In this chapter, we shall discuss the findings of the present study by taking into consideration the other findings in other populations especially in Northeast India. We shall also make a comparison with the CDC growth references in order to derive our discussion and conclusions.

GROWTH PATTERN

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, for many of these also arises through differential rates of growth of particular parts of the body relative to others.” Therefore, growth is a variable indicator, which can be used to identify either one or both genetic and environmental conditions in a population.

In the present study, the findings on the growth pattern of children are presented in Chapter III. The main purpose of the Chapter is to understand the sex differences in growth of Khasi children from 3 to 18 years. In doing so, comparative tables and figures of data on both boys and girls are presented throughout the Chapter. In discussing the growth pattern, or growth characteristics of children relative to age and sex, we shall restrict to linear measurements particularly to lower and upper extremities as has been generally done in other populations for comparative purposes (Tanner, 1978; Dasgupta et al., 1997; Begum and Choudhury, 1999, Khongsdier and Mukherjee, 2003).

Weight and height

The sex differences in weight are significant only in the younger and older age group, i.e., aged < 7 years and 12 years and above. Girls are significantly heavier than boys at 3 and 4 years of age, and boys are heavier than girls from 5 to 6 years of age. On the other hand, boys
are significantly heavier than girls after 12 years of age. Using the fourth degree polynomial model, the smooth curve confirms that both boys and girls are by and large similar in weight from 7 to 12 years of age. Thereafter, boys are taller than girls at all ages. The estimated age at peak velocity is 12.8 years for girls and 13.7 years for boys.

With respect to height, we have followed the Preece-Baines model 1 (PB1) of curve smoothing. The results indicated that the curve is by and large similar in both boys and girls up to about 12 years of age, and thereafter it is greater in boys. The estimated values for adult height are 157.5 cm for males and 152.0 cm for females. This indicates that both boys and girls have reached their adult height by the age of 18, although the girls may continue to grow. The present observation seems to confirm the earlier observation among the urban Khasis (Khongsdier and Mukherjee, 2003) and that observed among the girls of Assamese Muslims in Assam (Begum and Choudhury, 1999). The differences between the sexes in respect of the biological parameters are statistically significant as expected. The estimated age at maximum increment, presumably considered as age at peak height velocity, was 11.1 years for girls and 12.2 years for boys with the approximate height of 131.7 cm and 137.4 cm, respectively. Thus, it indicates that the adolescent growth spurt in height occurs about 1 year earlier in girls as compared to boys. Therefore, these findings on weight and height are by and large in confirmation with the general observation that much of the sex differences are a consequence of the variation in growth rates during the adolescent period (Tanner, 1978; Bogin, 1999). In other words, the sex differences in growth pattern are significant only during and after adolescent period.

**Sitting height**

Like in the case of height, the fitted curves, according to PB1 model, indicated that both boys and girls were similar in sitting height from 3 to about 12 years of age. Both boys and girls have reached their adult sitting height by the age of 18, and the adult sitting height in boys (81.78cm) are significantly higher than in girls (78.56 cm). It is found that boys have reached their adult sitting height at about 18 years of age. Like in the case of height, the estimated age at peak velocity is higher in boys (12.5 years) than in girls (11.2 years). Thus, the present analysis indicates that the adolescent growth spurt occurs earlier in girls than in boys, and the higher sitting height in boys at 18 years of age is largely due to their higher growth rate from 13 to 16 years of age. It is reported that among the Assamese Muslim children, the peak velocity was
about 13.9 years for boys and 11.6 years for girls (Begum and Choudhury, 1999), whereas among the Khasi girls it is reported to be 13.01 years (Mukherjee, 2002). Thus, it indicates that the peak velocity for both boys and girls of the present study is comparable to that reported for the Assamese Muslim boys and girls.

**Subischial height**

Like in the case of trunk height or sitting height, the lower extremity or subischial length (stature minus sitting height) is significantly higher in boys except during the adolescent period. The higher subischial length in girls from 10 to 12 years of age may be attributed to adolescent growth spurt as in the case of sitting height. According to PBI model, both boys and girls have by and large reached their adult subischial length by the age of 18, although girls may still continue to grow. Thus, we are not in position to conclude that the lower extremity reached its adult size earlier than the upper extremity as commonly observed in other populations (Tanner, 1978; Dasgupta and Das, 1997; Begum and Choudhury, 1999). However, our findings suggest that adolescent growth spurt in subischial length occurs earlier than that of sitting height. It is found that the estimated age at peak velocity in subischial length was 11.5 years for girls and 12.0 years for boys with the approximate height of 66.5cm and 65.8 cm, respectively.

**GROWTH STATUS**

In the present study, by “growth status” we mean the growth pattern of children in relation to their coevals at a given age in other populations, or in relation to the recommended growth references and/or standards. In Chapter I, we have pointed out that growth is a good indicator of nutritional status, which is greatly influenced by socioeconomic factors of a population, although it is also influenced by genetic factors. In other words, growth of children can also be regarded as a good indicator of socioeconomic status of a given population since socioeconomic factors play a very important role in regulating human nutrition, which is very important for normal growth and development (WHO Working group, 1986).

In order to have a better understanding of the growth status of children in the present study, an attempt has been made to compare our findings with the CDC and ICMR growth references. We shall restrict only to weight and height as data on other anthropometric measurements are not available in the CDC growth references (NCHS, 2000).

It may be noted here that in India we do not have the recommended growth references and/or standards. Although the data collected by the Indian Council of Medical Research
(ICMR, 1972) are old and lack representation of all sections of the Indian population, its use in the present study is but to understand the growth status of the Khasi children, but not as a target or standard of growth that one should assess the children’s growth in the present study. As a matter of fact, we have used the CDC growth references (Kuczmarski et al., 2000) for the assessment of the nutritional status of the children in the present study as generally recommended.

**Weight**

**Figure 5.1** shows the mean weight of boys in comparison with the CDC and ICMR growth references. It can be observed from the Figure that the mean weight of the Khasi boys is above the 50\(^{\text{th}}\) percentile of ICMR growth references across ages. It is also well above the 5\(^{\text{th}}\) percentile but below the 50\(^{\text{th}}\) percentile of CDC growth references from 3 to 8 years of age. The curve for Khasi boys is more or less according to the 5\(^{\text{th}}\) percentile of the CDC growth references from 8 to 12 years of age, and it is again above the 5\(^{\text{th}}\) percentile up to about 16 years of age.

Like in the case of boys, the mean weight of girls is above the 50\(^{\text{th}}\) percentile of ICMR growth references across ages (**Figure 5.2**). Similarly, the curve for girls lies above the 5\(^{\text{th}}\) percentile but below the 50\(^{\text{th}}\) percentile of CDC growth references from 3 to 8 years of age. From 8 to 12 years, the growth curve is more or less between to the 5\(^{\text{th}}\) percentile of the CDC references, and thereafter it lies between the 5\(^{\text{th}}\) and 50\(^{\text{th}}\) percentiles.
Figure 5.1. Weight of boys in comparison with CDC and ICMR growth references.

Figure 5.2. Weight of Khasi girls in comparison with growth references.
Figure 5.3. Height of Khasi boys in comparison with growth references

Figure 5.4. Height of Khasi girls in comparison with growth references
Height

With respect to height, **Figure 5.3** shows the mean height of Khasi boys plotted against CDC and ICMR growth references. It can be observed that the Khasi boys are above the 5th percentile of the CDC growth references but below the 50th percentile of the ICMR growth references from 3 to about 8 years of age. Thereafter, the curve is more or less in the 5th percentile of the CDC growth references up to about 12 years of age. The curve moves towards the 50th percentile of the ICMR growth reference during the adolescent period, i.e., between 12 and 14 years of age. However, it moves markedly below the 5th percentile of the CDC growth references after 14 years of age.

As for girls, **Figure 5.4** shows that the curve is well above the 5th percentile of the CDC growth references from 3 to 7 years of age, and it is more or less according to the 50th percentile of the ICMR growth references from 3 to 4 years of age. However, like in the case of boys, the curve is more or less in the 5th percentile of the CDC growth references up to about 11 years of age. Except during the adolescent spurt, the curve is much below the 5th percentile of the CDC growth references especially after 12 years of age.

Overall, it indicates that both boys and girls are above the 5th percentile of the CDC growth references from 3 to about 7 or 8 years of age. Thereafter, the curves for both boys and girls followed the 5th percentile growth trajectory of CDC growth references up to adolescent period, and thereafter the curves were below the 5th percentile of the CDC growth references.

These present findings may have certain implications for the role of biological and environmental factors including socioeconomic factors. Several authors have argued that the growth pattern of children in developing countries deviate significantly from the international growth references after 5 years of age. For example, Cameron (1992) has shown that the rural South African children followed near the 50th percentile at 5 years of age, but thereafter growth rate was slower than the reference rate, and it was near the 3rd percentile by the onset of adolescence. Similar findings can be observed in the growth studies in Northeast India (Begum and Choudhury, 1999; Khongsdier and Mukherjee, 2003). The present findings, especially on boys, also confirm that the growth curve is well above the 5th percentile but below the 50th percentile of CDC growth references from 3 to 8 years of age, and thereafter it is similar to the 5th percentile.
Comparison with Neighbouring Populations
As already mentioned in Chapter II, very few growth studies have been carried out in Northeast India, especially from 3 to 18 years of age. Recently, two growth studies were carried out: one among the urban Khasi of Meghalaya (Mukherjee, 2002) and the other among the Assamese Muslims of Assam (Begum and Choudhury, 1999). Thus, we shall restrict our comparison with only the urban Khasi and Assamese Muslims children.

Weight
It can be observed from Figure 5.5 that the Khasi boys of the present study are more or less similar to the Assamese Muslim and urban Khasi boys from 3 to 11 years, and thereafter they are heavier than the Assamese Muslim and urban Khasi boys. Like in the case of boys, Figure 5.6 shows that the Khasi girls of the present study are more or less similar to the Assamese Muslim and urban Khasi girls from 3 to 12 years, and thereafter the Assamese Muslim girls surpassed them up to about 14 years of age. After 14 years of age, the Assamese Muslim and urban Khasi girls are heavier than the Khasi girls of the present study.

Thus, it is evident from Figures 5.5 and 5.6 that both boys and girls of the present study are by and large similar to their Assamese Muslim and urban Khasi counterparts up to about 12 years of age. Thereafter, the boys are heavier than the Assamese Muslim and urban Khasi boys, whereas girls are lighter than the Assamese Muslim and urban Khasi girls after 14 years of age.
Figure 5.5. Weight of boys in comparison with other populations

Figure 5.6. Weight of girls in comparison with other populations
Figure 5.7. Height of boys in comparison with other populations

Figure 5.8. Height of girls in comparison with other populations
Height

Figure 5.7 shows that the Khasi boys of the present study are taller than the urban Khasi but shorter than the Assamese Muslim boys across age groups. Thus, it is contrary to expectation that the urban Khasi boys are taller than their counterparts in the rural area. Instead, it is also seen that the Khasi boys of the present study are by and large similar to the Assamese Muslim boys from 3 to 6 years of age, and thereafter the latter surpassed the former across ages. Like in the case of boys, the Khasi girls of the present study are similar to the Assamese Muslim girls from 3 to 5 years, and thereafter they are surpassed by the Assamese Muslim girls across ages, although they are taller than the urban Khasi girls (Figure 5.8).

Sitting height

As for sitting height, the Khasi boys of the present study are slightly greater than their urban counterparts from 3 to about 9 years of age (Figure 5.9). However, they are above the urban Khasi boys but much below the Assamese Muslim boys after 9 years of age. The situation is somewhat different in the case of girls. Figure 5.10 shows that the Khasi girls of the present study are by and large similar to their Urban Khasi counterparts across ages, but they are shorter in sitting height than the Assamese Muslim girls.

Chest circumference

Figure 5.11 shows the mean chest circumference of boys in comparison with the Assamese Muslim and urban Khasi boys. It is seen that the Khasi boys of the present study are similar to the Assamese Muslim boys, but they are lower than the urban Khasi boys up to about 12 years of age. During the adolescent period, they are similar to their urban counterparts. However, they are lower than the Assamese Muslim and urban Khasi boys after 16 years of age. As for girls, Figure 5.12 shows that they are in between the Assamese Muslim and urban Khasi girls from 3 to 6 years of age, and thereafter they are similar to the urban Khasi girls across ages.
Figure 5.9. Sitting height of boys in comparison with other populations

Figure 5.10. Sitting height of girls in comparison with other populations
Figure 5.11. Chest circumference of boys in comparison with other populations

Figure 5.12. Chest circumference of girls in comparison with other populations
Figure 5.13. Mid upper arm circumference of boys in comparison with other populations.

Figure 5.14. Mid upper arm circumference of girls in comparison with other populations.
Upper arm circumference

Figure 5.13 shows the mid upper arm circumference of boys in comparison with the Assamese Muslim and urban Khasi boys. The figure shows that the boys of the present study have a broader mid upper arm circumference than both the Assamese Muslim and urban Khasi boys across ages. They are however similar to the Assamese Muslim boys from 3 to 5 years of age. Like in the case of boys, Figure 5.14 shows that the mid upper arm circumference for the girls of the present study is greater than that for the Assamese Muslim and urban Khasi boys across ages.

On the basis of the above comparison, we may conclude that the Khasi children of the present study are by and large similar in body weight to their Assamese Muslim and urban Khasi counterparts up to about 12 years of age. Thereafter, the boys are heavier than the Assamese Muslim and urban Khasi boys, whereas girls are lighter than the Assamese Muslim and urban Khasi girls after 14 years of age. As for stature, they are taller than their urban counterparts across ages. They are similar to the Assamese Muslim children from 3 to about 6 years of age, and thereafter they are surpassed by the Assamese Muslim children. On average, they are however similar to their urban counterparts in respect of sitting height and chest circumference, irrespective of certain exceptions. It is also observed that the Khasi children of the present study have a have a broader mid upper arm circumference than both the Assamese Muslim and urban Khasi boys across ages.

NUTRITIONAL STATUS

In the previous Chapter, we have presented our findings on the nutritional status of the children. We have taken three important anthropometric indices, namely, weight-for-age, height-for-age and BMI-for-age, as generally recommended (WHO, 1983; WHO Working Group, 1986). As mentioned, weight-for-age is considered as a measure of underweight, whereas height-for-age is taken as an indicator of growth retardation or stunting in relation to the CDC growth references. On the other hand, BMI-for-age is considered as a good indicator of fatness, or thinness and/or wasting due to chronic energy deficiency (CED). We have presented our findings on the nutritional status in Chapter IV. It may be briefly summarized as follows:
(i) The overall prevalence of underweight for all sexes and ages was found to be 40.11%. It was slightly higher in boys (41.21%) than in girls (39.14%) despite the absence of statistical difference between the sexes. In addition, the differences between the younger age group (3-9 years) and older age group (10-18 years) are not statistically significant, although it was slightly higher in the older age group (Table 4.2).

(ii) The overall prevalence of stunting for all sexes and ages was 52.28%. It was higher in girls (53.68%) than in boys (50.71%), although it was not statistically significant (Table. The prevalence of stunting in the higher age group was significantly higher than that in the lower age group. It holds true for both boys and girls. However, the prevalence of stunting in the younger age group 3-9 years was also slightly higher in boys (38.94%) than in girls (37.33%). The situation is reverse in the older age group 10-18 years, which indicated the higher prevalence of stunting in girls.

(iii) The overall prevalence of wasting for all sexes and ages was 10.46%. The prevalence of wasting was by and large similar in both boys (10.30%) and girls (10.59%), and there were no significant differences between age groups. However, the prevalence of overweight seemed to be higher in the lower age group, which is likely to be an emerging problem in the next decade or so. It is also clearly evident that the nutritional status as indicated by BMI-for-age is much better than that indicated by weight-for-age and height-for-age.

Overall, it is found that about 40.11%, 52.28% and 10.46% of the children in the present study were underweight, stunted and wasted, respectively. Following the classificatory criteria proposed by Gorstein et al., (1994), we may conclude that the present population is characterized by a very high prevalence of underweight and stunting with a high prevalence of wasting. It is higher than that reported for the Hmar children of Manipur (Khongsdier and Varte, 2005) and Lotha children of Nagaland (Tsopoe, 2003). However, it is lower than that reported for the urban Khasi children, but by and large similar to those reported by the NFHS-3 (IIPS and Macro International, 2009). The difference between the rural and urban Khasi data may be because of two main reasons: It has been observed that the children of the present study are taller than the urban Khasi. Secondly, it may also because of the differences in the use of growth references.

In general, the present study has revealed the absence of statistical differences between the sexes in all the three forms of undernutrition. This observation is consistent with the earlier
studies that gender differences in nutritional status are not the main problem among populations in Northeast India, especially among the tribal populations (Khongsdier et al., 2005). In Southeast Asia, many scholars have often reported that child mortality is higher in females than in males due to anti-female discriminations in access to nutrition, education and health care (Das Gupta, 1987; Muhuri and Preston, 1991; Arnold et al., 1998). In this part of the globe, sons are preferred over daughters due to different economic, social and cultural factors (Mayer, 1999; Arnold et al., 2002; Mishra et al., 2004), which are operating differently in different population groups or culture areas. For example, it was suggested that excess female child mortality was lower in South than in North India due to variation in kinship systems and female autonomy, i.e., the “capacity to manipulate one’s personal environment” (Dyson and Moore, 1983). Females in South India enjoy more autonomy relative to males than do females in the North, and the magnitude of anti-female discrimination among children in access to food distribution and medical care is less in the South. On the basis of the first and second Indian National Family Health Surveys data, Mishra et al. (2004) also found that boys were more likely than girls to be fully immunized in North than in South India. On the contrary, girls aged below 3 years were more likely than boys to be underweight and stunted in the South than in the North. In addition, it has been suggested that economic and political factors, including political will, are more important than kinship structures in patterning gender differences between North and South India (Rahman and Rao, 2004).

Considering the findings of the present study, one may argue that the absence of sex differences in nutritional status among the Khasi children of the present study may be related to the practice of matrilineal system of society. It may, however, be noted that little is known about anti-male bias in the Khasi society (Gurdon, 1981; Pakyntein, 1999), which can be considered as comparable to anti-female bias as in other parts of South Asia including India (Jejeebhoy and Sathar, 2001; Fikree and Pasha, 2004). Further, recent studies have revealed the absence of gender differences even among patrilineal societies in Northeast India. Instead, there is an evidence of the higher prevalence of undernutrition in boys than in girls (Khongsdier et al., 2005). This may have certain implications if we take into consideration the higher prevalence of underweight in boys than in girls of the present study, despite the absence of statistical differences. It is generally believed that underweight is more related to environmental condition like inadequate nutrition and infection. Therefore, the higher prevalence of underweight in boys
may be related to the sex differences in responses to environmental factors. It has been suggested that girls are better "buffered" than boys against environmental factors like inadequate dietary intakes (Stinson, 1985; Bogin, 1999). This phenomenon has also been observed among the Lotha children of Nagaland (Tsopoe, 2003) and the Hmar children of Manipur (Khongsdier et al., 2005). Little is known about this problem in other Indian populations, thereby warranting more studies. Nevertheless, it is obvious that anti-female bias in India varies from one population to another or from one culture area to another, which might not be detected statistically at the national level (Marcoux, 2002). It is, therefore, crucial to understand the role of cultural diversity in patterning health and nutritional disparity in India. It is obvious, in this context, that there is a need for a holistic, community-based approach to understanding the health and nutritional inequalities in India.

As for the question of higher prevalence of stunting in girls, it is difficult to give a proper explanation as it is also related to past history of growth status, in addition to genetic factors. It may be mentioned that the higher prevalence of stunting in girls was also observed among the Lotha children of Nagaland (Tsopoe, 2003). As hinted above, it is unlikely that the phenomenon is due to patrilineal or matrilineal system of the society. Instead, it may be related to the relevance of international growth references to populations in Northeast India. It is evident that the prevalence of stunting in the higher age group was much higher than that in the lower age group for both boys and girls, and the differences between the two major age groups are highly statistically significant in both boys. We shall discuss briefly the relevance of the international growth references in the following section.

Relevance of International growth references
In Chapter I, we have mentioned that there are considerable differences between and within populations in the rate of physical growth and attainment of body size at any given age (Eveleth and Tanner, 1990). Such differences are often attributed to both genetic and environmental factors. However, growth retardation especially in developing countries is mainly due to environmental factors, including inadequate nutrition, infections and poor socio-economic conditions. Empirical evidence shows that under-five children belonging to the higher socio-
economic strata in developing countries have shown similar growth patterns to their coevals in developed or high-income countries (Habitch et al., 1974). Accordingly, growth retardation is generally considered an indicator of poor nutritional status, or failure in the expression of the "genetic potential" for growth (Gopalan, 1992). Accordingly, the growth curves of well-nourished children in high-income countries are widely used to assess or monitor the growth and nutritional status of children all over the world. It is argued that since children in high-income countries are unhindered by nutritional deprivation, thereby enjoying the maximal growth permitted by their genetic potential, they constitute a reference group against which to assess the nutritional status of all other groups of children. For this purpose, international standards, or growth references, such as the CDC growth references are widely used for assessing the nutritional status of children all over the world. The children who are below −2 SD or −2 Z score of these standards/references are classified as undernourished relative to their sex and age groups.

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

On the basis of his observation on the populations of India and Nepal, Seckler (1982) suggested that the children treated as mild and moderate undernourished, according to height for age with reference to international standards, should be regarded as "small but healthy." According to Seckler (1982), "about 90% of all the malnutrition found in these countries are those people with low height-for-age but with proper weight- for- height ratio. Now, if one thinks of malnutrition in the conventional imaginary of thin, wasted bodies, rather than in terms merely of short people, the incidence of malnutrition must be considerably reduced. Of course, since short people with proper weight to height ratio will also be light people, their consumption requirements will also be less than conventionally estimated" (Author's italics). This may have certain implication if we also take into consideration our present findings. It is found that the
overall prevalence of wasting for both boys and girls was only 10.46% as compared to the prevalent rates of underweight and stunting, which are 40.11% and 52.28% as measured by weight-for-age and height-for-age, respectively. These results in the Khasi children of the present study clearly indicate that the prevalence of under-nutrition according to weight-for-height is not as high as that indicated by weight-for-age and height-for-age.

Seckler was of the opinion that there were no functional impairments in the range of mild to moderate malnutrition as defined by growth standards, "because this range represents an adaptive response of body size to adverse conditions in order to avoid these impairments" (Author's italics). Accordingly, he suggested that appropriate reference standard for the assessment of undernutrition should be lower than the recommended reference value predicted under the concept of genetic potential for growth. Payne (1992), though in a different way, also supported that the scientific concept of nutrition should be concerned not with the failure of meeting some normative targets, but with the failure of maintaining the functional capabilities relative to nutritional intake. On the contrary, most of the individuals below the standards as proposed under the concept of genetic potential for growth do not show such functional impairment. Payne (1992) criticized the genetic potential theory for supporting the armpit of obesity and associated risks of NCDs.

The "small but health" hypothesis has been severely criticized by many scholars (Gopalan, 1992; Bogin, 1999), but its significance lies with the concept of small body size. It may be noted that Tanner (1978) warned against assuming that being small is necessarily bad. "Though rate of growth remains one of the most useful of all indices of public health and economic well-being in developing and heterogeneously developed countries, it must not be thought that bigger, or faster, is necessarily better" (Tanner, 1978). The advantage of small body size is that it enables a person to survive and sustain his level of activity in a given habitat of nutritional constraint, because a smaller body requires less energy. However, if the level of productivity in such small people is low, it proves to be disadvantageous (Ulijaszek, 1995, Strickland and Tuffrey, 1997).

In the present study, we are not dealing with the physical activity of the children, and thereby we are not in a position to either refute or support the above contention. However, it is clear that the applicability of the international growth references tends to be more irrelevant during and after adolescent period. It has been observed that both boys and girls are above the
5th percentile of the CDC growth references from 3 to about 7 or 8 years of age. Thereafter, the curves for both boys and girls followed the 5th percentile growth trajectory of CDC growth references up to adolescent period, and thereafter the curves were below the 5th percentile of the CDC growth references. This can also be observed with respect to the prevalence of stunting which is significantly related to age. We hope that future studies will shed much more light on this problem.

Socio-economic Condition and Under-nutrition

Under-nutrition affects all sexes and ages. What makes the situation more serious is that children under 5 years of age are the most vulnerable victims. Under-nutrition predisposes an individual to infection and vice versa. It is one of the major risk factors for infections and diseases (WHO, 2000a). About 50% of the total annual deaths in children under 5 years of age are associated with under-nutrition in developing countries (Rice et al., 2000; WHO, 2000b). Under-nutrition is attributable not only to poor access to food but also to other poor environmental conditions, such as poor housing and hygienic conditions, unsafe drinking water, heavy workloads, lack of preventive and control measures of locally endemic diseases and infections (Khongsdier, 2002). These poor environmental conditions are the common characteristics of population groups belonging to the lower socio-economic strata of the society, especially in developing countries (de Onis et al., 2000). In other words, the major cause of under-nutrition is poverty compounded by other poor environmental conditions that predispose an individual to morbidity and mortality. There is considerable evidence that children in the lower socio-economic groups especially in developing countries are often the victims of malnutrition and its associated morbidity and mortality (WHO, 2000a). In the present study, we have also observed that the prevalence of underweight and stunting is significantly higher in children with low economic condition. The important implication of the present study is that nutritional status is an indicator of not only the health inequality but also the social inequality in the Khasi society and perhaps in many populations in developing countries.

CONCLUDING REMARKS

As normally expected, the present study has revealed that there are significant differences between boys and girls in respect of growth patterns, especially during the adolescent period because of the inter- and intra-individual variation in timing of growth spurt. According to PB1 model, both boys and girls are similar in height up to about 12 years of age, and thereafter it is
greater in boys. The estimated values for adult height are 157.5 cm for males and 152.0 cm for females. This indicates that both boys and girls have reached their adult height by the age of 18, although the girls may continue to grow. The present observation seems to confirm the earlier observation among the urban Khasis (Khongsdier and Mukherjee, 2003) and that observed among the Assamese Muslims girls (Begum and Choudhury, 1999). However, it is likely that the girls of the present study may still continue to grow more in terms of lower extremity or leg length. Thus, we are not in position to conclude that the lower extremity reached its adult size earlier than the upper extremity as commonly observed in other populations (Tanner, 1978; Dasgupta and Das, 1997; Begum and Choudhury, 1999). However, our findings suggest that adolescent growth spurt in subischial length occurs earlier than that of sitting height.

The present study has also indicated that both boys and girls are above the 5th percentile of the CDC growth references from 3 to about 7 or 8 years of age. Thereafter, the curves for both boys and girls followed the 5th percentile growth trajectory of CDC growth references up to adolescent period, and thereafter the curves were below the 5th percentile of the CDC growth references. These present findings may have certain implications for the role of biological and environmental factors including socioeconomic factors. Several authors have argued that the growth pattern of children in developing countries deviate significantly from the international growth references after 5 years of age. For example, Cameron (1992) has shown that the rural South African children followed near the 50th percentile at 5 years of age, but thereafter growth rate was slower than the reference rate, and it was near the 3rd percentile by the onset of adolescence. Similar findings can be observed in the growth studies in Northeast India (Begum and Choudhury, 1999; Khongsdier and Mukherjee, 2003). The present findings, especially on boys, also confirm that the growth curve is well above the 5th percentile but below the 50th percentile of CDC growth references from 3 to 8 years of age, and thereafter it is similar to the 5th percentile.

As for nutritional status, the present study has revealed the absence of statistical differences between the sexes in all the three forms of undernutrition. This observation is consistent with the earlier studies that gender differences in nutritional status are the main problem in population in Northeast India, especially among the tribal populations (Khongsdier and Varte, 2005). However, despite the absence of statistical differences, the prevalence of underweight was higher in boys than in girls, whereas the prevalence of stunting was higher in
girls than in boys. It is generally believed that underweight is more related to environmental condition like inadequate nutrition and infection. Therefore, the higher prevalence of underweight in boys may have certain implications for the sex differences in responses to environmental factors. It has been suggested that girls are better "buffered" than boys against environmental factors like inadequate dietary intakes (Stinson, 1985; Bogin, 1999). This phenomenon has also been observed among the Lotha children of Nagaland (Tsopoe, 2003) and the Hmar children of Manipur (Khongsdier and Varte, 2005). Little is known about this problem in other Indian populations, thereby warranting more studies.

As for the question of higher prevalence of stunting in girls, it is difficult to give a proper explanation as it is also related to past history of growth status, in addition to genetic factors. It may be mentioned that the higher prevalence of stunting in girls was also observed among the Lotha children of Nagaland (Tsopoe, 2003). Thus, it is unlikely that the phenomenon is due to patrilineal or matrilineal system of the society. Instead, it may be related to the relevance of international growth references to populations in Northeast India. It is evident that the prevalence of stunting in the higher age group was much higher than that in the lower age group for both boys and girls, and the differences between the two major age groups are highly statistically significant in both boys. Therefore, it is likely that the applicability of the international growth references tends to be more irrelevant during and after adolescent period. This can also be observed with respect to the prevalence of stunting which is significantly related to age. We hope that future studies will shed much more light on this problem.

The present study has revealed that the prevalence of undernutrition, especially underweight, is significantly associated with household income and parental education. Therefore, the present study confirms the earlier observation that socioeconomic factors like income and parental education play a very important role in regulating the nutritional status of children (Eveleth and Tanner, 1990; Bogin, 1999).

Last but not least, the present study has also certain policy implications. Overall, it is evident that there is a high prevalence of undernutrition among the Khasi children, which is also consistent with the recent report by the NFHS-3 (IIPS and Macro International, 2009). Therefore, nutrition policies like the nutrition supplementary programme should be intensified in the state. Growth retardation is not only because of poor socioeconomic condition, but it has a vicious circle. It may affect the socioeconomic condition of an individual, or a population as
well, because of the poor earning capacity due to poor health status. It may be suggested that efforts to improve agricultural activity or food availability, dietary quality, hygiene, supply of safe-drinking water, and prevention and treatment of infectious diseases are likely to improve the health and nutritional status of the Khasi population over time.