | 470        | 83.40 $\pm$ 12.29 | 533         | 81.32 $\pm$ 11.65 | 35.61**             |
| Height for age | 365     | 92.50 $\pm$ 5.05  | 470        | 90.61 $\pm$ 4.97  | 533         | 90.31 $\pm$ 5.07  | 35.96**             |
| BMI            | 365     | 22.17 $\pm$ 5.83  | 470        | 21.68 $\pm$ 5.68  | 533         | 21.50 $\pm$ 6.03  | 1.73                |

\*P < 0.02, \*\*P < 0.000

Among girls the differences between Muslims and Christians according to Scheffe's test are found to be significant in respect of weight for age ( $3.89 \pm 0.84$ ,  $P < 0.000$ ) and height for age ( $1.86 \pm 0.35$ ,  $P < 0.000$ ), but not in respect of BMI. But the differences between Christian and Niam Khasi girls are not significant in all the indices, except in the case of weight for age ( $2.08 \pm 0.76$ ,  $P < 0.02$ ). Thus it indicates that the Christian and Niam Khasi children are by and large similar in height for age and BMI, although the former are higher in weight for age than the latter.

In order to have a better understanding of the effect of religion on nutritional status of Khasi children, an attempt has also been made to show the percentage distribution of weight for age according to three religious groups in Table 6.9. It is found that about 62.54%, 79.23% and 84.04% of the boys in Muslims, Christians and Niam Khasis, respectively, are underweight. Among girls, these frequencies of underweight are found to be 61.92%, 75.11% and 76.74%, respectively. The Chi-square values indicate that the differences between religious groups in respect of weight for age are highly significant (Boys:  $\chi^2 = 70.82$ ,  $DF = 6$ ,  $P < 0.000$ ; Girls:  $\chi^2 = 46.87$ ,  $DF = 6$ ,  $P$

< 0.000). Thus, it indicates that the Muslim Khasi boys and girls are better in weight for age when compared to their counterparts belonging to Christianity (Boys:  $\chi^2 = 38.75$ , DF = 2,  $P < 0.000$ ; Girls:  $\chi^2 = 20.20$ , DF = 2,  $P < 0.000$ ) and Niam Khasi (Boys:  $\chi^2 = 66.58$ , DF = 2,  $P < 0.000$ ; Girls:  $\chi^2 = 40.94$ , DF = 2,  $P < 0.000$ ). On the other hand, the Christian Khasi children appear to be heavier than the Niam Khasi children, although the differences are not statistically significant in the case of boys (Boys:  $\chi^2 = 4.04$ , DF = 2,  $P > 0.05$ ; Girls:  $\chi^2 = 8.56$ , DF = 2,  $P < 0.01$ ). Thus, the Muslim children are heavier than the Christian and Niam Khasi children, and the differences between the Christian and Niam Khasi children are significant only in the case of girls, i.e., the Christian girls are heavier than the Niam Khasi girls.

**Table 6.9.** Nutritional status according to weight for age by religious groups

| Nutritional status   | Boys               |                         |  | Girls              |                         |                            |
|----------------------|--------------------|-------------------------|--|--------------------|-------------------------|----------------------------|
|                      | Muslims<br>(N=339) | Christians<br>(N = 467) | Niam<br>Khasis<br>(N =545)             | Muslims<br>(N=365) | Christians<br>(N = 470) | Niam<br>Khasis<br>(N =533) |
| Normal ( $\leq 90$ ) | 127                | 97                      | 87                                     | 139                | 117                     | 124                        |
| %                    | 37.46              | 20.77                   | 15.96                                  | 38.08              | 24.89                   | 23.26                      |
| Mild (75-89.9)       | 149                | 206                     | 249                                    | 173                | 245                     | 243                        |
| %                    | 43.95              | 44.11                   | 45.69                                  | 47.40              | 52.13                   | 45.59                      |
| Moderate (60-74.9)   | 62                 | 158                     | 191                                    | 49                 | 104                     | 156                        |
| %                    | 18.29              | 33.83                   | 35.05                                  | 13.42              | 22.13                   | 29.27                      |
| Severe ( $< 60$ )    | 1                  | 6                       | 18                                     | 4                  | 4                       | 10                         |
| %                    | 0.29               | 1.28                    | 3.30                                   | 1.10               | 0.85                    | 1.88                       |
|                      |                    |                         | $\chi^2 = 70.82$ , DF = 6, $P < 0.000$ |                    |                         |                            |
|                      |                    |                         | $\chi^2 = 46.87$ , DF = 6, $P < 0.000$ |                    |                         |                            |

Like in the case of weight for age, the Muslim Khasi children are taller than the Christian and Niam Khasi children (Table 6.10). It is seen from Table 6.10 that the prevalence of stunting or growth retardation in boys is about 94.69%, 96.57% and 95.60% respectively in the Muslim, Christian and Niam Khasis. In the case of girls, these frequencies are 92.05%, 94.47% and 97.37%, respectively. The Chi-square values indicate that the differences in the percentage distribution of normal, mild, moderate and severe forms of nutritional status in respect of height for age are highly significant for both boys and girls (Boys:  $\chi^2 = 24.89$ , DF = 6,  $P < 0.001$ ; Girls:  $\chi^2 = 40.32$ , DF = 6,  $P < 0.000$ ).

It indicates that the children of Muslim Khasi are less retarded when compared with the Christian and Niam Khasi children, despite the fact that the prevalence of stunting is high in all the religious groups. With respect to the difference between the Christian and Niam Khasi children, it is seen from Table 6.10 that the frequency of mild and moderate forms of growth retardation is higher in the Christian Khasi boys than in the Niam Khasi boys, but the frequency of severe form is higher in the latter than in the former. However, these differences between the two religious groups are not statistically significant ( $\chi^2 = 1.54$ , DF =3,  $P > 0.05$ ). In the case of girls, the situation is reverse, which shows that the prevalence of mild and moderate forms of growth retardation is higher in the Niam Khasis than in the Christian Khasis, but the frequency of severe form of growth retardation is higher in the latter than in the former, although these differences are not statistically significant ( $\chi^2 = 6.94$ , DF =3,  $P > 0.05$ ). Thus, the Christian and Niam Khasi children are by and large similar in the prevalence of growth retardation. The significant differences between religious groups as indicated by the overall Chi-square test is mainly due to the differences between the Khasi Muslims children and other religious groups.

**Table 6.10.** Nutritional status according to height for age by religious groups

| Nutritional status    | Boys                                   |                         |                            | Girls                                  |                         |                            |
|-----------------------|--|-------------------------|----------------------------|--|-------------------------|----------------------------|
|                       | Muslims<br>(N=339)                     | Christians<br>(N = 467) | Niam<br>Khasis<br>(N =545) | Muslims<br>(N=365)                     | Christians<br>(N = 470) | Niam<br>Khasis<br>(N =533) |
| Normal ( $\leq 100$ ) | 18                                     | 16                      | 24                         | 29                                     | 26                      | 14                         |
| %                     | 5.31                                   | 3.43                    | 4.40                       | 7.95                                   | 5.53                    | 2.63                       |
| Mild (95-99.9)        | 62                                     | 54                      | 55                         | 80                                     | 54                      | 75                         |
| %                     | 18.29                                  | 11.56                   | 10.09                      | 21.92                                  | 11.49                   | 14.07                      |
| Moderate (90-94.9)    | 113                                    | 137                     | 151                        | 135                                    | 165                     | 197                        |
| %                     | 33.33                                  | 29.34                   | 27.71                      | 36.99                                  | 35.11                   | 36.96                      |
| Severe ( $< 90$ )     | 146                                    | 260                     | 315                        | 121                                    | 225                     | 247                        |
| %                     | 43.07                                  | 55.67                   | 57.80                      | 33.15                                  | 47.87                   | 46.34                      |
|                       | $\chi^2 = 24.89$ , DF = 6, $P < 0.001$ |                         |                            | $\chi^2 = 40.32$ , DF = 6, $P < 0.000$ |                         |                            |

**Table 6.11.** Nutritional status according to body mass index by religious groups

| Nutritional status     | Boys                              |             |             | Girls                            |             |             |
|------------------------|-----------------------------------|-------------|-------------|----------------------------------|-------------|-------------|
|                        | Muslims                           | Christians  | Niam Khasis | Muslims                          | Christians  | Niam Khasis |
| <b>3 - 9 years</b>     |                                   |             |             |                                  |             |             |
| Normal ( $\leq 15.0$ ) | 122 (80.26)                       | 160 (75.12) | 168 (71.79) | 134 (78.82)                      | 171 (80.66) | 166 (70.64) |
| Mild (14.0-14.9)       | 18 (11.84)                        | 26 (12.21)  | 16 (6.84)   | 16 (9.41)                        | 19 (8.96)   | 27 (11.49)  |
| Moderate (13.0-13.9)   | 3 (1.97)                          | 11 (5.16)   | 24 (10.25)  | 8 (4.71)                         | 10 (4.72)   | 19 (8.08)   |
| Severe ( $< 13.0$ )    | 9 (5.92)                          | 16 (7.51)   | 26 (11.11)  | 12 (7.06)                        | 12 (5.66)   | 23 (9.79)   |
|                        | $\chi^2 = 18.76, DF= 6, P < 0.01$ |             |             | $\chi^2 = 7.81, DF= 6, P > 0.05$ |             |             |
| <b>10-18 years</b>     |                                   |             |             |                                  |             |             |
| Normal ( $\leq 18.5$ ) | 181 (96.79)                       | 245 (96.46) | 292 (93.89) | 189 (96.92)                      | 245 (94.96) | 279 (93.69) |
| Mild (17.0-18.4)       | 5 (2.67)                          | 6 (2.36)    | 11 (3.65)   | 5 (2.56)                         | 9 (3.49)    | 14 (4.70)   |
| Moderate (16.0-16.9)   | 1 (0.55)                          | 1 (0.39)    | 5 (1.66)    | 0 (0.00)                         | 4 (1.55)    | 5 (1.68)    |
| Severe ( $< 16.0$ )    | 0 (0.00)                          | 2 (0.79)    | 3 (1.00)    | 1 (0.51)                         | 0 (0.00)    | 0 (0.00)    |
|                        | $\chi^2 = 3.49, DF= 2, P > 0.05$  |             |             | $\chi^2 = 2.67, DF= 2, P > 0.05$ |             |             |

Figures within parentheses indicate percentage

The percentage distribution of BMI according to three religious groups is shown in Table 6.11. In the age group 3 to 9 years, about 19.73%, 24.88% and 28.20% of boys and 21.18%, 19.34% and 29.36% of girls in the Muslims, Christians and Niam Khasis, respectively, have suffered from chronic energy deficiency. Thus it indicates that the prevalence of chronic energy deficiency is lower among the Muslims than that among the Christians and Niam Khasis, though it is lower among the Christians in the case of girls. However, the Chi-square test indicates that the differences between religious groups are significant only in boys ( $\chi^2 = 18.76, DF= 6, P < 0.01$ ) but not in girls ( $\chi^2 = 7.81, DF= 6, P > 0.05$ ). Table 6.11 further shows that in the age group 10-18 years, the differences between religious groups in respect of BMI are not statistically significant for both boys and girls. Thus, it indicates that religion plays little role in influencing the BMI of the children in the present study, although the influence of religion on weight for age and height for age seems to be important. It clearly shows that the Muslim children are heavier and taller than the Christian and Niam Khasi children. One possible explanation of such a trend in the Muslims may be due to intermixture, i.e., the Muslim

children are by and large the product of the intermixture between the Khasi females and the Muslim males who migrated to Meghalaya from other parts of India.

### Economic Condition

Table 6.12 shows the means and standard deviations of anthropometric indices used as indicators of nutritional status according to three income groups. It is seen that, with the exception of few cases, the mean values of weight for age, height for age and BMI are lower in the LIG when compared to the MIG and HIG. Adjusting for religion, the ANCOVA test also indicates that the differences between income groups are significant in all anthropometric indices for both boys and girls. According to Scheffe's test, the LIG children are significantly lower than those in the MIG and HIG in respect of all the three anthropometric indices, irrespective of the difference between LIG and MIG in BMI for girls ( $1.20 \pm 0.36$ ,  $P < 0.004$ ). Likewise, the differences between MIG and HIG children are found to be highly significant for weight for age, height for age and BMI.

**Table 6.12.** Anthropometric indices according to income groups

| Indices/sex    | LIG |                   | MIG |                   | HIG |                   | ANCOVA-F statistics |
|----------------|-----|-------------------|-----|-------------------|-----|-------------------|---------------------|
|                | N   | Mean $\pm$ SD     | N   | Mean $\pm$ SD     | N   | Mean $\pm$ SD     |                     |
| <b>Boys</b>    |     |                   |     |                   |     |                   |                     |
| Weight for age | 569 | 78.69 $\pm$ 11.80 | 500 | 82.71 $\pm$ 11.06 | 282 | 85.45 $\pm$ 11.11 | 38.51**             |
| Height for age | 569 | 88.38 $\pm$ 5.29  | 500 | 89.90 $\pm$ 5.11  | 282 | 92.79 $\pm$ 5.37  | 67.16**             |
| BMI            | 569 | 20.79 $\pm$ 5.84  | 500 | 22.82 $\pm$ 6.46  | 282 | 22.03 $\pm$ 5.93  | 15.03**             |
| <b>Girls</b>   |     |                   |     |                   |     |                   |                     |
| Weight for age | 503 | 80.95 $\pm$ 11.45 | 558 | 83.50 $\pm$ 11.65 | 307 | 88.25 $\pm$ 13.22 | 40.72**             |
| Height for age | 503 | 89.80 $\pm$ 5.53  | 558 | 90.73 $\pm$ 7.73  | 307 | 93.45 $\pm$ 4.71  | 58.41**             |
| BMI            | 503 | 21.16 $\pm$ 5.86  | 558 | 22.36 $\pm$ 6.09  | 307 | 21.58 $\pm$ 5.58  | 6.30*               |

\* $P < 0.002$ , \*\* $P < 0.000$

In order to understand the effect of economic condition on the nutritional status of the children in the present study, we have also made an attempt to show the prevalence of undernutrition in relation to the three levels of the monthly income of households. With respect to weight for age, Table 6.13 shows that about 81.90%, 76.60% and 67.73% of the boys and 79.52%, 72.94% and 58.96% of girls are underweight in the LIG, MIG and HIG, respectively. It indicates that the proportion of underweight children decreases with

the rise in income levels of the household. The Chi-square values also indicate that the differences between income groups in respect of the distribution of children according to different degrees of underweight are highly significant for both boys ( $\chi^2 = 107.09$ , DF = 6,  $P < 0.000$ ) and girls ( $\chi^2 = 62.08$ , DF = 6,  $P < 0.000$ ). Thus, it suggests that the income of household plays a very important role in influencing the nutritional status of children according to weight for age as has been shown in Table 6.12 with regards to ANCOVA test.

**Table 6.13.** Nutritional status according to weight for age by income groups

| Nutritional status   | Boys           |                  |   | Girls                                  |                  |                 |
|----------------------|----------------|------------------|---|--|------------------|-----------------|
|                      | LIG<br>(N=569) | MIG<br>(N = 500) | HIG<br>(N =282)                         | LIG<br>(N=503)                         | MIG<br>(N = 558) | HIG<br>(N =307) |
| Normal ( $\leq 90$ ) | 103            | 117              | 91                                      | 103                                    | 151              | 126             |
| %                    | 18.10          | 23.40            | 32.27                                   | 20.48                                  | 27.06            | 41.04           |
| Mild (75-89.9)       | 202            | 258              | 149                                     | 243                                    | 271              | 147             |
| %                    | 35.50          | 51.60            | 52.84                                   | 48.31                                  | 48.57            | 47.88           |
| Moderate (60-74.9)   | 246            | 123              | 41                                      | 149                                    | 129              | 31              |
| %                    | 43.23          | 24.60            | 14.54                                   | 29.62                                  | 23.12            | 10.10           |
| Severe ( $< 60$ )    | 18             | 2                | 5                                       | 8                                      | 7                | 3               |
| %                    | 3.16           | 0.40             | 1.77                                    | 1.59                                   | 1.25             | 0.98            |
|                      |                |                  | $\chi^2 = 107.09$ , DF = 6, $P < 0.000$ | $\chi^2 = 62.08$ , DF = 6, $P < 0.000$ |                  |                 |

The percentage distribution of height for age according to income groups is presented in Table 6.14. It is seen that the prevalence of stunting is very high in all the income groups for both boys and girls, but the percentage is higher in the lower income groups when compared with the HIG. Such a trend can also be observed with respect to the prevalence of severe forms of growth retardation, which is much higher in the LIG and MIG when compared with the HIG. These differences between income groups in respect of height for age are found to be statistically significant for both boys ( $\chi^2 = 102.50$ , DF = 6,  $P < 0.000$ ) and girls ( $\chi^2 = 99.15$ , DF = 6,  $P < 0.000$ ). This clearly indicates that income of the household plays a very important role in influencing the height for age of the children of the present study.

**Table 6.14.** Nutritional status according to height for age by income groups

| Nutritional status    | Boys           |                  |                                      | Girls          |                  |                                     |  |  |
|-----------------------|----------------|------------------|--------------------------------------|----------------|------------------|-------------------------------------|--|--|
|                       | LIG<br>(N=569) | MIG<br>(N = 500) | HIG<br>(N =282)                      | LIG<br>(N=503) | MIG<br>(N = 558) | HIG<br>(N =307)                     |  |  |
| Normal ( $\leq 100$ ) | 13             | 20               | 25                                   | 15             | 25               | 29                                  |  |  |
| %                     | 2.28           | 4.00             | 8.87                                 | 2.98           | 4.48             | 9.45                                |  |  |
| Mild (95-99.9)        | 50             | 60               | 61                                   | 56             | 79               | 74                                  |  |  |
| %                     | 8.79           | 12.00            | 21.63                                | 11.13          | 14.16            | 24.10                               |  |  |
| Moderate (90-94.9)    | 146            | 140              | 115                                  | 159            | 198              | 140                                 |  |  |
| %                     | 25.66          | 28.00            | 40.78                                | 31.61          | 35.48            | 45.60                               |  |  |
| Severe ( $< 90$ )     | 360            | 280              | 81                                   | 273            | 256              | 64                                  |  |  |
| %                     | 63.27          | 56.00            | 28.72                                | 54.27          | 45.88            | 20.85                               |  |  |
|                       |                |                  | $\chi^2 = 102.50, DF = 6, P < 0.000$ |                |                  | $\chi^2 = 99.15, DF = 6, P < 0.000$ |  |  |

**Table 6.15.** Nutritional status according to body mass index by income groups

| Nutritional status     | Boys        |             |                                     | Girls       |             |                                   |  |  |
|------------------------|-------------|-------------|-------------------------------------|-------------|-------------|-----------------------------------|--|--|
|                        | LIG         | MIG         | HIG                                 | LIG         | MIG         | HIG                               |  |  |
| 3 - 9 years            |             |             |                                     |             |             |                                   |  |  |
| Normal ( $\leq 15.0$ ) | 186 (68.89) | 163 (77.25) | 101 (78.91)                         | 171 (71.85) | 180 (78.60) | 121 (80.66)                       |  |  |
| Mild (14.0-14.9)       | 31 (11.48)  | 28 (13.27)  | 11 (8.59)                           | 26 (10.92)  | 21 (9.17)   | 14 (9.33)                         |  |  |
| Moderate (13.0-13.9)   | 20 (7.41)   | 11 (5.21)   | 7 (5.47)                            | 14 (5.88)   | 15 (6.55)   | 8 (5.33)                          |  |  |
| Severe ( $< 13.0$ )    | 33 (12.22)  | 9 (4.27)    | 9 (7.03)                            | 27 (11.34)  | 13 (5.68)   | 7 (4.66)                          |  |  |
|                        |             |             | $\chi^2 = 13.56, DF = 6, P < 0.03$  |             |             | $\chi^2 = 8.99, DF = 6, P > 0.05$ |  |  |
| 10-18 years            |             |             |                                     |             |             |                                   |  |  |
| Normal ( $\leq 18.5$ ) | 274 (91.64) | 286 (98.96) | 148 (96.10)                         | 248 (93.58) | 315 (98.96) | 150 (95.54)                       |  |  |
| Mild (17.0-18.4)       | 15 (5.01)   | 3 (1.04)    | 4 (2.60)                            | 11 (4.15)   | 10 (3.04)   | 5 (3.18)                          |  |  |
| Moderate (16.0-16.9)   | 6 (2.00)    | 0 (0.00)    | 1 (0.64)                            | 6 (2.26)    | 3 (0.91)    | 2 (1.27)                          |  |  |
| Severe ( $< 16.0$ )    | 4 (1.34)    | 0 (0.00)    | 1 (0.64)                            | 0 (0.00)    | 1 (0.30)    | 0 (0.00)                          |  |  |
|                        |             |             | $\chi^2 = 18.23, DF = 2, P < 0.000$ |             |             | $\chi^2 = 2.15, DF = 2, P > 0.05$ |  |  |

The percentage distribution of BMI for children aged 3-9 and 10-18 years are shown in Table 6.15. It is seen that the differences between income groups in respect of BMI are not significant in girls for both the age groups 3-9 and 10-18 years. But in the case of boys, the income of the household seems to be important and the differences between income groups are significant for both the age groups. For the age group 3-9 years, the prevalence of chronic energy deficiency in boys is about 31.11%, 22.75% and 21.09% in LIG, MIG and HIG, respectively. These frequencies are about 8.36%, 1.04% and 3.90% respectively in the age group 10-18 years. Thus it is obvious that the prevalence of chronic energy deficiency is higher in the LIG when compared to the MIG and HIG, and the influence of the income of household is clearly significant in BMI of boys, although it is also perceptible in girls.

## CHAPTER VII

### DISCUSSION

In the present Chapter, we shall briefly discuss our findings by comparing with other populations especially in Northeast India. We shall also look into the implications of the present findings.

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#### **Demography**

From an evolutionary point of view, human species- *Homo sapiens* – is more successful in adapting and thereby in maintaining and increasing its numbers. It is generally believed that one of the main reasons for the successful adaptation of human species is its ability to change the environments through culture. For example, development of technology and improved organization have aided human being to reduce the intensity of the forces of natural selection. Notwithstanding there are still many problems that we are confronting today through which natural selection is operating to shape the composition and diversity of human species. According to Molnar (1992), “The dimensions and scope of these ongoing processes require careful consideration, especially the increase in numbers of people and the burden these expanded populations place on the environment. Demographic factors of this expansion exert a major influence on gene frequencies. Epidemiology, the types and distribution of disease, is also altered each generation as new diseases gain in population influence while other ones decline as treats to human health.”

As hinted above, demographic parameters like fertility and mortality are very important to understand the genetic make up of a population, and thereby the evolutionary processes of human populations. It is theoretically believed that natural selection, one of the major evolutionary forces, is operating on human population through differential fertility and mortality (Crow, 1958; Johnston, 1973). Also, other demographic parameters like population size, mating patterns admixture rate, migration, etc., are very helpful in understanding the biological characteristics of the population (Basu, 1969;

Ghosh, 1976; Khongsdier and Ghosh, 1994). In the meantime, demographic parameters like fertility and mortality are largely influenced by various socioeconomic factors like religion, education, income, occupation, age at marriage, adoption of family planning, etc. (Mosley and Chen, 1984; Mahadevan, 1986; World Bank, 1999; Caldwell *et al.*, 1999; and others). So, it is quite imperative on the part of physical anthropologists to undertake studies on the effect of socioeconomic conditions on demographic parameters, particularly on fertility and mortality.

In the present study, we have observed that the Khasi population is highly *progressive* irrespective of religious groups, thereby indicating a recent higher fertility rate. Although the mean age at marriage among the Muslim, Christian and Niam Khasi women of the present study is higher than those reported for the populations of Assam (Sengupta and Gogoi, 1995), the mean numbers of live births to married women of all ages belonging to these three religious groups are found to be higher than the Christian (4.81) War Khasis (Khongsdier, 2001) and the Kochs of Garo Hills (Kotal, 2001). It is observed that the total fertility rate in these three religious groups is more or less similar to the War Khasi, but much higher than that reported for the state of Meghalaya (NCIIS, 2000) and the Kochs of Garo hills (Kotal, 2001), although it is not as high as that reported for the Dalus (Patra and Kapoor, 1996). The age specific fertility rate is found to have reached its peak point in the age group 25- 29 years in all the religious groups, and the total fertility rates are 5.38, 5.85 and 5.85 in the Christians, Muslims and Niam Khasis, respectively (Table 4.9). Thus, it indicates that the fertility rates are slightly higher in the Muslims and Niam Khasis when compared with the Christians.

It is observed that the fertility rate in the present population is negatively associated with the age at marriage and income levels of households. The effect of education, on the other hand, is not clearly perceptible in the present study, except among the Niam Khasi mothers, which indicates that educational level of the mothers is also very important in regulating the fertility rate. The effect of religion on fertility rate is not significant, although the total fertility rate is more or less same among the Muslims and Niam Khasis, but it is lower in the Christians. In other words, it is obvious that Family Planning Programme has gained little momentum in the Khasi population, irrespective of religious groups. Moreover, it is also observed that education of the mothers does not play a

significant role in regulating the fertility rate among the Muslim and Christian Khasis, although it is important in the Niam Khasi women. This insignificant effect of education on fertility rate in the Muslims and Christians is in contrast to the observation in other populations (Caldwell *et al.*, 1999), and it is difficult to give any clear-cut explanation. It is well known that Islam does not expressly forbid the voluntary restriction of birth, but children are regarded as the richest blessing that Allah bestows and therefore any attempt to prevent fertility is against the wishes of God (Choudhury, 1982). Of course, it is generally reported that Muslims have higher fertility rate followed by the Hindus and Christians (Irudaya Rajan and Rao, 1991). Likewise, the Bible does not specifically prohibit birth control, but certain Christian denominations like the Catholic Church are against the use of artificial means of birth control (Irudaya Rajan and Rao, 1991). Thus, it is likely that even education of the mothers may not become so important in such a situation.

In the present study, the term "Christians" refers to all Christian denominations including the Roman Catholics. Unfortunately, we have not collected data on specific Christian denomination and, therefore, we are not in position either to refute or support the contention that fertility rate is higher in the Catholics than in any other Christian denominations. We hope that further studies will throw much more light in this regard. The effect of other factors like age at marriage and income of the household on fertility rate seems to be very important in the Khasi population, irrespective of religious groups. The effect of age at marriage on fertility is by and large universal since the reproductive period is shorter in the case of those with higher age at marriage. On the other hand, the significant effect of the income of household on fertility rate in this population is likely to be related to the fact that people belonging to the higher economic groups are more conscious of the socio-economic welfare of their children. It is likely that they have higher aspiration for better education and higher economic status, thereby reducing the birth rate with a view to providing their children with such facilities.

The infant mortality rates in the Christians of the present study are similar to Christian War Khasis (6.89%), while the rates in the Muslims and Niam Khasis are similar to the Non-Christian War Khasi (Khongsdier, 2001), and for the state of Meghalaya (NCHS, 1999). However, the religious groups of the present study have lower

infant and juvenile mortality rates than the Dalus (Patra and Kapoor, 1996) and Chapra Kochs (Kotal, 2001) of Garo hills.

It is observed that the infant mortality rate increases with the increasing age of the mothers. It is found that the regression coefficient ( $\beta \pm$  standard error) of infant mortality (dependent variable) on maternal age is positively significant ( $0.021 \pm 0.008$ ,  $P < 0.011$ ), and it is negatively significant with respect to education ( $-0.150 \pm 0.074$ ,  $P < 0.043$ ) and income ( $-1.283 \pm 0.125$ ,  $P < 0.000$ ) as shown in Table 4.18.. However, the effect of religion on infant mortality is not statistically significant ( $0.051 \pm 0.101$ ,  $P > 0.05$ ). Thus, it indicates that maternal age, education and income are very important in influencing infant mortality in the present population. This may be due to the fact that mothers of higher age groups have higher fertility rate, which is theoretically correlated with higher infant mortality rate. The inverse relationship between infant mortality and educational as well as income level is according to the general observation in other populations (Rustein, 2000; Wagstaff, 2000), which indicate that mothers belonging to the higher educational and income levels are more conscious of the health of their children, and they have more access to modern medical aids, etc. On the other hand, religion does not seem to play very important role in influencing infant mortality rate.

With respect to reproductive wastage, it is found that the still birth rates (i.e., number of still-births per 100 pregnancies) are 3.16%, 3.18% and 3.56% in the Christians, Muslims and Niam Khasis, respectively, and the abortion rates to these three religious groups (i.e., number of abortions per 100 pregnancies) are 4.32%, 4.64% and 4.60%, respectively. Thus, the rates of reproductive wastage (i.e., number of abortions and still-births per 100 pregnancies) are 7.47%, 7.82% and 8.15% in the Christians, Muslims and Niam Khasis, respectively. It appears that the Muslims and Niam Khasis are more or less similar in the frequency of reproductive wastage, and it is slightly higher in the Christians, despite the absence of statistical difference. Like in the case of infant mortality, the frequencies of reproductive wastage in the three religious groups of the present study are similar to those reported for the War Khasis (Khongsdier, 2001), but higher than those reported for the Dalus (4.93%) of Garo hills (Patra and Kapoor, 1996).

## Growth Pattern

Besides the demographic aspects of population, physical growth and development of children is another important field of anthropological research. The pattern of human growth serves as a type of mirror that reflects the biocultural evolution of human population. 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." Further, Eveleth and Tanner (1990) have also observed "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 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." Since human growth and development is also largely influenced by socio-environmental factors like nutrition, infection, occupation, income and religion, it is very vital for understanding the biocultural variation and evolution of human populations (Tanner 1988, Eveleth and Tanner, 1990; Bogin, 1999).

The findings of the present study on growth patterns of children belonging to the three religious groups, viz., Muslims, Christians and Niam Khasis, are presented in Chapter V. Using the fourth degree polynomial model by which the height is equal to  $64.19 + 8.59(\text{Age}) - 0.47(\text{Age})^2 + 0.03(\text{Age})^3 - 5.46(\text{Age})^4$  cm for boys and to  $65.53 + 7.79(\text{Age}) - 0.43(\text{Age})^2 + 0.04(\text{Age})^3 - 0.001(\text{Age})^4$  cm for girls, the estimated value for adult height is found to be 154.20 cm for males and 146.83 cm for females. This indicates that the girls have reached their adult height by the age of 18, while the boys still continue to grow. The present observation seems to confirm that observation among the Assamese Muslim girls of Assam, though it is not so in the case of boys (Begum and Choudhury, 1999).

### Comparison with NCHS and ICMR Growth References

In order to have a better understanding of the growth status of children in the present study, an attempt has been made to compare their weight and height with those given by the U.S. National Centre for Health Statistics (NCHS, 2000) and Indian Council of Medical Research (ICMR, 1972). We shall restrict only to weight and height as data on other anthropometric measurements are not available in the latest NCHS growth references (NCHS, 2000).

The mean weight of Khasi boys plotted against the NCHS percentiles is shown in Figure 7.1. It can be observed from the Figure that the mean weight of the Khasi boys is more or less to the 25<sup>th</sup> percentiles of NCHS growth reference from 3 to 6 years of age. From 6 to 8 and 13 to 16 years of age, the curve for the mean weight of Khasi boys lies between 5<sup>th</sup> and 10<sup>th</sup> percentiles, and it is closer to the 10<sup>th</sup> percentile from 8 to about 11 years of age. From 11 to 13, it is closer to the 5<sup>th</sup> percentile of the growth reference, and from 16 years onwards the growth curve for the mean weight of the Khasi boys lies below the 5<sup>th</sup> percentile. It may be mentioned that the 50<sup>th</sup> percentile of the NCHS data is generally considered as 100 percent normal growth for children.

Like in the case of boys, the mean weight of girls falls at 25<sup>th</sup> percentile of the NCHS reference from 3 to 6 years of age, and thereafter it drops into 10<sup>th</sup> percentile up to about the age of 10 (Figure 7.2). From 10 years onwards, the growth curve for the weight of Khasi girls lies more or less between the 5<sup>th</sup> and 10<sup>th</sup> percentiles of the NCHS reference.

It is obvious that the mean weights of Khasi boys and girls are far below the 50<sup>th</sup> percentile of the NCHS growth reference especially at higher age groups. It is likely that ethnic difference in growth pattern does prevail especially in the higher age groups. In order to have a better understanding of this problem, an attempt has also been made to compare the present findings with the growth reference given by the Indian Council of Medical Research (ICMR, 1972), although it has been criticized that the ICMR growth reference does not represent all sections of the Indian population, and the data are old now. It is also suggested that the children belonging to the high economic class of the Indian population show more or less similar pattern of growth to those in the developed countries (Gopalan, 1992). Therefore, it is advisable to use the international growth reference, that is the NCHS data, for assessing the growth and nutritional status of Indian children. Accordingly, it is not surprised if this is the reason that the ICMR or other authorities have not published any new data on growth of Indian children.

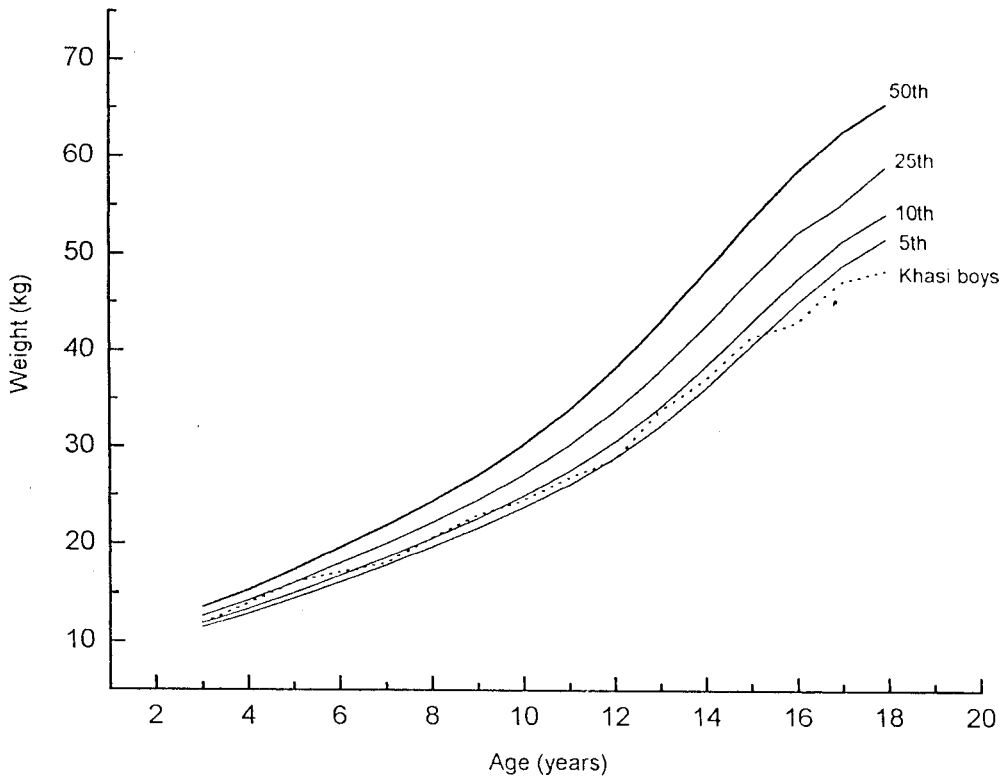


Figure 7.1. Mean weight of Khasi boys plotted on NCHS percentiles

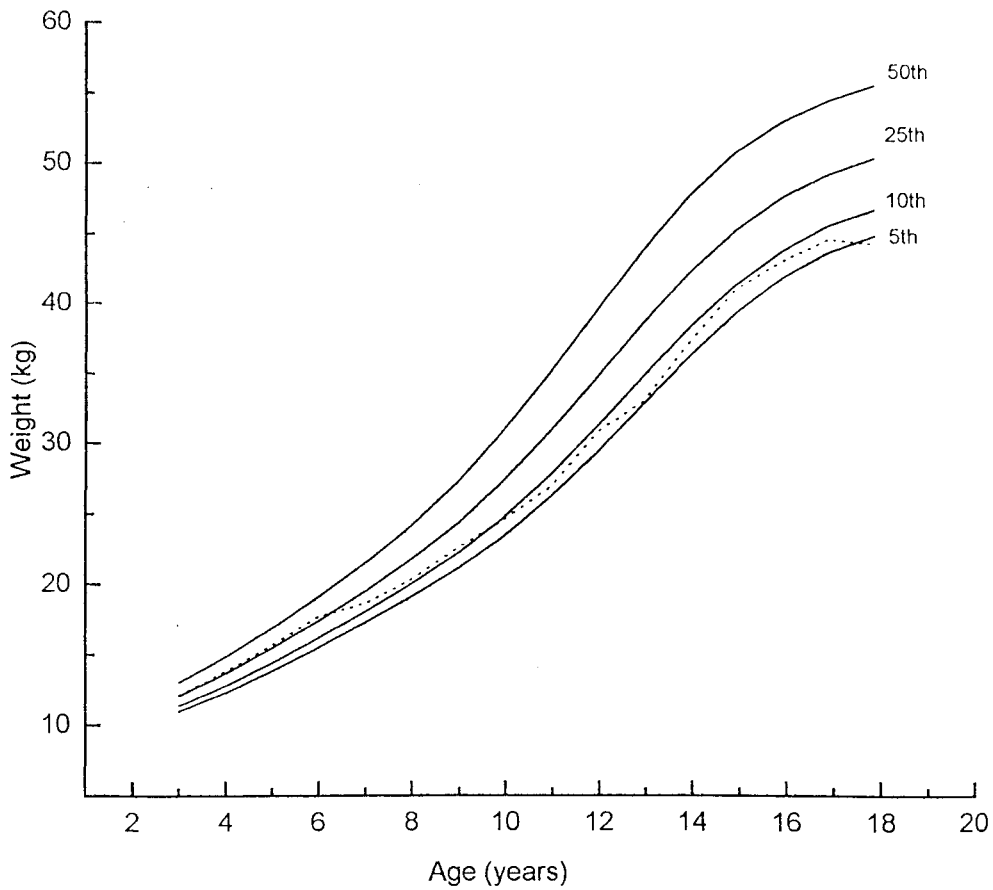


Figure 7.2. Mean weight of Khasi girls (dotted) plotted against NCHS percentiles

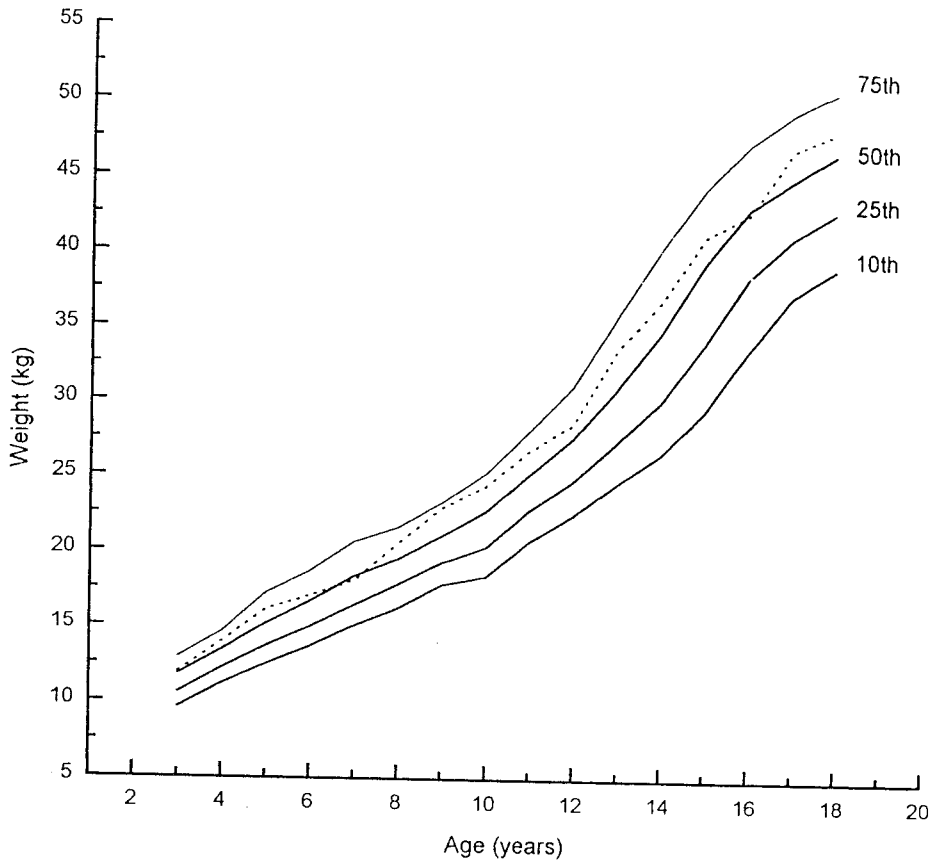


Figure 7.3. Mean weight of Khasi boys (dotted) against ICMR percentiles

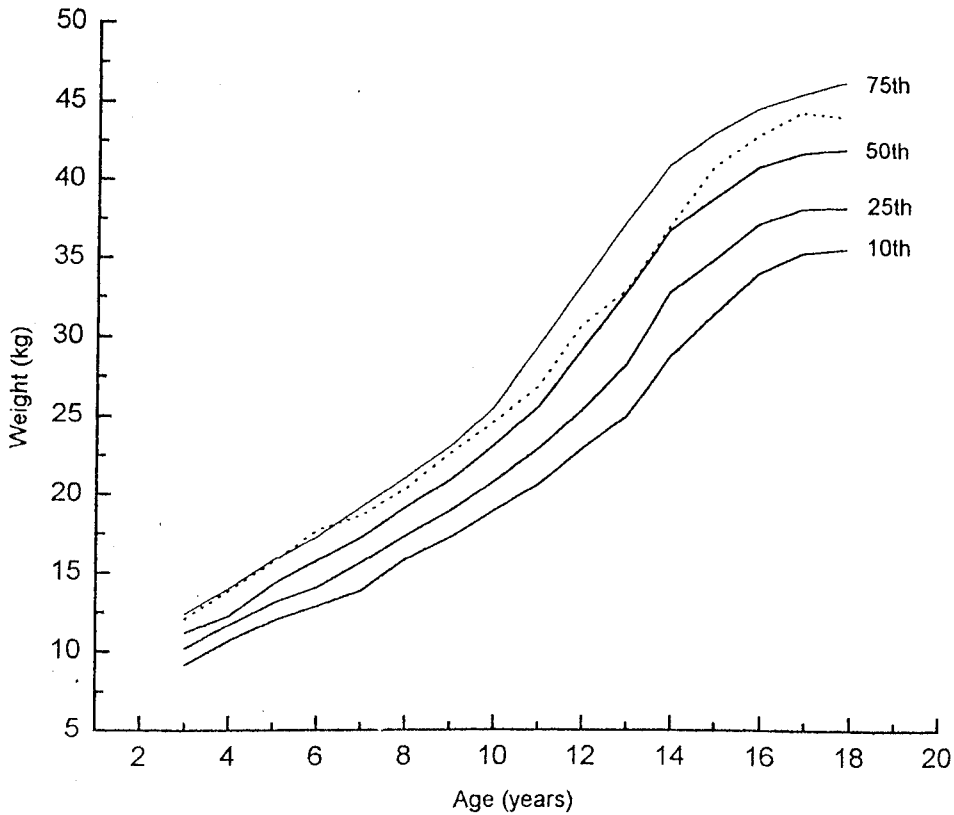


Figure 7.4. Mean weight of Khasi girls (dotted) against ICMR percentiles

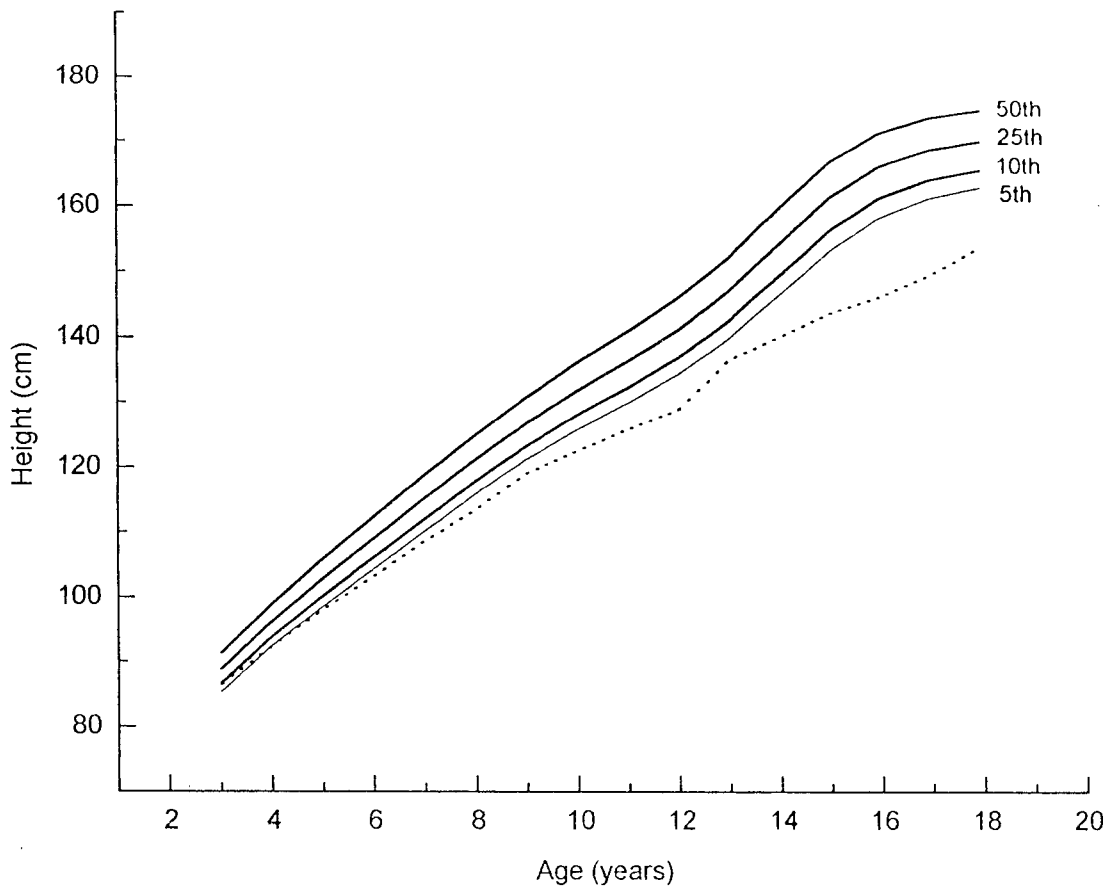


Figure 7.5. Mean height of Khasi boys (dotted line) plotted against NCHS percentiles

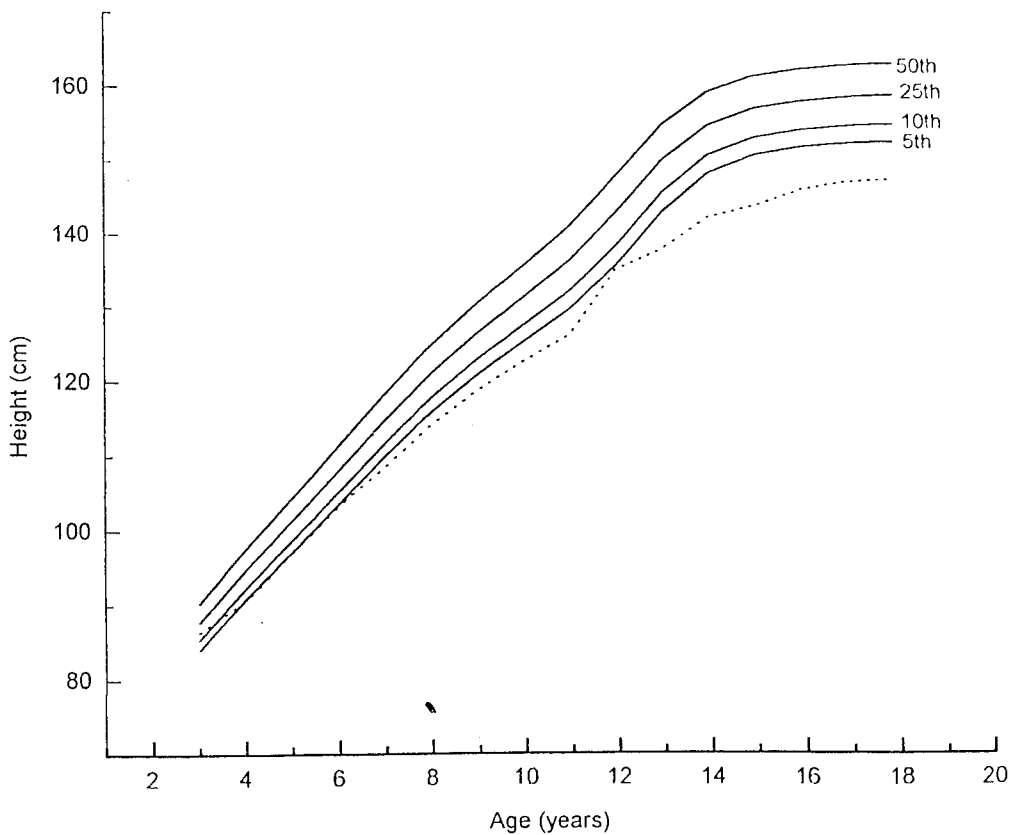


Figure 7.6. Mean height of Khasi girls (dotted) plotted against NCHS percentiles

Figure 7.3 shows the mean weight of Khasi boys plotted against the percentiles of the ICMR growth reference. It can be observed that the mean weight of the Khasi boys is above the 50<sup>th</sup> percentile from 3 to 18 years of age. Similar trend has been observed in the case of girls as shown in Figure 7.4. It is seen that the Khasi girls are more or less in the 75<sup>th</sup> percentile of the ICMR reference from 3 to 6 years of age, and thereafter they are similar to the boys in which the growth curve lies between 75<sup>th</sup> and 50<sup>th</sup> percentiles. Thus, the Khasi boys and girls are heavier than the ICMR children, but much lighter than the American children.

### Height

With respect to height, Figure 7.5 shows the mean height of Khasi boys plotted against NCHS percentiles. It can be observed that the Khasi boys are more or less in the 5<sup>th</sup> percentile of the NCHS reference from 3 to about 6 years of age, and thereafter the growth curve of Khasi boys falls much below the 5<sup>th</sup> percentile. Similarly, the growth curve for the mean height of girls is more or less in the 5<sup>th</sup> percentile from about 3 to 7 years, and thereafter it falls below the 5<sup>th</sup> percentile, except at 12 years of age, which is characterized by an adolescent growth spurt in girls (Figure 7.6).

Plotted against the ICMR percentiles, Figure 7.7 shows that the mean height for boys is comparable to the 25<sup>th</sup> percentile from 3 to 4 years of age, and thereafter it fluctuates between 10<sup>th</sup> and 25<sup>th</sup> percentiles up to about 15 years of age. From 15 years of age, the growth curve for boys falls below the 10<sup>th</sup> percentile of the ICMR reference. Nevertheless, it indicates that the Khasi boys are much shorter than the American boys, especially from the age of 7 onwards, but they are comparable to the Indian children as reported by the ICMR. In the case of girls, Figure 7.8 indicates that the growth curve is at about 50<sup>th</sup> percentile at the age of 3 years, it lies about 25<sup>th</sup> percentile of the ICMR growth reference from 4 to 10 years of age, and thereafter it fluctuates below and above the 25<sup>th</sup> percentile up to about 13 years of age. The curve tends to lie between the 10<sup>th</sup> and 25<sup>th</sup> percentiles from 13 years of age. Overall, it indicates that the girls are more comparable to the ICMR reference than the boys, although they are much shorter than the American children.

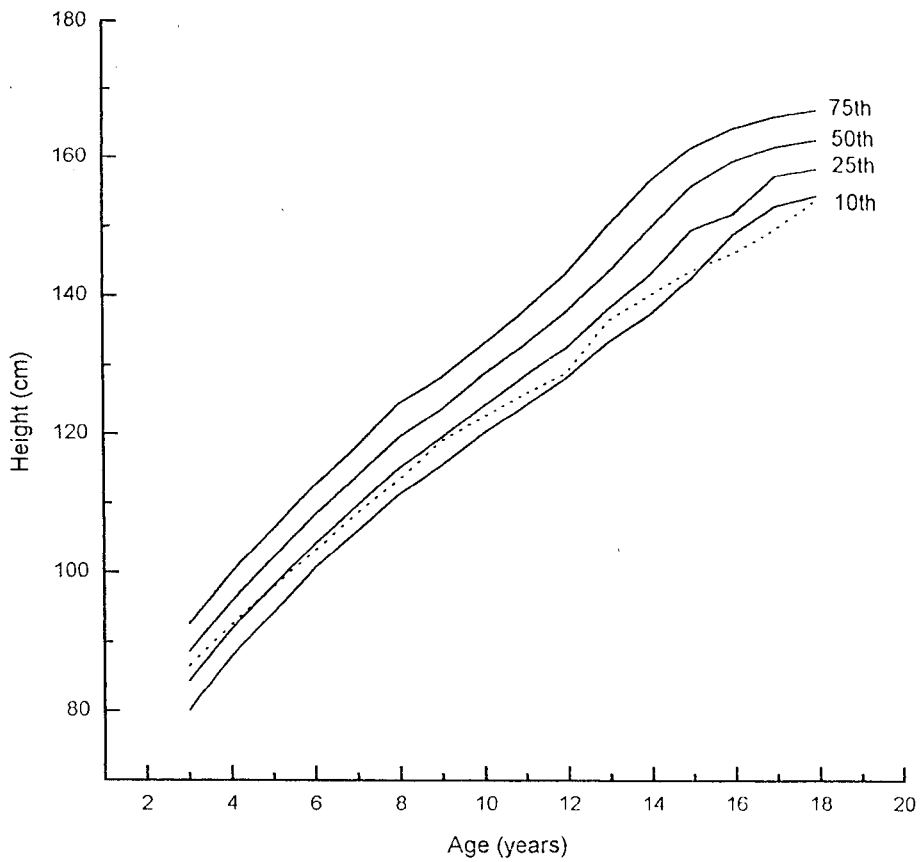


Figure 7.7. Mean height of Khasi boys (dotted) against ICMR percentiles

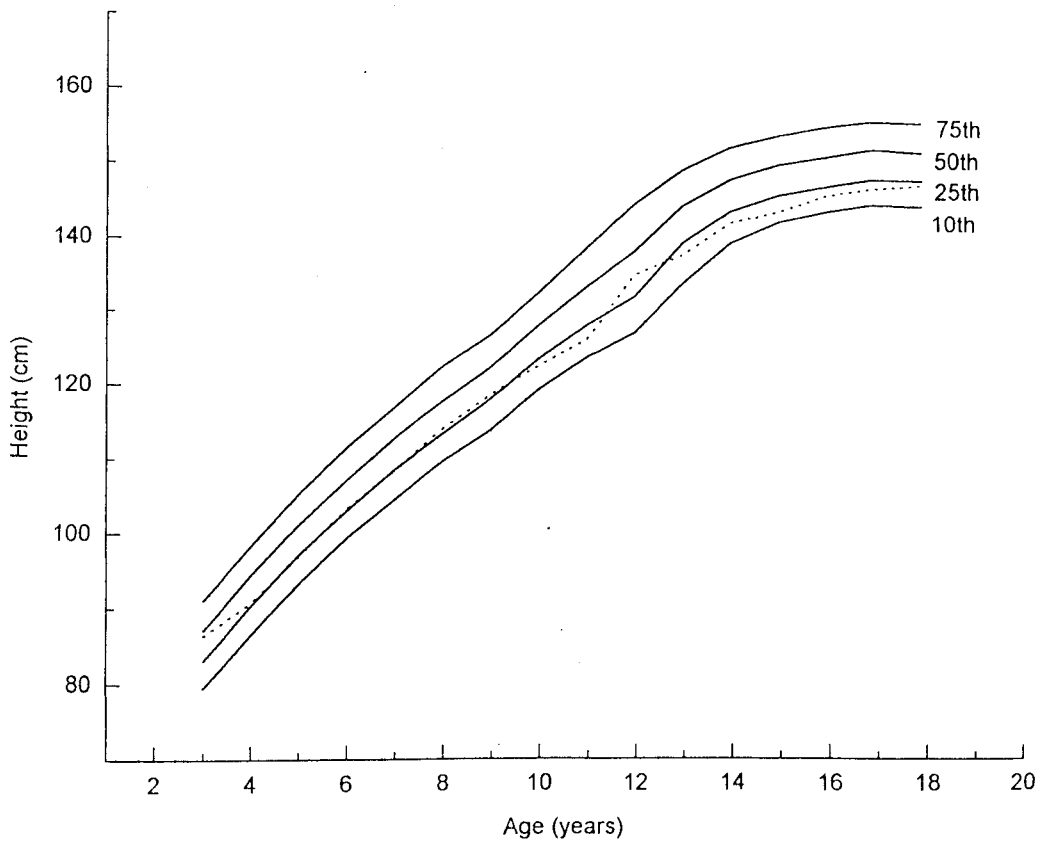


Figure 7.8. Mean height of Khasi girls (dotted) plotted against ICMR percentiles

### **Comparison with Neighbouring Populations**

As already mentioned in Chapter II, very few growth studies have been carried out in Northeast India. Recently, two growth studies were published: one among the War Khasi of Meghalaya (Khongsdier, 1996a) and the other among the Assamese Muslims of Assam (Begum and Choudhury, 1999). Thus, we shall restrict our comparison with only the War Khasi and Assamese Muslims children.

#### **Weight**

It can be observed from Figure 7.9 that the Khasi boys are more or less similar to the Assamese Muslim and War Khasi boys from 3 to 11 years, and thereafter the Assamese Muslim boys are heavier than the Khasi boys of Shilong and War area, except at about 13 years of age when all the three groups of boys show a similar pattern of growth in weight. The War Khasi boys lie in between the Assamese and Khasi boys from 11 to 13 years, and thereafter they are more or less like the Khasi boys of the present study. As far as girls are concerned, Figure 7.10 shows that all the three groups of girls are by and large similar in weight from 3 to 10 years of age. From 10 to 16 years of age, the Assamese Muslim girls are heavier than the Khasi and War Khasi girls, and thereafter they are surpassed by the Khasi girls of Shillong. In comparison with the War Khasi girls, the Khasi girls of the present study are slightly lower in weight from 10 to 14 years of age, and thereafter they are heavier than the War Khasi girls.

#### **Height**

Figure 7.11 shows that the Khasi boys are shorter than the War Khasi and Assamese Muslim boys all through age groups. Thus, it is contrary to expectation that the Khasi boys of Shillong may be taller than their counterparts in the War Khasi. Instead, it is also seen that the War Khasi boys are slightly taller than the Assamese Muslim boys from 3 to 5 years of age. From 5 to 7 years of age, they are more or less similar in height, and thereafter they are surpassed by the Assamese Muslim boys. Like in the case of boys, the War Khasi girls are taller than the Assamese Muslim girls from 3 to 5 years, and they are in between the Khasi and Muslim girls from 6 to 14 years; thereafter they tend to be in the same height with their coevals in Shillong (Figure 7.12).

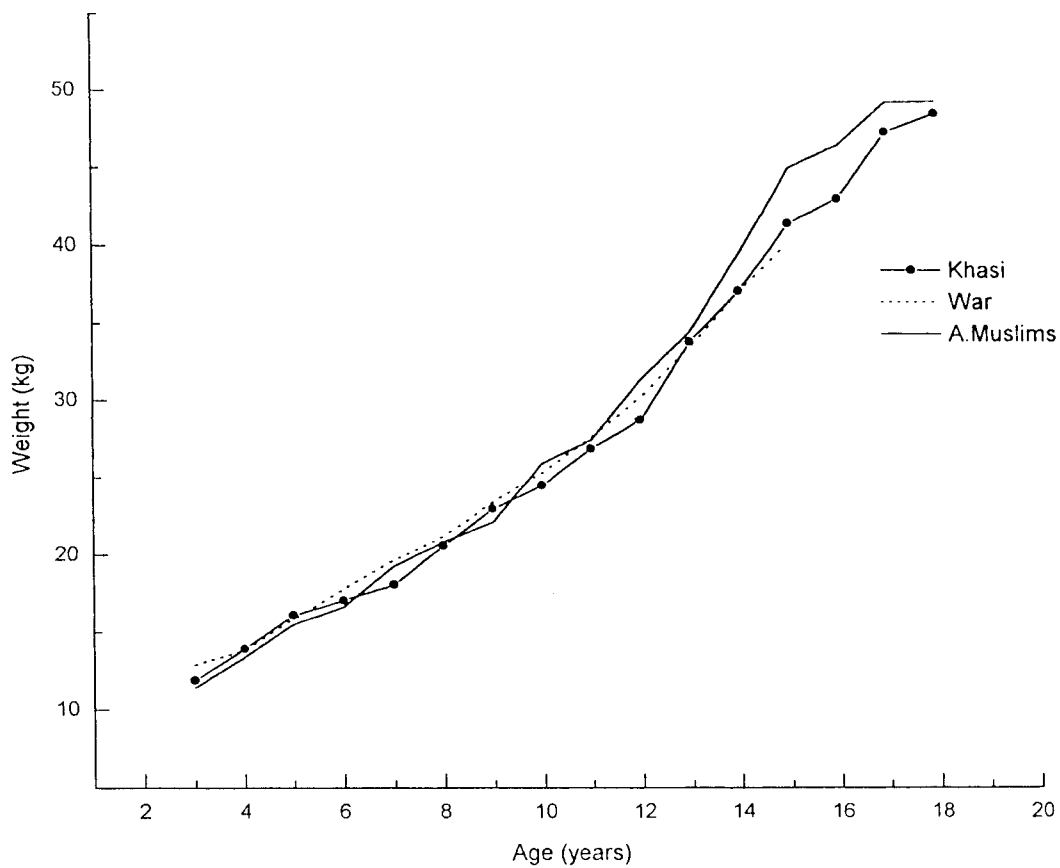


Figure 7.9. Mean weight of boys

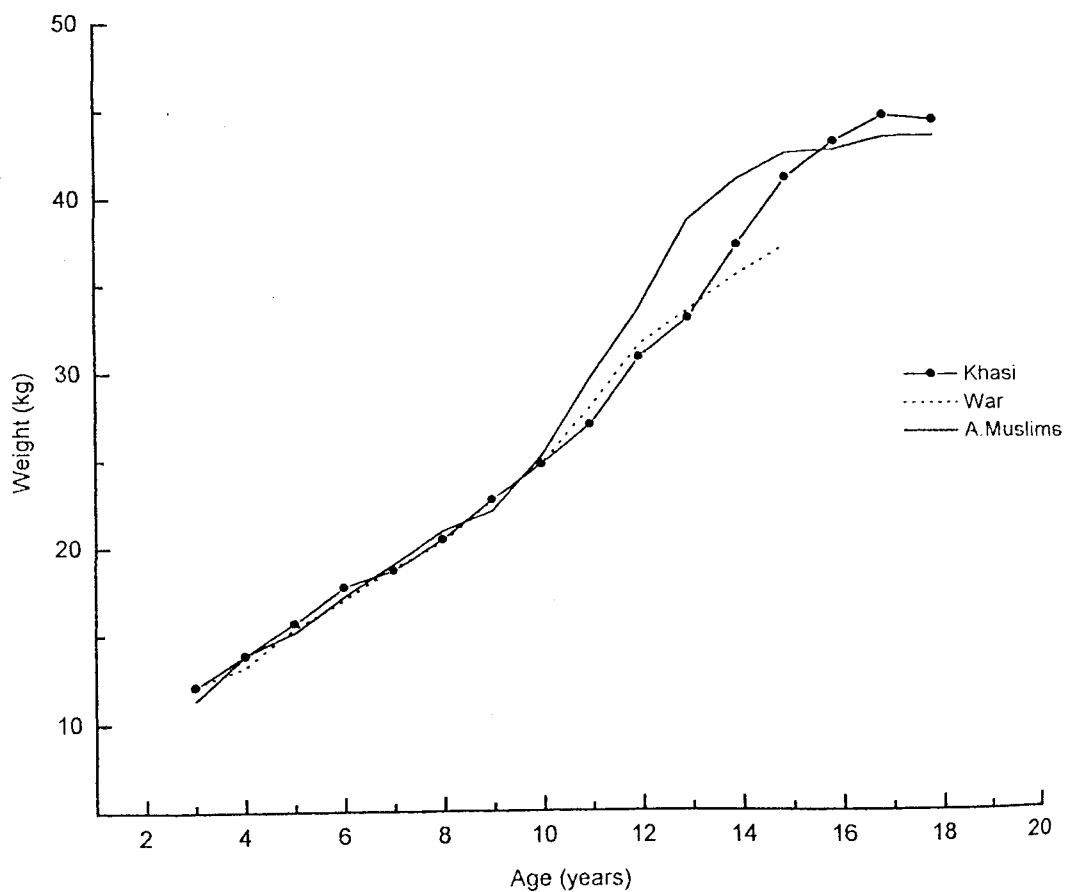


Figure 7. 10. Mean weight of girls

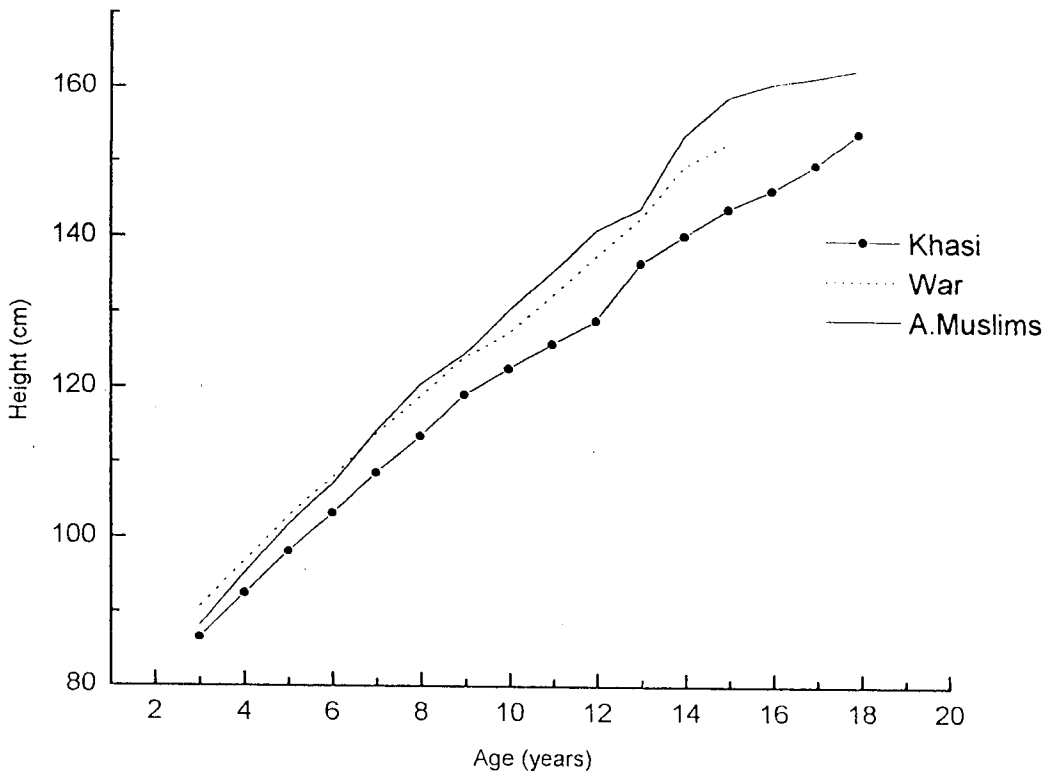


Figure 7.11. Height of boys

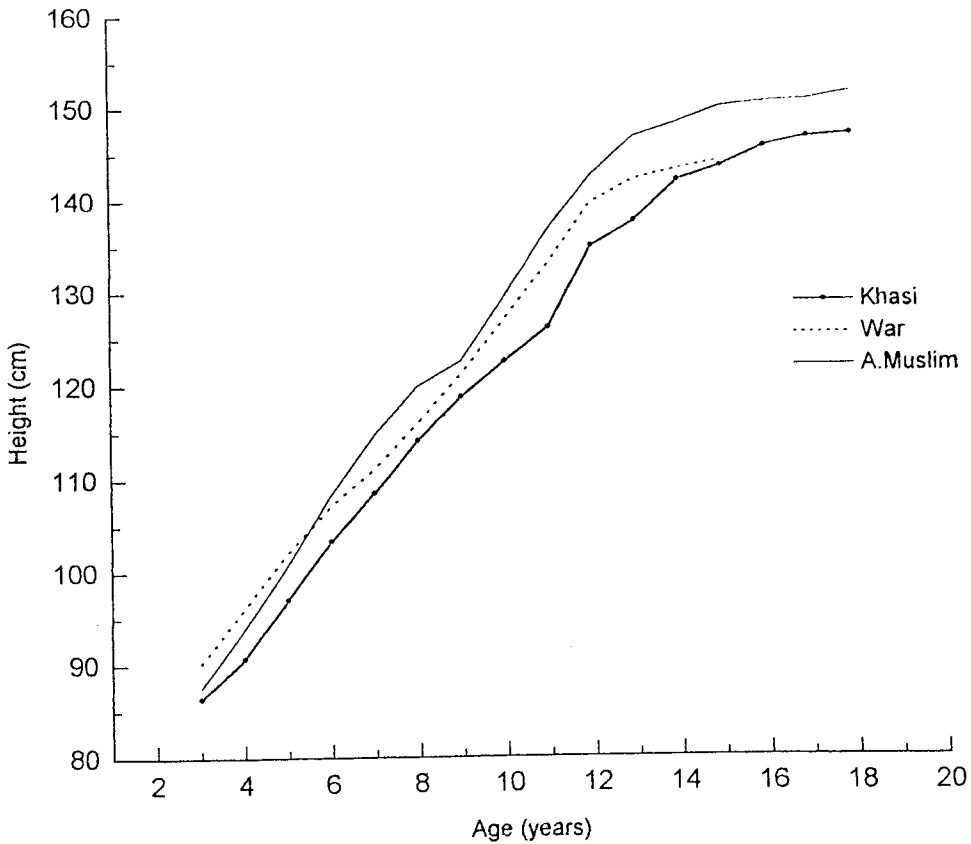


Figure 7.12. Height of girls

### **Sitting Height**

Figure 7.13 shows the mean sitting height of the Khasi boys in comparison with the War Khasi and Assamese Muslim boys. It can be observed that the Khasi boys are lower in sitting height across age groups, i.e., from 3 to 18 years of age. The mean sitting height in the War Khasi boys is higher than in the Assamese Muslim boys from the age of 3 to 6 years; they are more or less similar from 6 to 9 years of age, and thereafter, they are surpassed by Muslim boys. The same trend is observed in the case of girls (Figure 7.14) which indicates that the Khasi girls have the lowest sitting height across age groups, except from 17 years of age when they tend to have a similar sitting height with the Assamese Muslim girls. From 3 to 6 years of age, the War Khasi girls are higher in sitting height than both the Khasi and Assamese Muslim girls, and from about 14 to 15 years of age they are shorter in sitting height than the Khasi girls.

### **Head Circumference**

Like in the case of height and sitting height, Figure 7.15 shows that the Khasi boys have a lower head circumference than the War Khasi and Assamese Muslim boys across age groups. On the other hand, the mean head circumference in the War Khasi boys is in the middle of those for the Khasi and Assamese Muslim boys from 3 to 13 years of age, and thereafter it is higher in the latter than in the former. Unlike in the case of boys, the mean head circumference in Khasi girls is higher than that for the War Khasi girls from 6 to 7 years, and it is also higher than that for the Assamese Muslim girls from 16 to 17 years of age (Figure 7.16). Nevertheless, the War Khasi girls have broader head than the Khasi girls of the present study across age groups, except from 6 to 7 years which is higher in the latter. With respect to the difference between the War Khasi and Assamese Muslim girls, Figure 7.16 shows that the latter have broader head than the former from 3 to 12 years of age, and thereafter it is higher in the former.

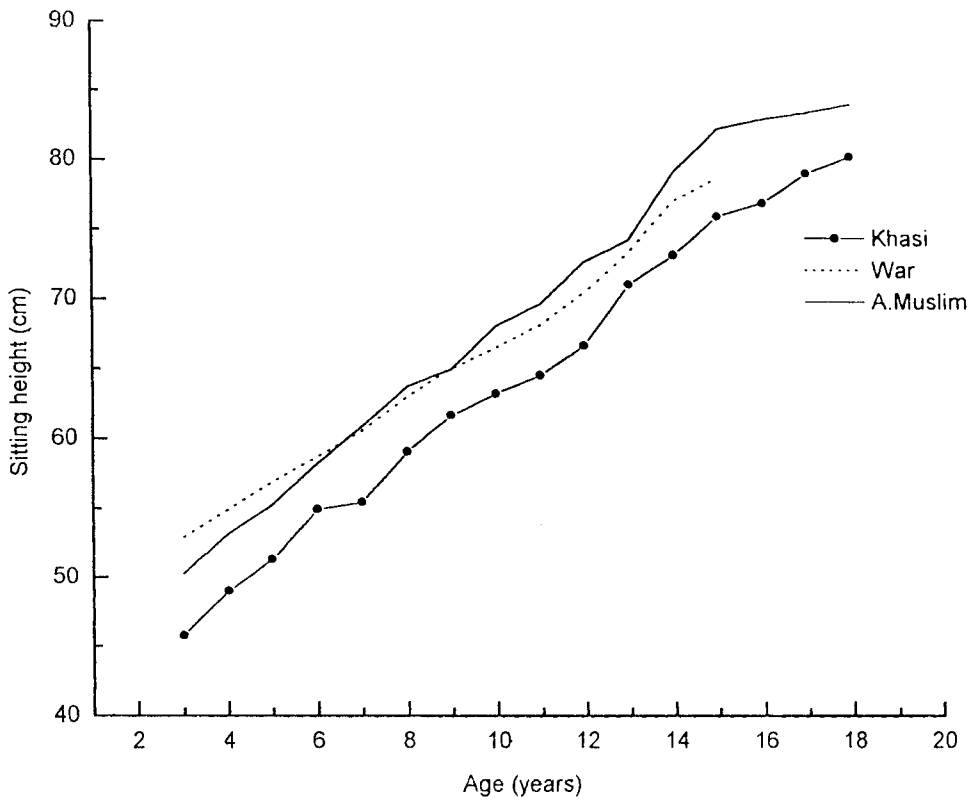


Figure 7.13. Sitting height of boys

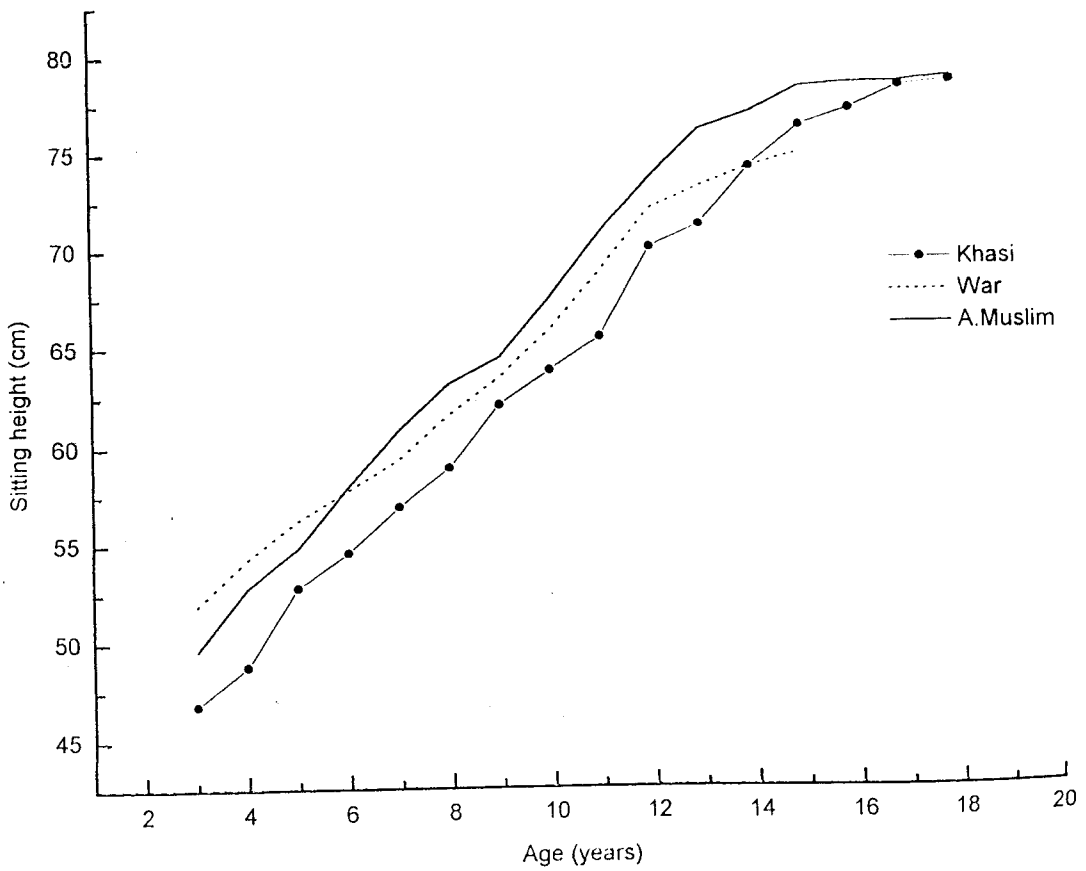


Figure 7.14. Sitting height of girls

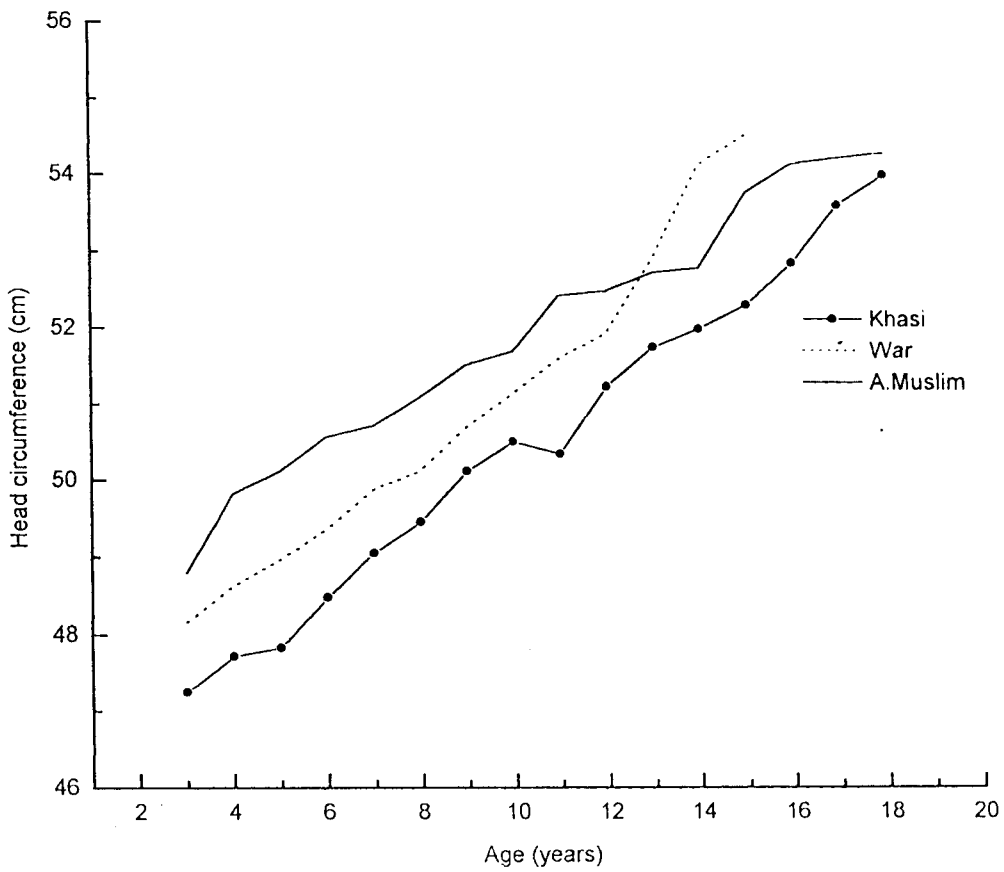


Figure 7.15. Head circumference of boys

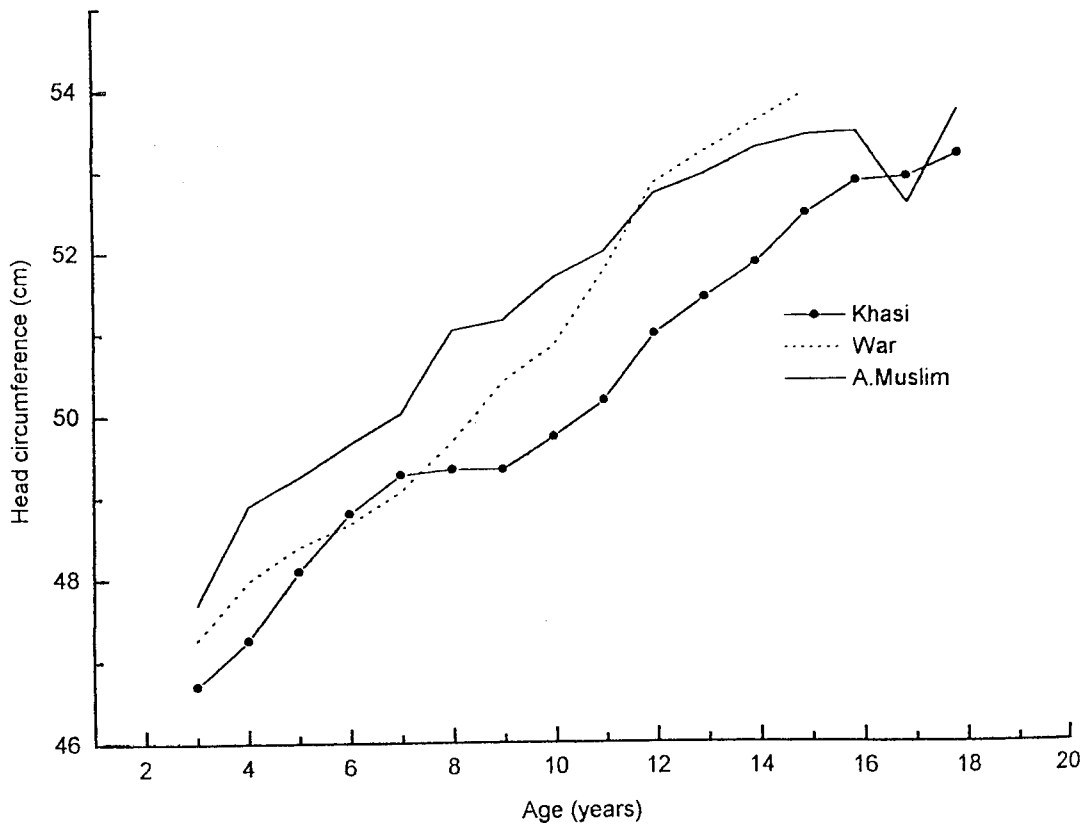


Figure 7.16. Head circumference of girls

### Mid Upper Arm Circumference

Figure 7.17 shows the mean arm circumference of the Khasi boys in comparison with the War Khasi and Assamese Muslim boys. It can be seen that like in the case of other measurements the arm circumference is lower in the boys of the present study when compared with the War Khasi and Assamese Muslim boys. This is true in all the age groups. On the other hand, the War Khasi and Assamese Muslim boys are more or less similar in mid upper arm circumference, although it is higher in Assamese Muslims from 3 to 4 years and 14 years onwards. Like in the case of boys, Figure 7.18 shows that the mean value of mid upper arm circumference is lower in the girls of the present study when compared to the War Khasi and Assamese Muslim girls across age groups. Further, the Figure shows that the growth curve for the mid upper arm circumference of the War Khasi boys is more or less similar to that for the Assamese Muslim girls from 10 to 12 years, and it higher in the War Khasi from 7 to 8 years. In other age groups, the mean value of mid upper arm circumference in the Assamese Muslim girls is higher than that in the War Khasi girls.

In view of the above comparison, it is obvious that the Khasi children of the present study are much shorter and lighter than the American children, but they are more or less comparable in weight and height to the Indian children as reported by the ICMR. In comparison with the War Khasi and Assamese children, the children of the present study are by and large similar in weight to the War Khasi and Assamese children, especially from 3 to about 11 years of age. But the children of the present study are shorter than the War Khasi and Assamese children in all age groups, and it is true in the case of sitting height as well. Similarly, the head and mid upper arm circumferences are lower in Khasi children of the present study when compared with the War Khasi and Assamese Muslim children.

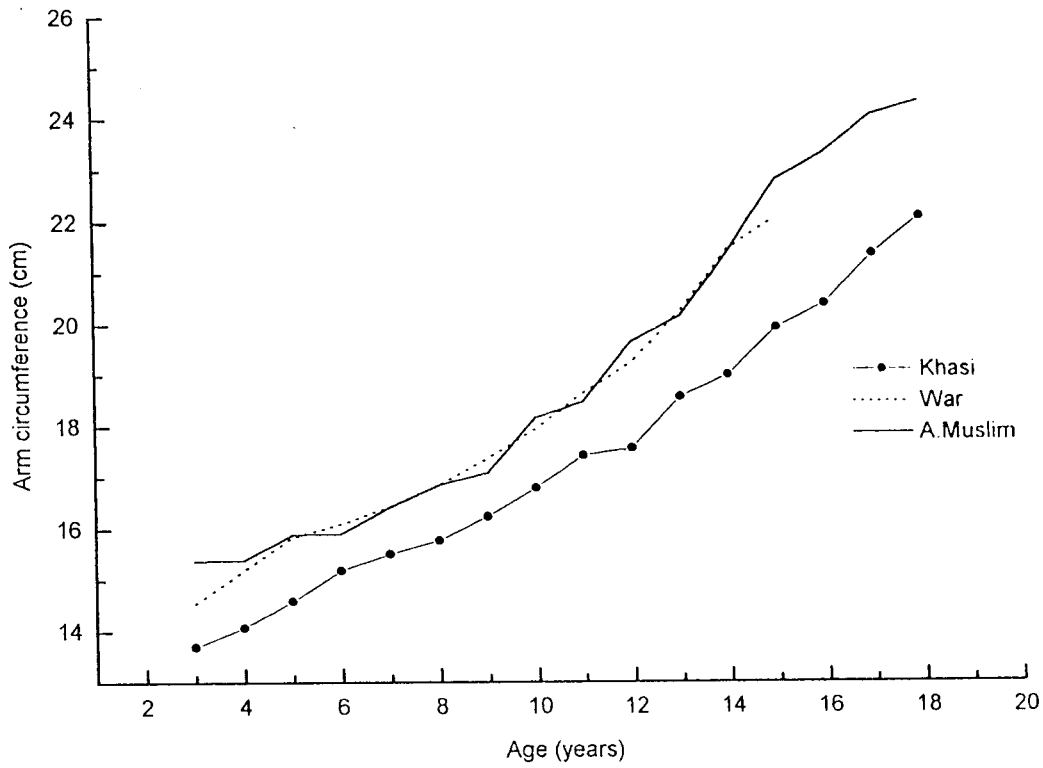


Figure 7.17. Arm circumference of boys

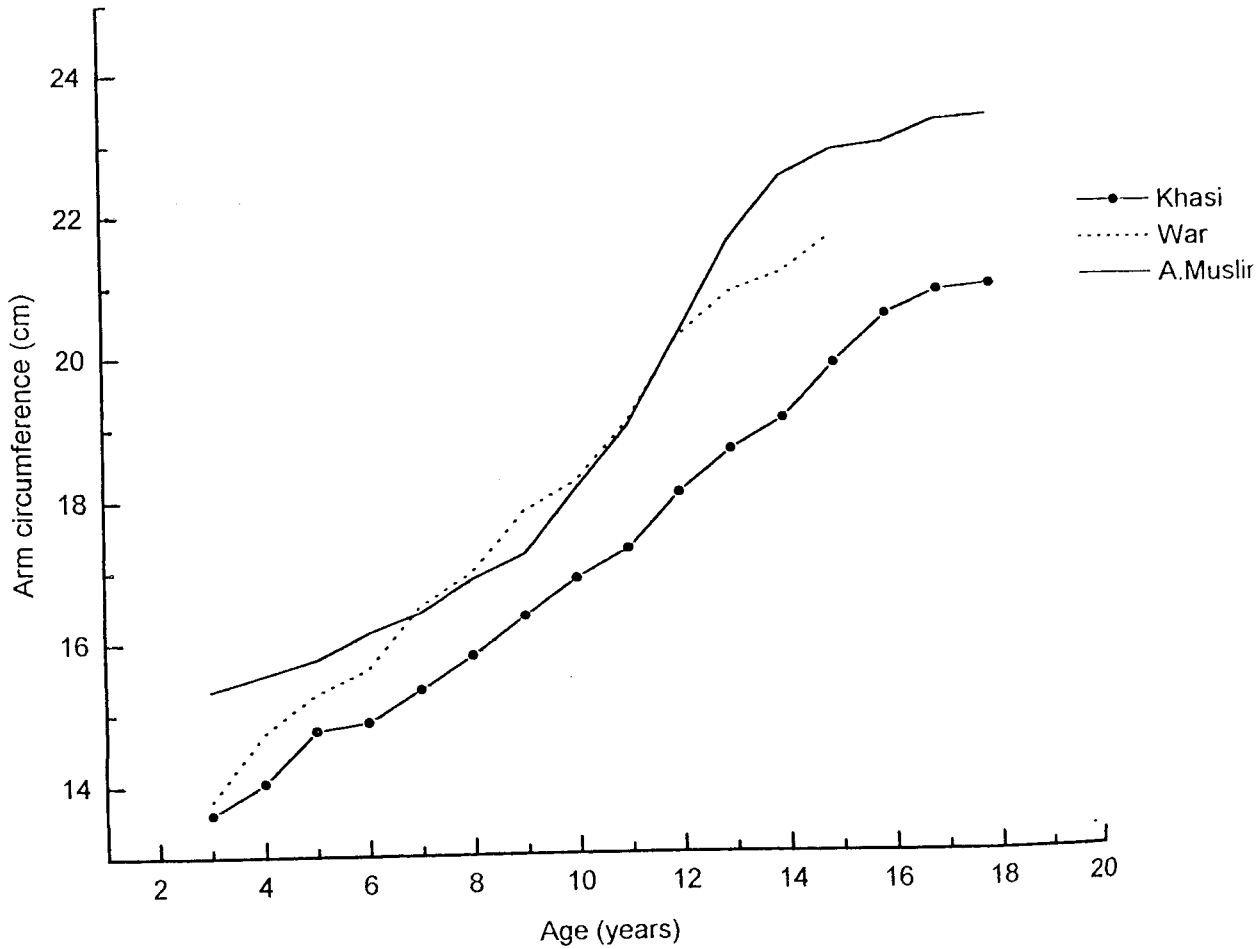


Figure 7. 18. Arm circumference of girls

## NUTRITIONAL STATUS

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 undernutrition and infections in developing countries are poverty, poor hygienic conditions and little access to preventive and health care (Mitra, 1985; WHO, 1990). Hence, assessment of the nutritional status of population has attracted the attention of not only the nutritionists and other biological scientists, but also the economists and other social scientists with a view to understanding the health and socioeconomic status of the population (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 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 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, skinfold thickness, weight for age, height for age, weight for height, body mass index, indices of upper arm circumference, etc., (Jelliffe, 1966; Frisancho, 1990) are used for assessing the nutritional status of children. In the present study, <sup>we</sup> have taken into consideration three anthropometric indices, i.e., weight for age, height for age and body mass index (BMI, for assessing the nutritional status of children in the present population.

It is observed in Chapter VI that the frequencies of mild, moderate and severe forms of underweight are 44.71%, 30.42% and 1.85% in boys and 48.32%, 22.59% and 1.32% in girls, respectively. It is found that the prevalence of underweight is higher in boys (76.98%) than in girls (72.22%), and the difference is statistically significant ( $\chi^2 = 24.94$ , DF = 3, P < 0.000). However, most of the underweight children are in the categories of mild and moderate degrees of undernutrition.

With respect to height for age, an indicator of growth retardation, about 95% of boys and girls in the present population are stunt. Whether stunting or short stature of these children should be regarded as growth retardation, thereby indicating of high undernutrition, is a moot question of interest. It has been suggested that the use of

national and international population references for assessing the nutritional status of children in terms of height for age may lead to overestimation of undernutrition in children of the short stature population like the Khasis (Khongsdier, 1996b). The same is true in the case of the present population which indicates the high prevalence of underweight and growth retardation according to NCHS growth references. This may also have certain implications if we take into consideration the lower frequency of undernutrition according to body mass index (BMI). It is observed that the frequencies of mild, moderate and severe forms of chronic energy deficiency in the children aged 3 to 9 years of age are respectively 12%, 6% and 8% in boys and 18%, 6% and 8% in girls.

In the case of children aged 10 to 18 years, about 95 % of boys and girls are well nourished in the present population. These results clearly indicate that the prevalence of undernutrition according to BMI is not as high as that indicated by weight and height for age. This may be due to the fact that weight for age and height for age are derived as percentage of the median of the international population reference, whereas BMI is directly obtained as a proportion of weight to the square of height of an individual, thereby it is independent of the so-called standard weight or height. As observed in other populations, BMI seems to be the better indicator of nutritional status than any other indices taken for the present study. Nevertheless, the present findings also indicate that the children in the higher age groups are better in nutritional status than those in the lower age groups, i.e., 3 to 9 years of age.

### **Nutritional Status and Socio-economic Condition**

It is generally reported that the widespread of undernutrition in developing countries is associated with poor hygienic conditions and socio-economic condition of the populations (Mitra, 1985; WHO, 1990). Therefore, assessment of the nutritional status of population has attracted the attention of not only the nutritionists and other biological scientists, but also the economists and other social scientists with a view to understanding the health and socioeconomic status of the population. In the present study, we have also been an attempt to show the prevalence of undernutrition according to religious and income groups of the population. This may be described as follows:

## Religion

With respect to religious groups, it is observed that the mean values of all these anthropometric indices are higher in the Muslim children than in the Christian and Niam Khasi children. After adjusting for the effect of economic condition, the one way analysis of covariance (ANCOVA) indicates that the differences in anthropometric indices between religious groups are highly significant for both boys and girls, except the BMI in girls. According to Scheffe's multiple range test, the Muslim boys are significantly higher than the Christian boys in weight for age (Difference  $\pm$  standard error:  $5.01 \pm 0.81$ ,  $P < 0.000$ ) and height for age ( $1.70 \pm 0.39$ ,  $P < 0.000$ ). With respect to BMI, there is an absence of significant difference according to Scheffe's test, but it is significant according to Least Square Significance Difference ( $0.94 \pm 0.44$ ,  $P < 0.03$ ). The differences between the Muslim and Niam Khasi boys are also significant in respect of all indices (Weight for age:  $6.88 \pm 0.79$ ,  $P < 0.000$ ; Height for age:  $2.07 \pm 0.38$ ,  $P < 0.000$ ; BMI:  $0.96 \pm 0.43$ ,  $P < 0.03$ ). On the other hand, the differences between Christian and Niam Khasi boys are significant only in respect of weight for age ( $1.87 \pm 0.72$ ,  $P < 0.03$ ). Nevertheless, it is clear that the Muslim boys are heavier than the Christian and Niam Khasi boys in respect of all anthropometric indices, thereby suggesting that the Muslim boys are better in nutritional status.

Among girls the differences between Muslims and Christians according to Scheffe' test are significant in respect of weight for age ( $3.89 \pm 0.84$ ,  $P < 0.000$ ) and height for age ( $1.86 \pm 0.35$ ,  $P < 0.000$ ), but not in respect of BMI. But the differences between Christian and Niam Khasi girls are not significant in respect of all indices, except in the case of weight for age ( $2.08 \pm 0.76$ ,  $P < 0.02$ ). Thus, it indicates that the Christian and Niam Khasi children are by and large similar in height for age and BMI, although the former are higher in weight for age than the latter.

In order to have a better understanding of the effect of religion on nutritional status of Khasi children, an attempt has also been made to show the percentage distribution of weight for age according to three religious groups. It is found that about 62.54%, 79.23% and 84.04% of the boys in Muslims, Christians and Niam Khasis, respectively, are underweight. Among girls, these frequencies of underweight are found to be 61.98%, 75.11% and 76.74%, respectively. The Chi-square values indicate that the

differences between religious groups in respect of weight for age are highly significant (Boys:  $\chi^2 = 70.82$ , DF = 6,  $P < 0.000$ ; Girls:  $\chi^2 = 46.87$ , DF = 6,  $P < 0.000$ ). Thus, the Muslim Khasi boys and girls are better in weight for age when compared to their counterparts belonging to Christianity (Boys:  $\chi^2 = 38.75$ , DF = 2,  $P < 0.000$ ; Girls:  $\chi^2 = 20.20$ , DF = 2,  $P < 0.000$ ) and Niam Khasi (Boys:  $\chi^2 = 66.58$ , DF = 2,  $P < 0.000$ ; Girls:  $\chi^2 = 40.94$ , DF = 2,  $P < 0.000$ ). On the other hand, the Christian Khasi children are heavier than the Niam Khasi children, although the differences are not statistically significant in the case of boys (Boys:  $\chi^2 = 4.04$ , DF = 2,  $P > 0.05$ ; Girls:  $\chi^2 = 8.56$ , DF = 2,  $P < 0.01$ ). Thus, the Muslim children are heavier than the Christian and Niam Khasi children, and the differences between the Christian and Niam Khasi children are significant only in the case of girls, i.e., the Christian girls are heavier than the Niam Khasi girls.

Like in the case of weight for age, the Muslim Khasi children are taller than the Christian and Niam Khasi children. It is found that the prevalence of stunting or growth retardation in boys is about 94.69%, 96.57% and 95.60% respectively in the Muslim, Christian and Niam Khasis. In the case of girls, these frequencies are 92.05%, 94.47% and 97.37%, respectively. The Chi-square values indicate that the differences in the percentage distribution of normal, mild, moderate and severe forms of nutritional status in respect of height for age are highly significant for both boys and girls (Boys:  $\chi^2 = 24.89$ , DF = 6,  $P < 0.001$ ; Girls:  $\chi^2 = 40.32$ , DF = 6,  $P < 0.000$ ).

It indicates that the children of Muslim Khasi are less retarded when compared with the Christian and Niam Khasi children, despite the fact that the prevalence of stunting is high in all the religious groups. With respect to the difference between the Christian and Niam Khasi children, the frequency of mild and moderate forms of growth retardation is higher in the Christian boys than in the Niam Khasi boys, but the frequency of severe form is higher in the latter than in the former, despite the absence of statistical difference. In the case of girls, the situation is reverse, which shows that the prevalence of mild and moderate forms of growth retardation is higher in the Niam Khasis than in the Christian Khasis, but the frequency of severe form of growth retardation is higher in the latter than in the former, although these differences are not statistically significant. So the Christian and Niam Khasi children are by and large similar in the prevalence of

growth retardation. The significant differences between religious groups as indicated by the overall Chi-square test are mainly due to the differences between the Khasi Muslim children and other religious groups.

With respect to BMI, in the age group 3 to 9 years, about 19.74%, 24.88% and 31.15% of boys and 21.18%, 19.34% and 29.36% of girls in the Muslims, Christians and Niam Khasis, respectively, have suffered from chronic energy deficiency. Thus it indicates that the prevalence of chronic energy deficiency is lower among the Muslims than that among the Christians and Niam Khasis, though it is lower among the Christians in the case of girls. However, the Chi-square test indicates that the differences between religious groups are significant only in boys ( $\chi^2 = 18.76$ , DF= 6,  $P < 0.01$ ) but not in girls ( $\chi^2 = 7.81$ , DF= 6,  $P > 0.05$ ). In the age group 10-18 years, the differences between religious groups in respect of BMI are not statistically significant for both boys and girls. Thus, it indicates that religion plays little role in influencing the BMI of the children in the present study, although the influence of religion on weight for age and height for age seems to be important. It clearly shows that the Muslim children are heavier and taller than the Christian and Niam Khasi children. One possible explanation of such a trend in the Muslims may be due to intermixture, i.e., the Muslim children are by and large the product of the intermixture between the Khasi females and the Muslim males who migrated to Meghalaya from other parts of India.

### **Economic Condition**

With the exception of few cases, the mean values of weight for age, height for age and BMI are lower in the LIG when compared to the MIG and HIG. Adjusting for religion, the ANCOVA test also indicates that the differences between income groups are significant in respect of all anthropometric indices for both boys and girls. According to Scheffe's test, the LIG children are significantly lower than those in the MIG and HIG in respect of all the three anthropometric indices, irrespective of the difference between LIG and MIG in respect of BMI for girls ( $1.20 \pm 0.36$ ,  $P < 0.004$ ). Likewise, the differences between MIG and HIG children are highly significant for weight for age, height for age and BMI.

In order to have a better understanding of the effect of economic condition on the nutritional status of the children in the present study, we have also made an attempt to show the prevalence of undernutrition according to three income groups. With respect to weight for age, it is found that about 81.90%, 76.60% and 67.73% of the boys and 79.52%, 72.94% and 58.96% of girls are underweight in the LIG, MIG and HIG, respectively. It indicates that the proportion of underweight children decreases with the rise in income levels of the household. The Chi-square values also indicate that the differences between income groups in respect of the distribution of children according to different degrees of underweight are highly significant for both boys ( $\chi^2 = 107.09$ , DF = 6,  $P < 0.000$ ) and girls ( $\chi^2 = 62.08$ , DF = 6,  $P < 0.000$ ). Thus, it suggests that the income of household is very important in influencing the nutritional status of children according to weight for age as has been observed with regards to ANCOVA test.

With respect to height for age, the prevalence of stunting is very high in all the income groups for both boys and girls, but the percentage is higher in the lower income groups when compared with the HIG. Such a trend is also observed with respect to the prevalence of severe forms of growth retardation, which is much higher in the LIG and MIG when compared with the HIG. These differences between income groups in respect of height for age are statistically significant for both boys ( $\chi^2 = 102.50$ , DF = 6,  $P < 0.000$ ) and girls ( $\chi^2 = 99.15$ , DF = 6,  $P < 0.000$ ). This clearly indicates that income of the household plays a very important role in influencing the height for age of the children of the present study.

With respect to BMI, the differences between income groups in respect of BMI are not significant in girls for both the age groups 3-9 and 10-18 years. But in the case of boys, the income of household seems to be important and the differences between income groups are significant for both the age groups. For the age group 3-9 years, the prevalence of chronic energy deficiency in boys is about 31.11%, 22.75% and 21.09% in LIG, MIG and HIG, respectively. These frequencies are about 8.36%, 1.04% and 3.90% respectively in the age group 10-18 years. Thus, it is obvious that the prevalence of chronic energy deficiency is higher in the LIG when compared to the MIG and HIG, and the influence of the income of household is clearly significant in BMI of boys, although it is also perceptible in girls.

## CONCLUDING REMARKS

### Growth and Nutritional Status

In comparison with international and national growth references, the Khasi children of the present study are much shorter and lighter than the U.S. NCHS children, but they are more or less comparable in weight and height to the Indian children as reported by the ICMR. In comparison with neighbouring populations, the children of the present study are by and large similar in weight to the War Khasi and Assamese children, especially from 3 to about 11 years of age. But they are shorter than the War Khasi and Assamese children in all age groups, and it is true in the case of sitting height as well. Similarly, the head and mid upper arm circumferences are lower in Khasi children of the present study when compared with the War Khasi and Assamese Muslim children.

These findings may have certain implications for ethnic or genetic variation in growth and nutritional status of population. It is obvious that anthropometric indices like height for age and even weight for age in relation to the so-called international standards (references) cannot be used as indicators of the nutritional status in a short stature population like the Khasi, especially in the higher age groups (Khongsdier, 1996b). Thus, BMI may be considered a better indicator of the nutritional status of children in the present study. It is likely that differences in stature between populations may be related not only to nutrition, but also to physical environment and genetic factors (Payne, 1992). However, this does not mean to reject the international references completely; their use is very important for comparative studies.

It may however be noted that the differences between religious groups are mainly due to the differences between the Muslim children and the Christian and Niam Khasi children. It is found that the Muslim children are heavier and taller than the Christian and Niam Khasi children, and there is not much difference between the Christians and Niam Khasis in respect of growth pattern, except in few cases.

Thus, it indicates that religion plays little role in influencing the BMI of the children in the present study, although the influence of religion on weight for age and height for age seems to be important. It clearly shows that the Muslim children are heavier and taller than the Christian and Niam Khasi children. One possible explanation of such a trend in the Muslims may be due to intermixture, i.e., the Muslim children in the present study are by and large the product of the intermixture between the Khasi females and the Muslim males who migrated to Meghalaya from different corners.

## CHAPTER VIII

### SUMMARY

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#### **Introduction**

Human evolution and variation are the two major objectives of study in physical anthropology. These two objectives of study are overlapping, and they cover a vast area of biological interest ranging from simple anthropometric study to molecular study of human evolution and variation. Recently, efforts have also been made to understand the relationship between human biology, especially to those aspects relating to health and nutrition, and various socio-cultural factors (Strickland and Tuffrey, 1997). In fact, it is now believed that the human biological processes are largely influenced by various sociocultural aspects of the human society. Thus, it is quite imperative on the part of physical anthropologists to undertake such studies with a view to understanding not only the processes of human evolution, but also the health and nutritional aspect of human population.

From an evolutionary point of view, demographic parameters like fertility and mortality are very important to understand the genetic make up of a population. It is theoretically believed that natural selection, one of the major evolutionary forces, is operating on human population through differential fertility and mortality (Crow, 1958; Johnston, 1973). Similarly, other demographic parameters like population size, mating patterns admixture rate, migration, etc., are very helpful in understanding the biological characteristics of the population (Basu, 1969; Ghosh, 1976; Khongsdier and Ghosh, 1994). However, demographic parameters like fertility and mortality are largely influenced by various socioeconomic factors like religion, education, income, occupation, age at marriage, adoption of family planning, etc. (Mosley and Chen, 1984; Mahadevan, 1986; Muhuri, 1995; World Bank, 1999; Caldwell *et al.*, 1999; and others). So, it is quite imperative on the part of physical anthropologists to undertake studies on the effect of

socioeconomic conditions on demographic parameters, particularly on fertility and mortality.

Besides the demographic aspects of population, physical growth and development of children is another important field of anthropological research. By the term growth, we mean a “quantitative increase in size or mass” of an organism, while development refers to a “progression of changes, either quantitative or qualitative, that leads from an undifferentiated or immature state to a highly organized, specialized, and mature state” (Bogin, 1999). The pattern of human growth serves as a type of mirror that reflects the biocultural evolution of human population. “Human biocultural evolution produced the pattern of growth and development that converts a single fertilized cell, with its complement of deoxyribonucleic acid (DNA) into a multicellular organism composed of hundreds of different tissues, organs, behavioral capabilities and emotions” (Bogin, 1999).

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”. Further, Eveleth and Tanner (1990) have also observed “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 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 a population. Since human growth and development is also largely influenced by socio-environmental factors like nutrition, infection, occupation, income and religion, it is very vital for understanding the biocultural variation and evolution of human populations (Tanner 1988, Eveleth and Tanner, 1990).

In the light of the above circumstances, demographic parameters and physical growth are helpful not only in understanding the process of human evolution and variation, but also reflect the health and economic condition of a population. In India, growth studies are very recent in origin, which still warrants further researches. So, it may be essential to conduct more researches on physical growth and development of children with a view to understanding the economic conditions and health and/or nutritional status of the different populations. It may be mentioned here that very few growth studies have so far been published in Northeast India (see review, Khongsdier and Ghosh, 1998). Moreover, almost all studies have been carried out among some populations of Assam only. Likewise, demographic studies of populations are very limited in number in this part of the country (Khongsdier, 2001).

With this end in view, we have undertaken a study on demography and growth pattern among the Khasi children of Shillong in Meghalaya with a view to understanding the following objectives:

1. To understand the demographic structure of the three religious groups of the Khasis, namely, Christians, Muslims and Niam Khasis of Shillong.
2. To understand the growth pattern and nutritional status of children aged 3 to 18 years.
3. To assess the effects of some socioeconomic factors like religion, income of household, etc., on demographic parameters, and growth patterns of children.

## **MATERIALS AND METHODS**

### **Study Area and population**

Khasi population is mainly distributed in Khasi and Jaintia hills of the State of Meghalaya. The term "Khasis" is a generic name referring to any one or all the five major subgroups, namely, Khyntriams, Pnars, Bhois, Wars and Lyngngams. However, in the present study, we are mainly concerned with the Khyntriams, who are also known as the Khasi proper.

The fieldwork was conducted in different intervals between November 1996 and February 1998 in Shillong. No sampling technique was applied for the selection of samples at both individual and population levels. However, an effort was made to include

in our study the three major religious groups, namely, Christian Khasis, Khasis of traditional religion (referred to herein as Niam Khasis), and Muslim Khasis. The Christian Khasis and Niam Khasis are distributed all over the Khasi hills, but the Muslim Khasis are mainly concentrated in Shillong, the capital of the state. Therefore, the present study was confined to Shillong only. According to our list of Muslim households prepared with the help of Islamic Organization of Shillong, the Muslim Khasis are restricted to certain localities such as Laban, Bishnupur, Garikhana, although some of them are also scattered in Nongthymmai, Laitumkhrach, Lawsohtun and Lummawbah areas. Therefore, data for the present study were collected from 584 households of the three religious groups inhabiting in the above mentioned localities of Shillong.

**Demographic data:** The nature of demographic data collected for the present study was based on those parameters suggested by the World Health Organization Working Group (WHO, 1964, 1968). Structured schedules were prepared relating to household census, fertility, mortality and socioeconomic parameters, and these schedules were completed through in-depth interview with the heads or elder members of households. A household schedule was used for the collection of data on individual records and socioeconomic parameters like name of informant, age, sex, marital status, relationship to head of the household, date and place at which record was taken, clan, tribe, religion, occupation, education, monthly income, community affiliation, total number of family members, place of birth, place of residence, etc. The fertility and mortality schedules were used for collection of data on pregnancy records of each mother, which include total number of conception, total number of live-births, birth order; age, sex and marital status of each offspring; number of dead children, sex, date of birth, age at death, causes of death, if any, number of reproductive wastage (abortions and still- births).

**Data on Growth of Children:** A cross-sectional method of study was followed for collection of data on physical growth of 2719 children aged 3 to 18 years (Eveleth and Tanner, 1990), taking into consideration the following anthropometric measurements:

Weight (kg)

Height vertex (cm)

Sitting height (cm)

Biacromial diameter (cm)

Bi-iliac diameter (cm)

Head circumference (cm)

Mid upper arm circumference (left) (cm)

Chest girth (cm)

An attempt was made to follow as far as possible the standard techniques of taking the measurements as described in *Weintraud and Lourie (1981)*. For assessing the nutritional status of children, we have adopted three anthropometric indices - weight for age, height for age and weight for height - which are considered as the indicators of nutritional status. These indices were derived as percentage of the international standard or reference, i.e., the growth reference of the U.S. National Centre for Health Statistics (NCHS, 2000).

### **Socio-economic Categories**

In the present study, three important socio-economic variables were taken into consideration. These include religion, monthly income of the household and level of education. These socio-economic variables were classified arbitrarily into a different group and/or category with a view to understanding their influence on demographic characteristics and growth and nutritional status of the study population. Our classification may be briefly described as follows:

**Religious groups:** The Khasi population (mostly Khyntriams) of the present study is divided into three broad religious groups, namely, the Christian Khasis, Niam Khasis and Muslim Khasis. By *Christian Khasis*, we mean those Khasis who have embraced Christianity or those Khasis who are Christians by faith, and the *Niam Khasis* refer to those Khasis who have followed and maintained their traditional religion. On the other hand, the Muslim Khasis are those Khasis who have embraced Islam, and the children belonging to this religious group are by and large the product of the intermixture between the Khasi females and Muslim males.

**Income groups:** The interval estimation based on standard deviation of the per capita monthly income of household was adopted for classifying the three economic groups (Khongsdier, 1997). Accordingly, the three economic groups were classified as follows:

Above  $(\bar{X} + 4SD/\sqrt{N})$  = High income group (HIG)

(  $\bar{X} - 4SD/\sqrt{N}$ ) to (Mean +  $4SD/\sqrt{N}$ ) = Middle income group (MIG)

Below (  $\bar{X} - 4SD/\sqrt{N}$ ) = Low income group (LIG)

**Educational Level:** The data on educational attainment of individuals in the present study were arbitrarily classified as follows: Individuals who were unable to read and write were classified as **Illiterate**. The individuals who were able to read and write and those who attended school up to standard IV were grouped into **Primary** level of education. **Secondary level** of education includes all those persons who attended school up to below matriculation. The individuals with education up to matriculation and above are included in the category of **Higher level** of education due to inadequacy of data.

**Statistical Analyses:** The data collected for the present study are quantified and analysed statistically, using SPSS Window software. The data are presented in terms of means, standard deviation, standard error and proportions or percentages. The differences between two means were tested, using t-student test, while the differences between more than two means were determined, using one-way analysis of variance (ANOVA). Analysis of covariance was also carried out for testing the differences among means, allowing for the effects of other covariates. The differences between proportions were tested, using chi-square test. Multiple regression analysis was also carried out for understanding the effects of socio-economic factors on demographic parameters and growth patterns of children. Logistic regression analysis was used for analyzing the effects of maternal age, education, income and religion on infant mortality.

## FINDINGS OF THE PRESENT STUDY

The findings of the present study are presented in three chapters. In chapter IV, we deal with the demographic characteristics of the three religious groups. The growth and nutritional status of children are presented in Chapters V and VI, respectively.

**Demographic characteristics:** The findings on important demographic characteristics of the three religious groups are as follows:

1. According to Sundborg's classification of population, a population is said to be *progressive* when the number of persons in relation to the total population are

40.00%, 50.00% and 10.00% in the age groups 0-14, 15-49 and 50 + years, respectively. The population is referred to as *stationary* if these frequencies are 33.00%, 50.00% and 17.00%, respectively; while the frequencies of 20.00%, 50.00% and 30.00%, respectively, are the characteristics of *regressive* population (Khongsdier, 2001). Following these classifications of population, the three religious groups of the Khasi population are found to be *progressive type*.

2. The over all sex ratio, i.e., the number of males per 100 females, is found to be 96.54, 95.14 and 97.99 in the Christians, Muslims and Niam Khasis, respectively, which is low despite absence of statistical difference from the ideal sex ratio of 1:1 for all the religious groups.
3. The mean age at marriage is much higher in males than in females for all religious groups. Among males it is found to be  $25.48 \pm 0.19$ ,  $25.45 \pm 0.17$  and  $25.94 \pm 0.21$  years in the Christians, Muslims and Niam Khasis, respectively. In the case of females, these mean values are  $20.32 \pm 0.21$ ,  $20.30 \pm 0.19$  and  $20.35 \pm 0.25$  years, respectively. The mean age at marriage among the Muslim, Christian and Niam Khasi women of the present study is higher than those reported for the populations of Assam (Sengupta and Gogoi, 1995), but it is more less similar to that reported for the War Khasi (Khongsdier, 2001).

### **Fertility**

1. The mean live births per mother living in wedlock till the age of 45 are found to be  $4.50 \pm 0.13$ ,  $4.89 \pm 0.18$  and  $4.82 \pm 0.15$  in the Christians, Muslims and Niam Khasis, respectively. Although it is slightly higher in the Muslims and Niam Khasis, the one-way analysis of variance (ANOVA) indicates that the differences between religious groups are not statistically significant ( $F = 190$ ,  $P > 0.05$ ). These mean live births to women living in wedlock for the three religious groups are similar to those reported for the Christian (4.08) and Non-Christian (4.91) War Khasis (Khongsdier, 2001).
2. With regard to all married women of all ages, the mean live births are  $4.93 \pm 0.14$ ,  $5.31 \pm 0.17$  and  $5.18 \pm 0.15$  in the Christians, Muslims and Niam Khasis, respectively, and the mean surviving children are  $4.51 \pm 0.11$ ,  $4.77 \pm 0.14$  and  $4.61 \pm 0.13$ , respectively. Thus, it indicates that the mean live births and surviving

children are higher in the Muslims and Niam Khasis in comparison with the Christians, despite the absence of statistical significance (Live births:  $F = 1.57$ ,  $P > 0.05$ ; Surviving children:  $F = 1.01$ ,  $P > 0.05$ ). In comparison with other populations, the three religious groups of the present study have higher live births than the Christian (4.81) War Khasis (Khongsdier, 2001) and the Kochs of Garo Hills (Kotal, 2001).

3. The age specific fertility rate is found to have reached its peak point in the age group 25- 29 years in all the religious groups, and the total fertility rates are 5.38, 5.85 and 5.85 in the Christians, Muslims and Niam Khasis, respectively. Thus, it indicates that the fertility rates are slightly higher in the Muslims and Niam Khasis when compared with the Christians. The total fertility rate in these three religious groups is more or less similar to the War Khasi, but much higher than that reported for the state of Meghalaya (NCHS, 1999) and the Kochs of Garo hills (Kotal, 2001), although it is not as high as that reported for the Dalus (Patra and Kapoor, 1996).

### **Mortality**

1. The infant mortality rates (i.e., number of deaths before 1 year of life per 100 live births) are 6.82%, 8.39% and 8.60% in the Christians, Muslims and Niam Khasis, respectively. Thus, the infant mortality rates are lower in the Christians than in the Muslims and Niam Khasis, despite the absence of statistical difference ( $\chi^2 = 3.60$ ,  $DF = 2$ ,  $P > 0.05$ ). With respect to juvenile mortality, the frequency is more or less same in the Christians (1.74%) and Muslims (1.68%), but it is higher in the Niam Khasis (2.33%), though the differences between the religious groups are not statistically significant ( $\chi^2 = 1.79$ ,  $DF = 2$ ,  $P > 0.05$ ).
2. The infant mortality rates in the Christians of the present study are similar to Christian War Khasis (6.89%), while the rates in the Muslims and Niam Khasis are similar to the Non-Christian War Khasi (Khongsdier), and for the state of Meghalaya (NCHS, 1999). However, the religious groups of the present study have lower infant and juvenile mortality rates than the Dalus (Patra and Kapoor, 1996) and Chapra Kochs (Kotal, 2001) of Garo hills.

3. With respect to reproductive wastage, it is found that the still birth rates (i.e., number of still-births per 100 pregnancies) are 3.16%, 3.18% and 3.56% in the Christians, Muslims and Niam Khasis respectively, and the abortion rates to these three religious groups (i.e., number of abortions per 100 pregnancies) are 4.32%, 4.64% and 4.60%, respectively. Thus, the rates of reproductive wastage (i.e., number of abortions and still-births per 100 pregnancies) are 7.47%, 7.82% and 8.16% in the Christians, Muslims and Niam Khasis, respectively. It appears that the Muslims and Niam Khasis are more or less similar in the frequency of reproductive wastage, and it is slightly higher in the Christians, despite the absence of statistical difference ( $\chi^2 = 0.42$ ,  $DF = 2$ ,  $P > 0.05$ ). Like in the case of infant mortality, the frequencies of reproductive wastage in the three religious groups of the present study are similar to those reported for the War Khasis (Khongsdier, 2001), but higher than those reported for the Dalus (4.93%) of Garo hills (Patra and Kapoor, 1996).

**Socio-economic Correlates:** In this thesis, an attempt has also been made to show the relationship between the demographic parameters and socio-economic factors like age of mothers, age at marriage, education of mothers, and income of household for all the three religious groups. The findings may be briefly described as follows:

1. It is found that the mean number of live births per married woman decreases with the rise in age at marriage. It holds true for the Christians, Muslims and Niam Khasis. The results of the multiple regression analysis on the effect of age at marriage on the number of live births after controlling for other factors like age, educational level, and income are shown in Chapter IV. It is found that the coefficient of regression ( $b \pm SE$ ) on the effect of age at marriage (independent variable) on the number of live births (dependent variable) is negatively significant for all the religious groups (Christians:  $b = -0.220 \pm 0.033$ ,  $t = 6.74$ ,  $P < 0.0001$ , Muslims:  $b = -0.218 \pm 0.041$ ,  $t = 5.43$ ,  $P < 0.0001$ , and Niam Khasis:  $b = -0.186 \pm 0.044$ ,  $t = 4.27$ ,  $P < 0.0001$ ). Thus, the present findings indicate that age at

marriage is a very important factor in controlling the fertility rates for all the religious groups.

2. As regards education, the coefficient of regression on the effect of education (independent variable) on the number of live births (dependent variable) is negative, but not significant in the Christians ( $b = -0.136 \pm 0.098$ ,  $t = 1.39$ ,  $P > 0.05$ ) and Muslims ( $-0.002 \pm 0.124$ ,  $t = 0.02$ ,  $P > 0.05$ ), although it is negatively significant in the Niam Khasis ( $-0.448 \pm 0.127$ ,  $t = 3.52$ ,  $P < 0.0001$ ). Thus, the present findings indicate that the education is not as important as expected in controlling the fertility rates among the Muslim and Christian Khasis, but it is certainly important in the Niam Khasis.
3. It is also found that the mean number of live births tends to decrease significantly with the increasing level of income level of the mothers for all the religious groups. The results of the multiple regression analysis (Chapter IV) show that the effect of income on the number of live births after controlling for other factors like age, age at marriage, and educational level is negatively significant for all the religious groups (Christians:  $b = -0.832 \pm 0.151$ ,  $t = 5.52$ ,  $P < 0.0001$ , Muslims:  $b = -0.739 \pm 0.189$ ,  $t = 3.92$ ,  $P < 0.001$ , and Niam Khasis:  $b = -0.987 \pm 0.161$ ,  $t = 6.12$ ,  $P < 0.0001$ ). Thus, the present findings indicate that the income of the household is a very important in controlling the fertility rates in the present population, irrespective of religious groups.

In view of all the socio-economic factors, the fertility rate in the present population is negatively associated with the age at marriage and income levels of mothers. The effect of education, on the other hand, is not clearly perceptible in the present study, except among the Niam Khasi mothers, which indicates that educational level of the mothers is also very important in regulating the fertility rate. The effect of religion on fertility rate is not significant, although the total fertility rate is more or less same among the Muslims and Niam Khasis, but it is lower in the Christians.

With respect to infant mortality (Chapter IV), it is found that the regression coefficient ( $\beta \pm$  standard error) of infant mortality (dependent variable) on maternal age is positively significant ( $0.021 \pm 0.008$ ,  $P < 0.011$ ), and it is negatively significant with respect to education ( $-0.150 \pm 0.074$ ,  $P < 0.043$ ) and income ( $-1.283 \pm 0.125$ ,  $P < 0.000$ ).

On the other hand, the effect of religion on infant mortality is not statistically significant ( $0.051 \pm 0.107$ ,  $P > 0.05$ ). Thus, it indicates that maternal age, education and income are very important in influencing infant mortality in the present population.

## **GROWTH PATTERN**

In the present study, we have described the growth pattern of the Khasi both boys and girls taking into consideration the body weight, height, sitting height, biacromial diameter, bi-iliac diameter, head circumference, arm circumference and chest circumference.

**Estimation of adult height:** According to fourth degree polynomial model by which the height is equal to  $64.19 + 8.59(\text{Age}) - 0.47(\text{Age})^2 + 0.03(\text{Age})^3 - 5.46(\text{Age})^4$  cm for boys and to  $65.53 + 7.79(\text{Age}) - 0.43(\text{Age})^2 + 0.04(\text{Age})^3 - 0.001(\text{Age})^4$  cm for girls, the estimated value for adult height is found to be 154.20 cm for males and 146.83 cm for females. This indicates that the girls have reached their adult height by the age of 18, while the boys still continue to grow. The present observation seems to confirm that observation among the Assamese Muslim girls of Assam, though it is not so in the case of boys (Begum and Choudhury, 1990).

### **Growth Pattern in Comparison With NCHS and ICMR Growth References**

In order to have a better understanding of the growth status of the children in this study, an attempt has been made to compare their weight and height with those given by the U.S. National Centre for Health Statistics (NCHS, 2000) and Indian Council of Medical Research (ICMR, 1972). We have restricted only to weight and height as data on other anthropometric measurements are not available in the latest NCHS growth reference.

With respect to weight, it has been observed that the mean weight of the Khasi boys is more or less to the 25th percentiles of NCHS growth reference from 3 to 6 years of age. From 6 to 8 and 13 to 16 years of age, the curve for the mean weight of Khasi boys lies between 5<sup>th</sup> and 10<sup>th</sup> percentiles, and it is closer to the 10<sup>th</sup> percentile from 8 to about 11 years of age. From 11 to 13 years, it is closer to the 5<sup>th</sup> percentile of the growth reference, and from 16 years onwards the growth curve for the Khasi boys lies below the

5<sup>th</sup> percentile. It may be mentioned that the 50<sup>th</sup> percentile of the NCHS data is generally considered as 100 per cent normal growth for children.

Like in the case of boys, the mean weight of girls falls at 25<sup>th</sup> percentile of the NCHS reference from 3 to 6 years of age, and thereafter it drops into 10<sup>th</sup> percentile up to about the age of 10. From 10 years onwards, the growth curve for the weight of Khasi girls lies more or less between 5<sup>th</sup> and 10<sup>th</sup> percentiles of the NCHS reference.

It is found that the mean weights of Khasi boys and girls are far below the 50<sup>th</sup> percentile of the NCHS growth reference especially at higher age groups. It is likely that ethnic difference in growth pattern does exist especially children in the higher age groups. In order to have a better understanding of this problem, an attempt has also been made to compare the present findings with the growth reference given by the Indian Council of Medical Research (ICMR, 1972), although it has been criticized that the ICMR growth reference does not represent all sections of the Indian population. It is also suggested that the children belonging to the high economic class of the Indian population show more or less similar pattern of growth to those in the developed countries (Gopalan, 1992). Therefore, it is recommended to use the international growth reference, i.e., the NCHS data, for assessing the growth and nutritional status of Indian children. Accordingly, it is not surprised if this is the reason that the ICMR or other authorities have not published any new data on growth of Indian children.

It is observed that the mean weight of the Khasi boys is above the 50<sup>th</sup> percentile of the ICMR reference from 3 to 18 years of age. A similar trend is observed in the case of girls (Chapter VII). The Khasi girls are more or less in the 75<sup>th</sup> percentile of the ICMR reference from 3 to 6 years of age, and thereafter they are similar to the boys in which the growth curve lies between 75<sup>th</sup> and 50<sup>th</sup> percentiles. Thus, the Khasi boys and girls are heavier than the ICMR children, but much lighter than the American children.

### **Height**

It is observed that the Khasi boys are more or less in the 5<sup>th</sup> percentile of the NCHS reference from 3 to about 6 years of age, and thereafter the growth curve of Khasi boys falls much below the 5<sup>th</sup> percentile. Similarly, the growth curve for girls is more or less in the 5<sup>th</sup> percentile from about 3 to 7 years, and thereafter it falls below the 5<sup>th</sup> percentile, except at 12 years of age, which is characterized by an adolescent growth spurt in girls.

Plotted against the ICMR percentiles, the mean height for boys is comparable to the 25<sup>th</sup> percentile from 3 to 4 years of age, and thereafter it fluctuates between 10<sup>th</sup> and 25<sup>th</sup> percentiles up to about 15 years of age. From 15 years of age, the growth curve for boys falls below the 10<sup>th</sup> percentile of the ICMR reference. Nevertheless, the present findings indicate that the Khasi boys are much shorter than the American boys, especially from the age of 7 onwards, but they are comparable to the Indian children as reported by the ICMR. In the case of girls, the growth curve is at about 50<sup>th</sup> percentile at the age of 3 years, it lies about 25<sup>th</sup> percentile of the ICMR growth reference from 4 to 10 years of age, and thereafter it fluctuates below and above the 25<sup>th</sup> percentile up to about 13 years of age. The curve tends to lie between the 10<sup>th</sup> and 25<sup>th</sup> percentiles from 13 years of age. Overall, it indicates that the girls are more comparable to the ICMR reference than the boys, although they are much shorter than the American children.

### **Comparison with Neighbouring Populations**

Very few growth studies have been carried out in Northeast India. Recently, two growth studies were published: one among the War Khasis of Meghalaya (Khongsdier, 1996a) and the other among the Assamese Muslims of Assam (Begum and Choudhury, 1999). Thus, we shall restrict our comparison with only the War Khasi and Assamese Muslims children.

### **Weight**

The Khasi boys are found to be more or less similar to the Assamese Muslim and War Khasi boys in weight from 3 to 11 years (Chapter VII). Thereafter, the Assamese Muslim boys are heavier than the Khasi boys of Shillong and War area, except at about 13 years of age when all the three groups of boys show a similar pattern of growth in weight. The War Khasi boys lie in between the Assamese and Khasi boys from 11 to 13 years, and thereafter they are more or less like the Khasi boys of the present study. As far as girls are concerned, all the three groups of girls are by and large similar in weight from 3 to 10 years of age. From 10 to 16 years of age, the Assamese Muslim girls are heavier than the Khasi and War Khasi girls, and thereafter they are surpassed by the Khasi girls of the present study. In comparison with the War Khasi girls, the Khasi girls of the present study are slightly lower in weight from 10 to 14 years of age, and thereafter they are heavier than the War Khasi girls.

### **Height**

The Khasi boys are found to be shorter than the War Khasi and Assamese Muslim boys for all age groups. Thus, it is in contrary to expectation that the Khasi boys of Shillong may be taller than their counterparts in the War Khasi area. Instead, it is also seen that the War Khasi boys are slightly taller than the Assamese Muslim boys from 3 to 5 years of age. From 5 to 7 years of age, they are more or less similar in height, and thereafter they are surpassed by the Assamese Muslim boys. Like in the case of boys, the War Khasi girls are taller than the Assamese Muslim girls from 3 to 5 years, and they are in between the Khasi and Muslim girls from 6 to 14 years; thereafter they tend to be in the same height with their coevals in Shillong.

### **Sitting Height**

It is observed that the Khasi boys are lower in sitting height than the War Khasi and Assamese Muslim boys across age groups, i.e., from 3 to 18 years of age (Chapter VII). The mean sitting height of the War Khasi boys is higher than that of the Assamese Muslim boys from the age of 3 to 6 years; they are more or less similar from 6 to 9 years of age, and thereafter, they are surpassed by Muslim boys. A similar trend is observed in the case of girls, which indicates that the Khasi girls have the lowest sitting height across age groups, except from 17 years of age when they tend to have a similar sitting height with the Assamese Muslim girls. From 3 to 6 years of age, the War Khasi girls are higher in sitting height than both the Khasi and Assamese Muslim girls, and from about 14 to 15 years of age they are shorter in sitting height than the Khasi girls.

### **Head Circumference**

Like in the case of height and sitting height, the Khasi boys have a lower head circumference than the War Khasi and Assamese Muslim boys across age groups (Chapter VII). On the other hand, the mean head circumference in the War Khasi boys is in the middle of those for the Khasi and Assamese Muslim boys from 3 to 13 years of age, and thereafter it is higher in the latter than in the former. Unlike in the case of boys, the mean head circumference in Khasi girls is higher than that for the War Khasi girls from 6 to 7 years, and it is also higher than that for the Assamese Muslim girls from 16 to 17 years of age. Nevertheless, the War Khasi girls have broader head than the Khasi girls of the present study across age groups, except from 6 to 7 years which is higher in the latter. With respect to the difference between the War Khasi and Assamese Muslim girls,

it is observed that the latter have broader head than the former from 3 to 12 years of age, and thereafter it is higher in the former.

### **Mid Upper Arm Circumference**

It can be seen that like in the case of other measurements the arm circumference is lower in the boys of the present study when compared with the War Khasi and Assamese Muslim boys (Chapter VII). This is true in all the age groups. On the other hand, the War Khasi and Assamese Muslim boys are more or less similar in mid upper arm circumference, although it is higher in Assamese Muslims from 3 to 4 years and 14 years onwards. Like in the case of boys, it is found that the mean value of mid upper arm circumference is lower in the girls of the present study when compared to the War Khasi and Assamese Muslim girls across age groups. Further, the growth curve for the mid upper arm circumference of the War Khasi girls is more or less similar to that for the Assamese Muslim girls from 10 to 12 years, and it higher in the War Khasi from 7 to 8 years. In other age groups, the mean value of mid upper arm circumference in the Assamese Muslim girls is higher than that in the War Khasi girls.

In view of the above comparison, it is obvious that the Khasi children of the present study are much shorter and lighter than the American children, but they are more or less comparable in weight and height to the Indian children as reported by the ICMR. In comparison with neighbouring populations, the children of the present study are by and large similar in weight to the War Khasi and Assamese children, especially from 3 to about 11 years of age. But they are shorter than the War Khasi and Assamese children in all age groups, and it is true in the case of sitting height as well. Similarly, the head and mid upper arm circumferences are lower in Khasi children of the present study when compared with the War Khasi and Assamese Muslim children.

### **Growth Status and Socio-economic condition**

In order to understand the effect of socio-economic condition on the growth status of Khasi children, we have made an attempt to show how the growth of children is related to religion and income of the households. It is found that religion and income of the household are very important in influencing the growth pattern of children in the present study (Chapter V). It may, however, be noted that the differences between religious groups are mainly due to the differences between the Muslim children and the Christian

and Niam Khasi children. It is found that the Muslim children are heavier and taller than the Christian and Niam Khasi children, and there is not much difference between the Christians and Niam Khasis in respect of growth pattern, except in few cases.

### **NUTRITIONAL STATUS**

Nutritional status is defined as the 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 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, skinfold thickness, weight for age, height for age, weight for height, body mass index, indices of upper arm circumference, etc., (Jelliffe, 1966; Frisancho, 1990) are used for assessing the nutritional status of children. In the present study, we have taken into consideration three anthropometric indices, i.e., weight for age, height for age and body mass index (BMI, for assessing the nutritional status of children in the present population.

#### **Weight for age**

Weight for age, expressed as percentage of individual weight to the median or 50<sup>th</sup> percentile of the international population reference (i.e., NCHS reference or standard) is generally considered as one of the indicators of underweight. It is found that the mean weight for age is higher in girls than in boys from 3 to 7 years of age, except at the age of 5 when both boys and girls show a similar mean value (Chapter VI). It is also found that the differences between boys and girls in respect of mean weight for age are not statistically significant from 8 to 14 years of age, although the girls are higher in mean value at the age of 13, that is, during the maximum growth spurt of their adolescent period. On the other hand, the mean weight for age is significantly higher in girls than in boys from 14 to 18 years, which indicates the great sex dimorphism during adolescent period.

Following the cut-off points suggested by Comez *et al.* (1956), the frequencies of mild, moderate and severe forms of underweight are 44.71%, 30.42% and 1.85% in boys and 48.32%, 22.59% and 1.32% in girls, respectively (Table 6.2). It indicates that most

of the underweight children are in the categories of mild and moderate degrees of undernutrition. Overall, it suggests that the prevalence of underweight is higher in boys (76.98%) than in girls (72.22%), and the difference is statistically significant ( $\chi^2 = 24.94$ , DF = 3, P < 0.000).

### **Height for age**

In the present study, height for age is expressed as percentage of individual weight to the median of the NCHS population reference. It is widely accepted as one of the best indicators of stunting or short stature due to inadequate nutrition or undernutrition. Like in the case of weight for age, the differences between boys and girls in height for age are not significant from 3 to 13 years of age, despite the significant difference at the age of 12 (Chapter VI). But from 14 years onwards, the mean height for age is significantly higher in girls than in boys.

Following the cut-of points proposed by Visweswara Roa *et al.*(1986), about 95% of boys and girls in the present population are stunt. Whether stunting or short stature of these children should be regarded as growth retardation, thereby indicating of high undernutrition, is a moot question of interest. It has been suggested that the use of national and international population references for assessing the nutritional status of children in terms of height for age may lead to overestimation of undernutrition in children of the short stature population like the Khasis (Khongsdier, 1996b). In the present study, an attempt has also been made to show the different levels of growth retardation as per the ICMR reference of height for age. It shows that about 84.85% of boys and 77.41% of girls have a growth retardation, although the frequency is lower than that derived from the NCHS standard. So the present findings seem to confirm those observations made among the War Khasi (Khongsdier, 1996b). The same is true in the case weight for age since weight is also correlated with height.

With regard to sex differences in nutritional status, which is to a great extent independent of standard, the prevalence of growth retardation, especially those children with moderate and severe forms of undernutrition, is significantly higher in boys than in girls ( $\chi^2 = 58.85$ , DF = 3, P < 0.000). Whether or not these findings are associated with the matrilineal system of the society is a different question because we do not have data

on child care of the society. But the results of the present study indicate that girls are better than boys in nutritional status.

### **Body mass index**

Body mass index (BMI) is generally considered as the best indicator of fatness or thinness and wasting due to chronic energy deficiency (Ferro-Luzi *et al.*, 1992). It is obtained as weight (kg) divided by height (m<sup>2</sup>) of the individual, and it is independent of age. It is found that there is not much difference between boys and girls in respect of BMI, although it is significantly higher in boys than in girls at the ages 13, 17 and 18.

As regards the nutritional status according to BMI, we have followed the cut-off point of 15.0 for the children aged 3 to 9 years (Visweswara Rao *et al.*, 1986), whereas the cut-off point of 18.5 proposed by Ferro-Luzi *et al.* (1992) has been adopted for assessing the nutritional status of children aged 10 to 18 years. It is observed that the frequencies of mild, moderate and severe forms of chronic energy deficiency in the children aged 3 to 9 years of age are respectively 12%, 6% and 8% in boys and 18%, 6% and 8% in girls. Thus, the frequency of mild chronic energy deficiency is about 6% higher in girls than in boys, although the difference between sexes is not statistically significant ( $\chi^2 = 6.44$ , DF = 3, P > 0.05). In the case of children aged 10 to 18 years, about 95 % of boys and girls are well nourished in the present population.

In view of these results, it is obvious that the children in the higher age groups are better in nutritional status than those in the lower age groups, i.e., 3 to 9 years of age. Another important point is that the nutritional status of children according to BMI is much better than that observed with respect to weight for age and height for age. This may be due to the fact that weight for age and height for age are derived as percentage of the median of the international population reference, whereas BMI is directly obtained as a proportion of weight to the square of height of an individual, thereby it is independent of the so-called standard weight or height. As observed in other populations, BMI seems to be the better indicator of nutritional status than any other indices taken for the present study.

## Nutritional Status and Socio-Economic Condition

It is generally reported that the widespread of undernutrition in developing countries is associated with poor hygienic conditions and socio-economic condition of the populations (Mitra, 1985; WHO, 1990). Therefore, assessment of the nutritional status of population has attracted the attention of not only the nutritionists and other biological scientists, but also the economists and other social scientists with a view to understanding the health and socioeconomic status of the population. In the present study, we have also been an attempt to show the prevalence of undernutrition according to religious and income groups of the population. This may be described as follows:

### Religion

With respect to religious groups, it is observed that the mean values of all these anthropometric indices are higher in the Muslim children than in the Christian and Niam Khasi children (Chapter VI). After adjusting for the effect of economic condition, the one way analysis of covariance (ANCOVA) indicates that the differences in anthropometric indices between religious groups are highly significant for both boys and girls, except the BMI in girls. According to Scheffe's multiple range test, the Muslim boys are significantly higher than the Christian boys in weight for age (Difference  $\pm$  standard error:  $5.01 \pm 0.81$ ,  $P < 0.000$ ) and height for age ( $1.70 \pm 0.39$ ,  $P < 0.000$ ). With respect to BMI, there is an absence of significant difference according to Scheffe's test, but it is significant according to Least Square Significance Difference ( $0.94 \pm 0.44$ ,  $P < 0.03$ ). The differences between the Muslim and Niam Khasi boys are also significant in respect of all indices (Weight for age:  $6.88 \pm 0.79$ ,  $P < 0.000$ ; Height for age:  $2.07 \pm 0.38$ ,  $P < 0.000$ ; BMI:  $0.96 \pm 0.43$ ,  $P < 0.03$ ). On the other hand, the differences between Christian and Niam Khasi boys are significant only in respect of weight for age ( $1.87 \pm 0.72$ ,  $P < 0.03$ ). Nevertheless, it is clear that the Muslim boys are heavier than the Christian and Niam Khasi boys in respect of all anthropometric indices, thereby suggesting that the Muslim boys are better in nutritional status.

Among girls the differences between Muslims and Christians according to Scheffe' test are significant in respect of weight for age ( $3.89 \pm 0.84$ ,  $P < 0.000$ ) and height for age ( $1.86 \pm 0.35$ ,  $P < 0.000$ ), but not in respect of BMI. But the differences between Christian and Niam Khasi girls are not significant in respect of all indices,

except in the case of weight for age ( $2.08 \pm 0.76$ ,  $P < 0.02$ ). Thus, it indicates that the Christian and Niam Khasi children are by and large similar in height for age and BMI, although the former are higher in weight for age than the latter.

In order to have a better understanding of the effect of religion on nutritional status of Khasi children, an attempt has also been made to show the percentage distribution of weight for age according to three religious groups. It is found that about 62.54%, 79.23% and 84.04% of the boys in Muslims, Christians and Niam Khasis, respectively, are underweight (Table 6.9). Among girls, these frequencies of underweight are found to be 61.98%, 75.11% and 76.74%, respectively. The Chi-square values indicate that the differences between religious groups in respect of weight for age are highly significant (Boys:  $\chi^2 = 70.82$ ,  $DF = 6$ ,  $P < 0.000$ ; Girls:  $\chi^2 = 46.87$ ,  $DF = 6$ ,  $P < 0.000$ ). Thus, the Muslim Khasi boys and girls are better in weight for age when compared to their counterparts belonging to Christianity (Boys:  $\chi^2 = 38.75$ ,  $DF = 2$ ,  $P < 0.000$ ; Girls:  $\chi^2 = 20.20$ ,  $DF = 2$ ,  $P < 0.000$ ) and Niam Khasi (Boys:  $\chi^2 = 66.58$ ,  $DF = 2$ ,  $P < 0.000$ ; Girls:  $\chi^2 = 40.94$ ,  $DF = 2$ ,  $P < 0.000$ ). On the other hand, the Christian Khasi children are heavier than the Niam Khasi children, although the differences are not statistically significant in the case of boys (Boys:  $\chi^2 = 4.04$ ,  $DF = 2$ ,  $P > 0.05$ ; Girls:  $\chi^2 = 8.56$ ,  $DF = 2$ ,  $P < 0.01$ ). Thus, the Muslim children are heavier than the Christian and Niam Khasi children, and the differences between the Christian and Niam Khasi children are significant only in the case of girls, i.e., the Christian girls are heavier than the Niam Khasi girls.

Like in the case of weight for age, the Muslim Khasi children are taller than the Christian and Niam Khasi children. It is found that the prevalence of stunting or growth retardation in boys is about 94.69%, 96.57% and 95.60% respectively in the Muslim, Christian and Niam Khasis. In the case of girls, these frequencies are 92.05%, 94.47% and 97.37%, respectively. The Chi-square values indicate that the differences in the percentage distribution of normal, mild, moderate and severe forms of nutritional status in respect of height for age are highly significant for both boys and girls (Boys:  $\chi^2 = 24.89$ ,  $DF = 6$ ,  $P < 0.001$ ; Girls:  $\chi^2 = 40.32$ ,  $DF = 6$ ,  $P < 0.000$ ).

It indicates that the children of Muslim Khasi are less retarded when compared with the Christian and Niam Khasi children, despite the fact that the prevalence of

stunting is high in all the religious groups. With respect to the difference between the Christian and Niam Khasi children, the frequency of mild and moderate forms of growth retardation is higher in the Christian boys than in the Niam Khasi boys, but the frequency of severe form is higher in the latter than in the former. However, these differences between the two religious groups are not statistically significant ( $\chi^2 = 1.54$ , DF =3,  $P > 0.05$ ). In the case of girls, the situation is reverse, which shows that the prevalence of mild and moderate forms of growth retardation is higher in the Niam Khasis than in the Christian Khasis, but the frequency of severe form of growth retardation is higher in the latter than in the former, although these differences are not statistically significant ( $\chi^2 = 6.94$ , DF =3,  $P > 0.05$ ). So the Christian and Niam Khasi children are by and large similar in the prevalence of growth retardation. The significant differences between religious groups as indicated by the overall Chi-square test are mainly due to the differences between the Khasi Muslims children and other religious groups.

On the basis of BMI, in the age group 3 to 9 years, about 19.74%, 24.88% and 31.15% of boys and 21.18%, 19.34% and 29.36% of girls in the Muslims, Christians and Niam Khasis, respectively, have suffered from chronic energy deficiency. Thus it indicates that the prevalence of chronic energy deficiency is lower among the Muslims than that among the Christians and Niam Khasis, though it is lower among the Christians in the case of girls. However, the Chi-square test indicates that the differences between religious groups are significant only in boys ( $\chi^2 = 18.76$ , DF = 6,  $P < 0.01$ ) but not in girls ( $\chi^2 = 7.81$ , DF= 6,  $P > 0.05$ ). In the age group 10-18 years, the differences between religious groups in respect of BMI are not statistically significant for both boys and girls. Thus, it indicates that religion plays little role in influencing the BMI of the children in the present study, although the influence of religion on weight for age and height for age seems to be important. It clearly shows that the Muslim children are heavier and taller than the Christian and Niam Khasi children. One possible explanation of such a trend in the Muslims may be due to intermixture, i.e., the Muslim children are by and large the product of the intermixture between the Khasi females and the Muslim males who migrated to Meghalaya from other parts of India.

### Economic Condition

With the exception of few cases, the mean values of weight for age, height for age and BMI are lower in the LIG when compared to the MIG and HIG (Chapter VI). Adjusting for religion, the ANCOVA test also indicates that the differences between income groups are significant in all anthropometric indices for both boys and girls. According to Scheffe's test, the LIG children are significantly lower than those in the MIG and HIG in respect of all the three anthropometric indices, irrespective of the difference between LIG and MIG in respect of BMI for girls ( $1.20 \pm 0.36$ ,  $P < 0.004$ ). Likewise, the differences between MIG and HIG children are highly significant for weight for age, height for age and BMI.

In order to have a better understanding of the effect of economic condition on the nutritional status of the children in the present study, we have also made an attempt to show the prevalence of undernutrition according to three income groups. With respect to weight for age, it is found that about 81.90%, 76.60% and 67.73% of the boys and 79.52%, 72.94% and 58.96% of girls are underweight in the LIG, MIG and HIG, respectively. It indicates that the proportion of underweight children decreases with the rise in income levels of the household. The Chi-square values also indicate that the differences between income groups in respect of the distribution of children according to different degrees of underweight are highly significant for both boys ( $\chi^2 = 107.09$ ,  $DF = 6$ ,  $P < 0.000$ ) and girls ( $\chi^2 = 62.08$ ,  $DF = 6$ ,  $P < 0.000$ ). Thus, it suggests that the income of household is very important in influencing the nutritional status of children according to weight for age as has been observed with regards to ANCOVA test.

With respect to height for age, the prevalence of stunting is very high in all the income groups for both boys and girls, but the percentage is higher in the lower income groups when compared with the HIG. Such a trend is also observed with respect to the prevalence of severe forms of growth retardation, which is much higher in the LIG and MIG when compared with the HIG. These differences between income groups in respect of height for age are statistically significant for both boys ( $\chi^2 = 102.50$ ,  $DF = 6$ ,  $P < 0.000$ ) and girls ( $\chi^2 = 99.15$ ,  $DF = 6$ ,  $P < 0.000$ ). This clearly indicates that income of the household plays a very important role in influencing the height for age of the children of the present study.

With respect to BMI, the differences between income groups in respect of BMI are not significant in girls for both the age groups 3-9 and 10-18 years. But in the case of boys, the income of household seems to be important and the differences between income groups are significant for both the age groups. For the age group 3-9 years, the prevalence of chronic energy deficiency in boys is about 31.11%, 22.75% and 21.09% in LIG, MIG and HIG, respectively. These frequencies are about 8.36%, 1.04% and 3.90% respectively in the age group 10-18 years. Thus, it is obvious that the prevalence of chronic energy deficiency is higher in the LIG when compared to the MIG and HIG, and the influence of the income of household is clearly significant in BMI of boys, although it is also perceptible in girls.

### CONCLUDING REMARKS

The findings of the present study were broadly presented into demographic, growth and nutritional aspects. As regards demographic aspects, it is observed that the three religious groups of the Khasi population are found to be *progressive type*, i.e., all the three religious groups are characterized by a fairly high rate of fertility. The total fertility rate in these three religious groups is more or less similar to the War Khasi, but much higher than the Kochs of Garo hills. Although it is slightly higher in the Muslims and Niam Khasis, the differences between religious groups in fertility rates are not statistically significant, indicating the insignificant effect of religion on fertility rate in the Khasi population. In other words, it is obvious that Family Planning Programme has gain little momentum in the Khasi population, irrespective of religious groups. Moreover, it is also observed that education of the mothers does not play a significant role in regulating the fertility rate among the Muslim and Christian Khasis, although it is important in the Niam Khasi women. This insignificant effect of education on fertility rate in the Muslims and Christians is in contrast to the observation in other populations (Murthi *et al.*, 1995), and it is difficult to give any clear-cut explanation. It is well known that Islam does not expressly forbid the voluntary restriction of birth, but children are regarded as the richest blessing that Allah bestows and therefore any attempt to prevent fertility is against the wishes of God (Choudhury, 1982). Of course, it generally reported that Muslims have higher fertility rate followed by the Hindus and Christians (Irudaya Rajan and Rao,

1991). Likewise, the Bible does not specifically prohibit birth control, but certain Christian denominations like the Catholic Church are against the use of artificial means of birth control (Irudaya Rajan and Rao, 1991). Thus, it is likely that even education of the mothers may not become so important in such a situation.

In the present study, the term Christians” refers to all Christian denominations including the Roman Catholics. Unfortunately, we have not collected data on specific Christian denomination and, therefore, we are not in position either to refute or support the contention that fertility rate is higher in the Catholics than in any other Christian denominations. We hope that further studies will throw much more light in this regard. The effect of other factors like age at marriage and income of the household on fertility rate seems to be very important in the Khasi population, irrespective of religious groups. The effect of age at marriage on fertility is by and large universal since the reproductive period is shorter in the case of those mothers with higher age at marriage. On the other hand, the significant effect of the income of household on fertility rate in this population is likely to be related to the fact that people belonging to the higher economic groups are more conscious of the socio-economic welfare of their children. It is likely that they have higher aspiration for better education and higher economic status, thereby reducing the birth rate with a view to providing their children with such facilities.

With regard to infant mortality, it is observed that the rate increases with the increasing age of the mothers. This may be due to the fact that mothers of higher age groups have higher fertility rate, which is theoretically correlated with higher infant mortality rate. The inverse relationship between infant mortality and educational as well as income level is according to the general observation in other populations, which indicate that mothers belonging to the higher educational and income levels are more conscious of the health of their children, and they have more access to modern medical amenities, etc. On the other hand, religion does not seem to play very important role in influencing infant mortality rate.

According to the present findings the girls have reached their adult height by the age of 18, while the boys still continue to grow. In comparison with international and national growth references, the Khasi children of the present study are much shorter and lighter than the U.S. NCHS children, but they are more or less comparable in weight and

height to the ICMR children. In comparison with neighbouring populations, the children of the present study are by and large similar in weight to the War Khasi and Assamese children, especially from 3 to about 11 years of age. But they are shorter than the War Khasi and Assamese children in all age groups, and it is true in the case of sitting height as well. Similarly, the head and mid upper arm circumferences are lower in Khasi children of the present study when compared with the War Khasi and Assamese Muslim children.

These findings may have certain implications for ethnic or genetic variation in growth and nutritional status of population. It is obvious that ~~the~~ anthropometric indices like height for age and even weight for age in relation to the so-called international standards (references) cannot be used as indicators of the nutritional status in a short stature population like the Khasis, especially in children of higher age groups (Khongsdier, 1996b). Thus, BMI may be considered a better indicator of the nutritional status of children in the present study. It is likely that differences in stature between populations may be related not only to nutrition, but also to physical environment and genetic factors (Payne, 1992). However, this does not mean to reject the international references completely; their use is very important for comparative studies.

The differences between income groups seem to confirm the earlier observations that children belonging to the higher economic groups are better in growth and nutritional status than their counterparts in the lower economic strata (Gopalan, 1992). The simple reason is that children in the higher economic strata have better nutrition and health facilities. But the most significance of the present findings is the differences between religious groups in respect of growth and nutritional status. It is found that the Muslim children are heavier and taller than the Christian and Niam Khasi children, and there is not much difference between the Christians and Niam Khasis in respect of growth pattern, except in few cases. One possible explanation of such a trend in the Muslims may be due to intermixture, i.e., the Muslim children in the present study are by and large the product of the intermixture between the Khasi females and the Muslim males who migrated to Meghalaya from different areas.

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