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

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, technological development has aided human being to reduce the intensity of natural selection, i.e., by manipulating fertility rates and controlling mortality rates. 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.”

Demographic variables are very important to understand the genetic structure of a given population, and thereby the evolutionary processes of human populations. It is theoretically believed that natural selection, one of the major evolutionary forces, is operating in human population through differential fertility and mortality (Crow, 1958; Johnston, 1973). Also, other demographic variables like population size, mating patterns admixture rate, migration, etc., are very helpful in understanding the biological characteristics of human populations (Basu, 1969; Khongsdier, 2005c). In the meantime,
demographic variables are largely influenced by various socio-economic 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 important for the physical anthropologists to undertake studies on the effect of socio-economic factors on demographic traits, particularly on fertility and mortality.

**Fertility**

In the present study, we have observed that the Hmar population is highly progressive, thereby indicating a high fertility rate. It is found that the mean age at marriage among the Hmar women (20.78 years) is higher than those reported for many populations of Assam (Sengupta and Gogoi, 1995; Gogoi, 2002). Also, the mean number of live births to married women of all ages is higher than those reported for different sub-groups of the Kochs in Garo hills (Kotal, 2002) and Pnars (3.35) of Jatinga (Khongsdier et al., 2001). It is, however, lower than those reported for the Mukhloms (5.20) of Arunachal Pradesh (Sarkar, 2002), Khasis (5.18) of Shillong (Mukherjee, 2002) and War Khasis (Khongsdier, 2005). It is observed that the total fertility rate in the Hmars is much higher than that reported for the state of Mizoram (2.30) by the National Family Survey (IIPS, 2000) and the Kochs of Garo hills (Kotal, 2002). The age specific fertility rate reached its peak point in the age group 25-29 years, and the total fertility rates are more or less similar to those reported for the different religious groups of the Khasis of Shillong (Mukherjee, 2002). In comparison with the recent findings on some populations in Northeast India, the fertility rate among the Hmars of the present study seems to be fairly high.

It is observed that the fertility rate in the Hmar population is negatively associated with the maternal age, age at marriage and household income. The effect of age at marriage on fertility is by and large universal since the reproductive period is shorter in the case of those women with higher age at marriage (as briefly reviewed in Chapter I). On the other hand, the significant effect of household income on fertility rate in this population seems 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 such people have higher aspiration for better education and higher economic status,
thereby reducing the birth rate in order to provide their children with the best facilities (Mukherjee, 2002).

What is interesting in the present study is that the effect of maternal education is not clearly perceptible after adjusting for maternal age and household income. This insignificant effect of education on fertility rate in the Hmars of the present study is inconsistent with the general observation in other populations (Caldwell et al., 1999), and it is difficult to give any clear-cut explanation. It is, however, clear that maternal education is not the only factor that can regulate fertility rates in the Hmar population. For example, it is possible that most educated mothers are in the lower age groups, whereas illiterate mothers or mothers without educational background are more in the older age groups, thereby resulting in sampling variation. In addition, it is likely that other social and cultural factors might have played a significant role in either directly regulating fertility rate or indirectly controlling the effect of education on fertility rate.

As pointed out in Chapter I, maternal education is expected to reduce birth rates for the following reasons (Murthi et al., 1995): 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 methods.

Unquestionably education is critical for disseminating safe and effective birth control methods to slow down population growth. However, it is evident from the present findings that that education alone may not be sufficient to bring about changes in fertility behavior without taking into consideration other social and cultural situations. According to Jennings (1970), “If it is difficult to inform people in the Western cultures where education is valued and the need for birth control is appreciated, it is infinitely more difficult to instill necessary ideas in people who link many children with cultural ideals. Education will be effective only to the degree that cultural values and customs are
understood and the principles of acculturation are applied.” For example, 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). Indeed, 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, all of the subjects were Christians hence it is difficult to suggest the role of religion. However, cultural practices and values have not been totally abandoned by the Hmars, although they have accepted Christianity. The possible role of son preference in enhancing fertility among the educated women cannot be completely ruled out if one talks about the importance of lineage system among the Hmars. We hope that future studies will throw much more light on what we have pointed out here.

**Infant Mortality**

The infant mortality rate in the Hmars (2.83%) of the present study is lower than many populations in Northeast India. Recent studies show that the infant mortality rates among the Christian and Non-Christian Khasis of Shillong are 6.82% and 8.60%, respectively (Mukherjee, 2002). Gogoi (2002) also reported that the infant mortality rate among the Christian and Non-Christian Mundas of Assam were 5.93% and 7.44%, respectively. Thus, it indicates that the infant mortality rate is much lower in the Hmars than in these populations of Assam and Meghalaya. It is also lower than that reported for the Pnars (4.20%) of Jatinga (Khongsdier *et al.*, 2001) and Christian and Non-Christian War Khasis (Khongsdier, 2005). Thus, in comparison with some populations reported recently from Northeast India, the infant mortality rate in the Hmars is moderately low. Similarly, the rate of reproductive wastage (abortion and still-birth) is moderately in the Hmars when compared with the Mundas of Assam (Gogoi, 2002), Khasis (Mukherjee, 2002) and Pnars of Jatinga (Khongsdier *et al.*, 2001). It is similar to those reported for the Mukloms of Arunachal Pradesh (Sarkar, 2002). Kotal (2002) reported that the child mortality (deaths between 1 and 4 years of life) rates among the Koch sub-groups, namely,
Chapras, Sangas, Satparis, Tintikiyas and Wanangs of Garo Hills were 13.72%, 8.37%, 7.55%, 8.58% and 13.81%, respectively. In comparison with these Koch subgroups of Garo Hills, the child mortality among the Hmars is moderately low.

It is observed that the infant mortality rate increases with the increasing age of mothers. It is found that infant mortality is positively associated with maternal age (b = -0.029 ± 0.011, t = 2.62, p < 0.009) and negatively associated with maternal education (b = -0.052 ± 0.026, t = 2.00, p < 0.05). However, the effect of household income on infant mortality is not statistically significant. Thus, it indicates that maternal age and education are very important factors 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 education is according to the general observation in other populations (Rustein, 2000; Wagstaff, 2000), which indicate that mothers belonging to the higher educational levels are more conscious of the health of their children, and they have more access to modern medical aids, etc. On the other hand, the insignificant effect on infant mortality rate indicates that economic condition alone is not sufficient to bring down mortality rate, unless the mothers are also educated or well conscious of the health care of their children.

GROWTH PATTERN

Besides demographic aspects, 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 bio-cultural 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 such as nutrition, infection, occupation, income and religion, it is very vital for understanding the bio-cultural variation and evolution of human populations (Tanner 1988, Eveleth and Tanner, 1990; Bogin, 1999).

In the present study, we have considered the growth of children aged 2 to 10 years of age. The main purpose is to assess the nutritional status of children in relation to other demographic and socio-economic conditions of the study population. However, an attempt will be also made in this section to assess the growth status of Hmar children. 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. Thus, in this section of the present Chapter, we shall look into the growth status of the Hmar children to understand the population variation, which may reflect the socio-economic conditions of the study population. In this regard, we shall take into consideration only some important anthropometric variables like weight and height, which are also reported for few populations in Northeast India, such as War Khasis (Khongsdier, 1996), Khynriam Khasis (Mukherjee, 2002), Assamese Muslims (Begum and Choudhury, 1999) and Kalitas (Choudhury and Bhuyan, 1994).

It may be noted here that in India we do not have the recommended growth references and/or standards. Although the growth data collected by the Indian Council of Medical Research (ICMR, 1972) are old and unrepresentative of all sections of the Indian population, its use in the present study is but to understand the growth status of the Hmar 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 NCHS/WHO growth references (WHO, 1983) for the assessment of the nutritional status of the children in the present study as internationally recommended.
Fig. 6.1 Mean weight (kg) of Hmar boys in comparison with ICMR and NCHS growth references.

Fig. 6.2 Mean body weight of Hmar boys in comparison with other populations in Northeast India.
Fig. 6.3. Mean weight of Hmar girls in comparison with ICMR and NCHS growth references

Fig. 6.4. Mean body weight of Hmar girls in comparison with their counterparts in Northeast India
Weight

Figure 6.1 shows the mean weight of Hmar boys in comparison with the ICMR and NCHS/WHO growth references. It is observed that the Hmar boys are above the 50th percentile of the ICMR growth references from 2 to 10 years of age, although they are similar at about 5 years. In comparison with the NCHS growth references, the Hmar boys are far below the 50th percentile from 2 to 10 years of age, but they are above the 3rd percentile across these ages. Nevertheless, it is evident that the Hmar boys of the present study are above the 50th percentile of the ICMR growth references. In comparison with their counterparts reported from some populations of Northeast India, the Hmar boys are comparable to the War Khasi boys (Khongsdier, 1996) from 3 to 5 years of age and to the Khynriam Khasi boys (Mukherjee, 2002) from 4 to 5 years of age (Figure 6.2). However, the War Khasi boys are heavier than the Hmar boys from 5 to 10 years of age. The Hmar boys are heavier than the Khynriam Khasi boys from 5 years onwards, although the latter are heavier at 9 years of age. In comparison with the Assamese boys, the Hmar boys are heavier than the Kalita boys (Choudhury and Bhuyan, 1994) across ages. They are also heavier than the Assamese Muslim boys (Begum and Choudhury, 1999) from 3 to 6 and 8 to 9 years, although the latter are heavier from 9 to 10 years of age. In general, it reveals that the Hmar boys are above the 50th percentile of the ICMR growth references and heavier than the Kalita boys, although they are lighter than the War Khasi boys from 5 to 10 years of age. They are comparable to the Assamese Muslim boys.

As for girls, Figure 6.3 shows the mean weight of Hmar girls in comparison with the ICMR and NCHS growth references. The Hmar girls are above the 50th percentile of the ICMR and 3rd percentile of the NCHS growth references from 2 to 10 years of age. They are, however, far below the 50th percentile of the NCHS growth references. In comparison with some populations in Northeast India, the Hmar girls are heavier than the Kalita girls across ages (Figure 6.4). They are similar to the Khynriam and Assamese Muslim girls from about 3 to 5 years, and thereafter they are lighter up to about 8 years of age. The Hmar girls are similar to the Assamese Muslim girls from 8 to 10 years, although they are lighter than the Khynriam and War Khasi girls in this age group. They are also heavier than the War Khasi girls from about 3.5 to 5 years, and thereafter the latter surpassed the former up to about 8 years. On average, like their male counterparts,
the Hmar girls are above the 50th percentile of the ICMR growth references and heavier than the Kalita girls of Assam. They are comparable to the War Khasi and Assamese Muslim girls, irrespective of certain fluctuations.

Figure 6.5 shows the mean height of Hmar boys in comparison with the ICMR and NCHS growth references. It can be observed that the Hmar boys are below the 50th percentile of the ICMR growth references across ages although they are more or less comparable from 2 to about 3.5 years of age. The Hmar boys are also far below the 50th percentile of the NCHS growth references, but they are more or less comparable to the 3rd percentile of the international growth references across ages. In comparison with their counterparts reported from some populations of Northeast India, the Hmar boys are taller than the Khynriam boys across ages, but shorter than the War Khasi, Kalita and Assamese Muslim boys (Figure 6.6). They are similar to the Assamese Muslim girls only from 3 to 4 years of age. Thus, on average, the Hmar boys seem to be better in growth status of height when compared with the Khynriam Khasi and ICMR growth references. However, they are shorter than War Khasi, Kalita and Assamese Muslim boys.

Figure 6.7 shows the mean height of Hmar girls in comparison with the ICMR and NCHS growth references. It is seen that the Hmar girls are above the 50th percentile of the ICMR growth references, although they are similar at about 5 years of age. The Hmar girls are also above the 3rd percentile but far below the 50th percentile of the NCHS growth references. In comparison with the 4 selected populations in Northeast India, the Hmar girls are taller than the Khynriam Khasi and Kalita girls across ages, except from 4 to 5 years of age when they are similar to the Kalita girls (Figure 6.8). They are also similar to the War Khasi girls from 7 to 10 years of age, and to the Assamese Muslim girls from 3 to 5 years of age. However, they are shorter than the War Khasi girls from 3 to 7 years of age, although the latter are taller before 7 years of age. The Assamese Muslim girls are also taller than the Hmar girls from 5 years onwards. On average, the Hmar girls are above the 50th percentile of the ICMR growth references with respect to growth in height, although they are far below the 50th percentile of the NCHS growth references. They are taller than the Kalita and Khynriam Khasi children. They are similar to the war Khasi girls from 7 to 10 years of age and to the Assamese Muslim girls from 3 to 5 years of age. They are, however, shorter than the War Khasi and Assamese Muslim girls from 3 to 7 years and 5-10 years of age, respectively.
Fig. 6.5. Mean height of Hmar boys in comparison with ICMR and NCHS growth references.

Fig. 6.6. Mean height of Hmar boys in comparison with their counterparts in Northeast India.
Fig. 6.7. Mean height of Hmar girls in comparison with ICMR and NCHS growth references

Fig. 6.8. Mean height of Hmar girls in comparison with their counterparts in Northeast India
NUTRITIONAL STATUS

The present findings indicate that boys have a higher prevalence of underweight when compared with girls across age groups. Also, children in the lower age groups are better in weight-for-age compared with those in the higher age groups. Similarly, the mean Z-scores for height-for-age are higher in girls than in boys, especially after 4 years of age. The overall prevalence of stunting (moderate plus severe forms) for all age groups is significantly higher in boys (52.94%) than in girls (44.44%) with the estimated OR of 1.45 (95% CI = 1.02-2.06). In addition, the sex difference in the prevalence of stunting according to height-for-age index is more marked in the higher age groups. It is found that about 48.54% and 56.58% of boys are stunted in the age groups 2-5 and 6-10 years, respectively. As for girls, these frequencies are about 42.39% and 45.63%, respectively, although it is not statistically significant. With respect to weight-for-height, there are no significant differences between boys and girls, except at 4 years of age when girls had higher mean values than boys. Overall, according to the classificatory criteria proposed by Gorstein et al. (1994), the present population is characterized by a high prevalence of underweight (28.40% for both sexes) and a very high prevalence of stunting (48.72% for both sexes).

There are two major implications with respect to above summary of the present findings on the nutritional status of children. These implications may be described as follows:

Sex differences

The present study clearly indicates the higher prevalence of under-nutrition in boys than in girls. There are again two major implications with respect to this sex difference in nutritional status: the first implication is concerned with the hypothesis of the "biological fragility" of males as compared to females (Kraemer, 2000), while the second implication is related to the role of cultural diversity in regulating health and nutritional inequalities.

Role of biological factors

As for the role of biological factors, our findings are consistent those revealed by various nutrition surveys for under-five children in many developing countries (Marcoux, 2002). Nutrition surveys at the national level in many developing countries have revealed that nutritional status, as indicated by anthropometric indicators, is better among girls than
among boys aged below 5 years (Marcoux, 2002; Garenne, 2003). According to Marcoux (2002), "boys usually fare worse than girls by anthropometric indicators" and "it appears that the issue of sex biases in food distribution has been overstated in advocacy of work." On the basis of evidence from 41 Demographic Health Surveys, Sommerfelt and Arnold (1998) also drew a similar conclusion on sex differences in anthropometric indicators of nutritional status. Our findings also corroborate those reported for adolescents in Jamaica (Jackson et al., 2002), Brazil (Wang et al., 2002), China (Hesketh et al., 2002; Wang et al., 2002) and Bolivia (Pérez-Cueto et al., 2005) in general, and to the adolescents of the present population (Khongsdier et al., 2005) in particular. Thus, our study may have certain implications with respect to the observation that boys are more vulnerable than girls to adverse conditions, such as infections and/or nutritional deprivation (Tanner, 1962; Stinson, 1985; Worthman, 1996), notwithstanding other risks of different obstetric complications (Mizuno, 2000).

It is well known that boys are, on average, larger than girls until the beginning of the adolescent growth spurt in girls. However, the adolescent growth spurt begins earlier in average girls than in average boys, when the former are larger and more sexually mature than do the latter. During their adolescent growth spurt, boys again surpass girls until adulthood with a larger body size and more physically powerful sex. Compared to females, males generally expend more energy per unit body mass especially during adolescence (Spurr and Reina, 1989; van Mil et al., 2001). Considering their greater physiological requirement of energy due to changes in body size and physical strength, boys are perhaps more vulnerable than girls to poor environmental conditions during the pre-adolescent and adolescent stages of growth and development. It is often hypothesised that growth before adolescence is more sensitive to environmental factors (Bogin, 1999), whereas growth during adolescence is a result of the complex interaction between biological and environmental factors. The greater vulnerability to poor environmental quality in boys is, perhaps, due to the greater changes in body size and composition as compared to girls. Such a greater vulnerability in boys may be more pronounced during the pre-adolescent stages when growth is more sensitive to poor environmental quality, especially inadequate nutrition and its synergistic relation to infections (Scrimshaw et al., 1968). The present findings indicated that pre-adolescent girls in the study populations
also fared better than their male counterparts with respect to the prevalence of under-nutrition.

The synergistic relation between under-nutrition and infectious diseases is well documented, especially among young children (Scrimshaw et al., 1968; Rice et al., 2000). As for sex differences, it is unclear whether certain Y-linked genes and/or recessive genes located on the sex chromosomes are responsible for lower resistance to infections? It is suggested that a higher level of testosterone in males could have an immunosuppressive effect, thereby making males more susceptible to infectious diseases (Folstad and Karter, 1992). There are, however, inconsistent results on sex differences in the prevalence of certain infectious diseases. For example, malaria vulnerability does not appear to be associated with sex except in pregnant women (Bates et al., 2004). A study in Thailand revealed that the prevalence of malaria in males and females is inconsistent and varies according to sources of data drawn from communities or health care centers (Vlassoff and Bonilla, 1994). As for tuberculosis, several studies have revealed the absence of sex differences in the prevalence of tuberculosis before 16 years of age, thereafter it is more prevalent in males (Holmes et al., 1998; Martinez et al., 2000; Salim et al., 2004). However, the difficulty in excluding social and cultural factors relative to sex differences in access to treatment, social stigmas, presentation of symptoms and responses to tuberculin testing has complicated the issue of sex differences in tuberculosis susceptibility (Hudelson, 1996; Diwan and Thorson, 1999; Thorson and Diwan, 2001). In addition, the HIV/AIDS epidemic, which affects males and females differently according to geographical locations, has made the tuberculosis issue further complicated (Diwan and Thorson, 1999; de la Hera et al., 2004).

Although there is conflicting evidence of sex differences in susceptibility to certain infections, it is often reported that males are likely to have higher mortality than females throughout life (Waldron, 1983; Kraemer, 2000; Ashorn et al., 2002; Kruger and Nesse, 2004). The higher ratio of male to female at birth may be one of the selective forces to compensate for such excess male mortality (Stevenson et al., 2000). According to Darwin (1871), excess male mortality could be attributed to natural selection, including sexual selection, although he expressed his difficulty in giving a proper explanation of excess male to female ratio at birth. Indeed, mortality is due to different
factors including nutrition and/or infections, thereby it is more difficult to apportion the biological factors concerning excess male mortality as compared to specific infections or diseases. Nonetheless, sex biological factors including genetic and endocrine factors (Daly and Wilson, 1983) should be also taken into consideration in order to have a better understanding of gender differences in nutritional status and/or health inequalities.

Role of cultural diversity

Although there is conflicting evidence of sex differences in nutritional outcomes in South Asia, it is 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 South Asia, 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).

Although our study is inconsistent with those reported for under-five children in South Asia (Miller, 1997; Choudhury et al., 2000; Nubé and van den Boom, 2003; Shaikh et al., 2003), it may have certain implications for the role of cultural diversity in health and nutritional disparity in India. The excess under-nutrition among boys in the present study does seem to be indicative of the absence of female discrimination in the Hmar society. However, it does not mean for us to generalise that there was an absence of
excess female under-nutrition in other Indian patrilineal societies. Considering our study and other studies, it is likely 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).

Nutritional and health discriminations against girls in India may vary from one region to another depending upon a number of cultural factors relating to beliefs, ideas and behaviours that are socially transmitted from one generation to another in a specific population or culture area (Jejeebhoy and Sathar, 2001). Subject to further studies, such cultural factors may in turn act as constraints of the so-called universal factors (socio-economic factors) of social and economic change, such as employment, educational and income levels. Hence, the impact of these socio-economic factors on gender discrimination and/or sex differences in nutritional and health status may also vary from region to region (Sen, 2003). Recently, it is also reported that adolescent boys in the Khasi matrilineal society had higher prevalence of under-nutrition than their female counterparts (Khongsdier et al., 2005). The authors have, however, cautioned 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). 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.

Relevance of NCHS/WHO growth references
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 U.S. National Center for Health Statistics (NCHS) growth reference population endorsed by the World Health Organization (WHO, 1983, 1995) 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 3.16% as compared to the prevalent rates of underweight and stunting, which are 28.40% and 48.72% as measured by weight-for-age and height-for-age, respectively. These results in the Hmar population 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 present findings seem to be consistent with the observation made by Seckler (1982). It may also be mentioned that the WHO has now proposed to set up new growth references for international use with the aim of developing a new reference for assessing the growth and nutritional status of infants and young children. (de Onis, M. et al. 1997).

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 Hmar population and perhaps in many populations in developing countries. We shall discuss more on this issue when we discuss the health and nutritional status of adults in the present population.
ADULT NUTRITIONAL AND HEALTH STATUS

In the present study, we have taken nutritional status, morbidity and hemoglobin as indicators of the health and nutritional status of Hmar adults (see Chapter V). The nutritional status was assessed using body mass index (BMI), which is derived from anthropometric measurements of body weight and height, as internationally recommended (WHO Working Group, 1986; WHO, 1995). Data on morbidity were based on "self-reported illness experience" of a subject as generally adopted in surveys, which did not involve a clinician (Strickland & Ulijaszek, 1993; Garcia & Kennedy, 1994; Strickland & Tuffrey, 1997). Hemoglobin level was measured following Sahli’s method (WHO, 1983). These indicators of the health and nutritional status were also correlated with socio-economic variables such as household income and education with a view to understanding the interaction between biological and cultural traits- the subject matter of anthropology as a discipline. In the present section, we shall restrict to discuss our findings on these health and nutritional traits.

Body Mass Index

In Chapter V, we have shown that the mean BMI is 20.70 kg/m² and 20.67 kg/m² in adult males and females, respectively. These mean values of BMI among the Hmars are higher than those reported for 12 populations in Northeast India (Khongsdier, 2001). It is also higher than those reported for the War Khasi males (Khongsdier, 2002, 2005c). The prevalence of chronic energy deficiency (CED) (< 18.5 kg/m²) was about 14.78% in males and 16.12% in females. These prevalent rates of CED are also lower than those reported for several populations of Northeast India, including caste groups like Brahmans, Kalitas, Jogis, Kaibartas and Hinduised groups like Ahoms, Kochs and Rajbhanjis (Khongsdier, 2001). They are also lower than the tribal groups like Lalungs, Miris (Khongsdier, 2001) and War Khasis (Khongsdier, 2002). Thus, it may be concluded that the nutritional status in the present populations is better than many populations in Northeast India. It is also found that the prevalence of overweight is 12.96% in males and 16.12% in females (Chapter V). This indicates that overweight is an emerging problem in the Hmar population. Considering BMI as an indicator of standards of living in developing countries (Nube, 1998; Khongsdier, 2002), it may be suggested that the Hmar population is also better in economic condition, as indicated by BMI index, than many
other populations in Northeast India. The other possible explanation is that BMI is lower in those populations with higher sitting height (Norgan, 1994; Khongsdier, 2001). However, Hmar adults do not seem to deviate significantly from many populations in Northeast India (Khongsdier, 2001) with respect to cormic index. Thus, the higher BMI in Hmar population does not seem to be associated with cormic index, despite the presence of significant correlation between BMI and cormic index in the present analysis. In other words, although BMI is associated with cormic index, the Hmars are not much different from other populations in Northeast India with respect to cormic index.

The point that we would like to make here is that, although under-nutrition remains a major health problem in many developing countries, over-nutrition is also emerging with the improvement in socio-economic condition and increasing urbanization (Khongsdier, 2005c). Consequently, the double burden of under- and over-nutrition exerts considerable impact on the economy and health system in many developing countries (Popkin, 1998, 2002). In general, many countries in Asia are in this situation due to "changing dietary pattern towards energy-dense and high fat diets, together with a more sedentary lifestyle arising from increasing urbanization" (Florentino, 2002). The increasing urbanization, changes in standards of living, dietary patterns, and occupational work patterns are the key factors to risks of the epidemic of obesity and associated morbidity and mortality.

A recent review has revealed that India is also characterized by the development and nutrition transition that may contribute to the risk of overweight and obesity, especially in urban areas (Shetty, 2002). Visweswara Rao et al. (1995) reported that the prevalence of overweight among adults in urban colonies of Hyderabad was 21.8% in males and 27.4% in females, while the prevalence of obesity was 2.1% and 8.9%, respectively. It was also observed that the prevalence of overweight and obesity was higher in the higher income groups for both males and females. A study conducted in urban Delhi by the Nutrition Foundation of India also revealed that the prevalence of overweight (defined as $\geq$ 25 of BMI) among the "middle class" increased from low- to high-income groups, showing that about 32.2% of males and 50.0% of females in the high-income group suffered from overweight (Gopalan, 1998). Both of these studies indicated that the prevalence of overweight and obesity was higher in females than in males. In the present study, we
have also observed that the prevalence of overweight in females (16%) than in males (13%).

Thus the spread of overweight and obesity needs to be monitored and prevented, but it should not be done at the expense of the efforts to alleviate under-nutrition. Most nutrition programmes in developing countries pay more attention to alleviating under-nutrition, especially in providing food complements, without much attention to monitor and prevent the epidemic of overweight and obesity that may create more harm in the future generations (Uauy and Kain, 2002).

Another point of significance with respect to the findings of the present study is the relationship between BMI and socio-economic conditions. It is observed that mean BMI is positively associated with household income of the household, whereas the prevalence of CED is negatively associated with income. Thus, the suggestion that BMI is an indicator of standards of living seems to have implication for the Hmar population as mentioned above. However, the present study failed to get any significant relationship between BMI and educational level. This indicates that the important factor for BMI is economic condition of the household, rather than social factors like education.

**Morbidity**

The present analysis given in Chapter V reveals that the overall prevalence of morbidity is 11.45%, which is lower than that reported for the War Khasis (Khongsdier, 2002). The prevalence of morbidity is significantly higher in males (13.36%) than in females (7.44%). It is found that the prevalence of morbidity increases with the increasing age groups of both males and females. It is also higher in the undernourished and overweight individuals as compared to those in the normal category of nutritional status. The effect of household income on morbidity is not clearly perceptible in the present study. However, education of the individuals seems to be important in regulating morbidity pattern.

In view of the above, one may argue that the results of the present study are as generally expected. However, the sex differences and the absence of significant relationship between morbidity and household income may need further explanation. With respect to sex differences, our argument is the same as in the case of the sex differences in the nutritional status of the children given earlier in the present chapter.
Therefore, we shall summarize it later in the end of this chapter. The absence of significant relationship between morbidity and household income is difficult to give explanation because our findings show that the individuals in the higher economic groups are better in nutritional status. Our expectation is that families with higher income are better in health status because of not only their better nutritional status but also due to their greater access to health facilities than those in the lower income group. Thus, it may be speculated, on the basis of the present findings, that household income is not enough to bring about good health if the individuals lack awareness of hygienic conditions, nutrition and health facilities or services which prevent from morbidity and mortality. Education seems to play a very important role in creating this sort of awareness among the members of the present population. Therefore, morbidity in the present population is more related to education than to household income.

Hemoglobin Content
It is found that the mean hemoglobin among the Hmars of the current study is 13.05 g/dl for males and 12.27 g/dl for females. These mean hemoglobin levels among the Hmars are higher than those reported for some populations in Northeast India, but lower than the Christian and Non-Christian War Khasis (Khongsdier, 1997). It is found that the mean Hb content decreases with the increasing age groups of both males and females. It is also associated with nutritional status and household income. The prevalence of anemia is significantly higher in males (38.98%) than in females (37.55%). It is observed that the prevalence of anemia increases with the increasing age groups of both males and females. It is also associated with household income and individual education (see Chapter IV). The findings on hemoglobin and anemia in the present populations seem to be consistent with the general observation that hemoglobin level is higher in males than in females, and also decreases with age (WHO, 1968). Also, it clearly indicates that hemoglobin level and the prevalence of anemia is to a great extent influenced by socio-economic conditions as generally observed in developing countries.
OVERALL HEALTH STATUS

In view of the present findings, the question may arise as to what is the overall health development in the present population? The answer to this question may be difficult because it depends on the nature and types of health indicators taken under a given study. It is well known that human development index (HDI) is measured by taking the average of (1) life expectancy, (2) weighted average of functional literacy and combined elementary and secondary net enrolment rate, and (3) real per capita income. Considering the concept of HDI, we have also measured the population or overall health index in the present study by taking into consideration the average of infant mortality, proportions of children with underweight, stunting and wasting, and proportions of adults with self-reported morbidity, chronic energy deficiency (CED) and anemia. Assuming that the ideal population health index as 1 and the least population health as 0, we calculated the overall health index (OHI) as follows:

\[ OHI = \frac{\sum H}{N} \]

where

\[ N = \text{Number of health indicators} \]

\[ \sum H = H_1 + H_2 + H_3 + \ldots + H_n \]

- \( H_1 \) = Health index due to infant mortality (i.e., \( H_1 = 1 - P_1 \))
- \( H_2 \) = Health index due to underweight (i.e., \( H_2 = 1 - P_2 \))
- \( H_3 \) = Health index due to stunting (i.e., \( H_3 = 1 - P_3 \))
- \( H_4 \) = Health index due to wasting (i.e., \( H_4 = 1 - P_4 \))
- \( H_5 \) = Health index due to CED (i.e., \( H_5 = 1 - P_5 \))
- \( H_6 \) = Health index due to morbidity (i.e., \( H_6 = 1 - P_6 \))
- \( H_7 \) = Health index due to anemia (i.e., \( H_7 = 1 - P_7 \))

- \( P_1 \) = Infant mortality rate (per live birth)
- \( P_2 \) = Proportion of underweight children
- \( P_3 \) = Proportion of stunted children
- \( P_4 \) = Proportion of wasted children
- \( P_5 \) = Proportion of adults with CED
- \( P_6 \) = Proportion of adults with self-reported morbidity
- \( P_7 \) = Proportion of adults with anemia
### Table 6.1. Distribution of health indicators by income groups

<table>
<thead>
<tr>
<th>Health Indicators</th>
<th>LIG</th>
<th>MIG</th>
<th>HIG</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infant mortality (P₁)</td>
<td>0.0283</td>
<td>0.0256</td>
<td>0.0315</td>
<td>0.0283</td>
</tr>
<tr>
<td>Underweight (P₂)</td>
<td>0.3099</td>
<td>0.2989</td>
<td>0.1538</td>
<td>0.2840</td>
</tr>
<tr>
<td>Stunting (P₃)</td>
<td>0.5263</td>
<td>0.4827</td>
<td>0.2949</td>
<td>0.4832</td>
</tr>
<tr>
<td>Wasting (P₄)</td>
<td>0.0292</td>
<td>0.0460</td>
<td>0.0256</td>
<td>0.0316</td>
</tr>
<tr>
<td>Chronic energy deficiency (P₅)</td>
<td>0.1804</td>
<td>0.1205</td>
<td>0.1237</td>
<td>0.1554</td>
</tr>
<tr>
<td>Self-reported morbidity (P₆)</td>
<td>0.1117</td>
<td>0.1289</td>
<td>0.1058</td>
<td>0.1145</td>
</tr>
<tr>
<td>Anemia (P₇)</td>
<td>0.4265</td>
<td>0.3571</td>
<td>0.2626</td>
<td>0.2051</td>
</tr>
</tbody>
</table>

### Table 6.2. Overall Health Index (OHI) by income groups

<table>
<thead>
<tr>
<th>Indices</th>
<th>LIG</th>
<th>MIG</th>
<th>HIG</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health index due to mortality (H₁)</td>
<td>0.9717</td>
<td>0.9744</td>
<td>0.9685</td>
<td>0.9717</td>
</tr>
<tr>
<td>Health index due to underweight (H₂)</td>
<td>0.6901</td>
<td>0.7011</td>
<td>0.8462</td>
<td>0.7160</td>
</tr>
<tr>
<td>Health index due to stunting (H₃)</td>
<td>0.4737</td>
<td>0.5173</td>
<td>0.7051</td>
<td>0.5168</td>
</tr>
<tr>
<td>Health index due to stunting (H₄)</td>
<td>0.9708</td>
<td>0.9540</td>
<td>0.9744</td>
<td>0.9684</td>
</tr>
<tr>
<td>Health index due to CED (H₅)</td>
<td>0.8196</td>
<td>0.8795</td>
<td>0.8763</td>
<td>0.8446</td>
</tr>
<tr>
<td>Health index due to morbidity (H₆)</td>
<td>0.8883</td>
<td>0.8711</td>
<td>0.8942</td>
<td>0.8855</td>
</tr>
<tr>
<td>Health index due to anemia (H₇)</td>
<td>0.5735</td>
<td>0.6429</td>
<td>0.7374</td>
<td>0.7949</td>
</tr>
<tr>
<td>Overall Health Index (OHI)</td>
<td>0.7997</td>
<td>0.7915</td>
<td>0.8574</td>
<td>0.8140</td>
</tr>
</tbody>
</table>

### Table 6.3. Overall Health Index (OHI) by educational groups

<table>
<thead>
<tr>
<th>Indicators</th>
<th>No education</th>
<th>Primary</th>
<th>Secondary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health index due to mortality (H₁)*</td>
<td>0.9561</td>
<td>0.9819</td>
<td>0.9770</td>
</tr>
<tr>
<td>Health index due to underweight (H₂)*</td>
<td>0.7227</td>
<td>0.6763</td>
<td>0.7349</td>
</tr>
<tr>
<td>Health index due to stunting (H₃)*</td>
<td>0.4538</td>
<td>0.4820</td>
<td>0.5663</td>
</tr>
<tr>
<td>Health index due to stunting (H₄)*</td>
<td>0.9916</td>
<td>0.9640</td>
<td>0.9598</td>
</tr>
<tr>
<td>Health index due to CED (H₅)</td>
<td>0.7788</td>
<td>0.8326</td>
<td>0.8759</td>
</tr>
<tr>
<td>Health index due to morbidity (H₆)</td>
<td>0.8387</td>
<td>0.8824</td>
<td>0.9056</td>
</tr>
<tr>
<td>Health index due to anemia (H₇)</td>
<td>0.5077</td>
<td>0.6349</td>
<td>0.6576</td>
</tr>
<tr>
<td>Overall Health Index (OHI)</td>
<td>0.7499</td>
<td>0.7792</td>
<td>0.8110</td>
</tr>
</tbody>
</table>

*Based on maternal education
Table 6.1 shows the distribution of the individuals according to different health indicators for the low income group (LIG), middle income group (MIG) and high income group (HIG). The OHI (0.8140 or 81.40%) and its components are given in Table 6.2. The OHI in the high income group (0.8574 or 85.74%) is much higher than in the middle (0.7915 or 79.15%) and low (0.7997 or 79.97%) income groups. Similarly, Table 6.3 shows that the OHI is higher in the individuals with secondary level of education (0.8110 or 81.10%) than in those with no education (0.7499 or 74.99%) and primary level of education (0.7792 or 77.92%). This clearly reveals that the health status in the higher socio-economic group is better than that in the lower ones.

On the basis of these findings, the moot anthropological question is that whether being in poor socio-economic condition is also indicative of being victims of natural selection? Natural selection acts primarily at the individual level. The simple definition of natural selection given by Darwin (1859) is the “preservation of favourable individual differences and variations, and the destruction of those which are injurious.” He further clarified that “under the term of "variations," it must never be forgotten that mere individual differences are included.” Thus, natural selection operates primarily at the individual level through differential survival and reproduction. The aggregate or average differential survival and reproduction of a given number of individuals may be considered its action at a group or population level.

Like the present study, there is considerable evidence that the health and nutritional status of the poor is worse than is the rich. Mortality rates due to malnutrition, infections and other causes of deaths are much higher in the lower socio-economic classes (Khongsdier, 2006). The significance of these inequalities also influenced the writings of Malthus (1803) and Darwin (1871, 1859). According to Malthus (1803), the “constant tendency in all animated life to increase” would prevent any permanent amelioration of poverty in the lower classes. In Central and South Asia, the positive checks including epidemics and consequences of “indigence and bad nourishment” would fall heavily on those in the lowest socio-economic strata “before any considerable degree of want had reached the middle classes of the society” (Malthus, 1803). Acknowledging this important observation of Malthus, Darwin (1871) wrote, “As all animals tend to multiply beyond their means of subsistence, so it must have been with the progenitors of
man; and this would inevitably lead to a struggle for existence and to natural selection.” Although Darwin did not say that natural selection is stronger among the poor, he also observed the “greater death-rate of infants in the poorest classes … as well as the greater mortality, from various diseases, of the inhabitants of crowded and miserable houses, at all ages” (Darwin, 1871). It was Franz Boas (Boas, F. 1938) who argued that natural selection in humans operates primarily through social stratification. In addition, malnutrition, associated with poor environmental conditions in the lower socio-economic strata, is suggested to be a strong force of natural selection especially among children and reproductively-active women (Segraves, 1977). Thus, the view that socio-economic inequality mediates the process of natural selection in human populations seems to have originated with Darwin himself (Strickland & Tuffrey, 1997).

Natural selection is a blind natural force that preserves the beneficial variations and eliminates the injurious ones. The process of preserving the beneficial variations is also known as the survival of the fittest in the struggle for existence. According to Malthusian and Darwinian points of view, the struggle for existence, or competition for survival, is due to the increase in population beyond the means of subsistence. The short supply of resources, therefore, increases competition in different forms including social stratification in which “members of the privileged class may own even up to or over 10,000% of what a poor person owns” (Cohen, 1998). The high prevalence of malnutrition and infections is a clear evidence of poor access to adequate nutrition and health amenities among the lower socio-economic classes. From this point of view, one may argue that social stratification mediates natural selection in human populations in the form of malnutrition and infections, which ultimately lead to higher morbidity and mortality in the lower strata of social stratification. However, this argument is based simply on differential survival or survival of the fittest due to limited resources mediated by social stratification.

Natural selection or survival of the fittest also occurs whenever two or more individuals of distinct genotypes transmit their genes to the succeeding generations at different rates, despite the absence of limited resources (Birch, 1957). Any population is capable of increasing in number only when the progeny are able to survive and reproduce from generation to generation. Considering the findings on differential fertility and
mortality in the present study, one may argue that reproductive success is lower in the higher socio-economic groups than in the lower socio-economic groups because fertility and mortality rates are lower in the former than in the latter. Indeed, there might not be a large difference between low and high socio-economic classes in differential reproduction because a higher mortality rate among the low socio-economic class is compensated for by a higher fertility rate. There is considerable evidence that fertility rates are higher in the lower socio-economic groups than in the higher ones. "This situation is undesirable, irrespective of any genetic considerations. People who should be able to provide the best environment for the physical and mental development of their children produce fewest progeny" (Dozhansky, 1962).

According to the adaptive systems theory, parents living in risky and uncertain environment maximize the current reproduction in terms of the quantity of offspring to minimize the risk of lineage extinction because of high mortality; while parents living in good environmental conditions maximize the quality of their offspring by reducing the quantity of the current reproduction (Chisholm and Burbank, 2001). Consequently, the future reproductive success of the parents under good environmental conditions is higher than that of the parents under poor environmental conditions because the high quality offspring are more likely to survive and reproduce from generation to generation.

In the present study, although we observed higher fertility and mortality in the lower socio-economic groups, we were not concerned with the case study or longitudinal study of the quality of offspring in the lower and high socio-economic groups of the Hmar population. More studies are needed to know whether or not the higher fertility and mortality rates in the lower classes are a form of plasticity to minimize the lineage extinction at the cost of high mortality? There is also a possibility of minimizing the lineage extinction at the expense of individual physical disadvantages (Strickland and Tuffrey, 1997). However, such a form of plasticity, if any, is because of necessity rather than for long-term benefits of populations (Khongsdier, 2006). Natural selection that operates in the lower strata of social stratification does not result in a long-term beneficial adaptation. As for the upper class, Harrison (1998) points out, "any physiological ability facilitating access to better environments will be strongly favoured through the greater success, reproduction and offspring survival which the better environments are likely to
promote . . . . Darwinian fitness will tend to be highest in the upper class, especially in the absence of contraception, and physiological ability can influence the probability of being in those classes” through its effects on health and functional capability. Despite improvement in agricultural productivity in the 20th century, millions of people in developing countries still remain poor and undernourished because food is “neither produced nor distributed equitably” (WHO, 2000a). This problem remains a major setback to the “recognized fundamental human right to adequate food and nutrition, and freedom from hunger and malnutrition, particularly in a world that has both the resources and knowledge to end this catastrophe” (WHO, 2000b).

CONCLUDING REMARKS
In the present study, we have taken demographic parameters, growth of children, adult body dimensions, morbidity and anemia as indicators of the health and nutritional status of the Hmar population. Our findings indicate that the Hmar population is highly progressive due to high fertility and lower mortality rates. The growth status of children aged 2-10 years of age is far below the 50th percentile of the WHO/NCHS growth references, although it is above the 50th percentile of the ICMR references. As for nutritional status of children, the Hmar population is characterized by a high prevalence of underweight (28.40% for both sexes) and a very high prevalence of stunting (48.72% for both sexes) but with low prevalence of wasting (3.16%), according to the classificatory criteria proposed by Gorstein et al., (1994), which takes into consideration all the three anthropometric indices (Table 4.14). With respect to the nutritional status of adults, the Hmar population seems to be better than those reported for many populations in Northeast India. There is also an indication of overweight perhaps due to improved standards of living as generally suggested in developing countries (Nube, 1998; Khongsdier, 2002). The better nutritional status in the adults of the present population is also consistent with the results on lower morbidity and anemia. The present findings have many implications which may be summarized briefly as follows:

1. The present findings seem to have certain implications for the application of the demographic transition theory. It is well known that the second stage of demographic transition theory predicts that improvement in standard of living and
health facilities results in population growth due to high fertility and low mortality. The poor performance of family planning welfare programmes and/or low practice of family planning methods of contraception enhances the fertility rate or population growth. It is observed that only about 5% of the Hmars married women adopted family planning methods. Therefore, fertility rate is still high in the population, thereby suggesting a need for greater political will to implement family planning programmes.

2. It is observed that the fertility rate in the present population is negatively associated with the maternal age, age at marriage and income levels of households. 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 household income 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 in order to provide their children with the best facilities (Mukherjee, 2002). What is interesting in the present study is that the effect of maternal education disappeared after adjusting for maternal and household income. This insignificant effect of education on fertility rate in the Hmars of the present study is inconsistent with the general observation in other populations (Caldwell et al., 1999), and it is difficult to give any clear-cut explanation. It, however, suggests that maternal education is not the only factor that can regulate fertility rates in the Hmar population. For example, our analysis indicates that most educated mothers are in the lower age groups, whereas the proportion of illiterate mothers or mothers without educational background is higher in the older age groups, thereby resulting in sampling variation. In addition, it is likely that other social and cultural factors also might have played a significant role in either directly regulating fertility rate or indirectly controlling the effect of education on fertility rate. This, however, does not mean to say that education is not important in the Hmar population. It is observed that maternal age and maternal education are
very important factors in controlling infant mortality. Further studies are needed to have a better understanding of this problem in the Hmar population.

3. The high prevalence of underweight and stunting in Hmar children is contradicted by the low prevalence of wasting. This has an implication for the relevance of the international growth references/standards to the study population. It has been suggested that the use of international growth references is relevant only to the children below 5 years of age in South Asian populations (Khongsdier and Mukherjee, 2003). In the present study, we also observed the higher prevalence of underweight and stunting in the higher age group (6-10 years) than in the lower age group (below 6 years) for both boys and girls. The low prevalence of wasting as indicated by weight-for-height is consistent with the observation made by Seckler (1982) in Indian and Nepali populations. This is due to the fact that weight-for-height is independent of age, whereas indices of underweight and stunting are dependent of age. In short, the role of genetic factors and errors in the estimation of age cannot be totally ruled out in the present study. Weight-for-height is, therefore, a better indicator of nutritional status.

4. The present findings also indicate the co-existence of under- and over-nutrition (as indicated by BMI) in the Hmar population. Recent reviews has revealed that although under-nutrition remains a major health problem in many developing countries, over-nutrition is also emerging with the improvement in socio-economic condition and/or increasing urbanization (Popkin, 2002, Khongsdier, 2005c). Consequently, the double burden of under- and over-nutrition exerts considerable impact on the economy and health system in many developing countries. In general, many countries in Asia are in this situation due to "changing dietary pattern towards energy-dense and high fat diets, together with a more sedentary lifestyle arising from increasing urbanization" (Florentino, 2002). The increasing urbanization, changes in standards of living, dietary patterns and occupational work patterns are the key factors to risks of the epidemic of obesity and associated morbidity and mortality. Therefore, the spread of overweight and obesity in the Hmar population needs to be monitored and prevented, but it should not be done at the expense of the efforts to alleviate under-nutrition.
5. On average, the present findings indicate that the health and nutritional status is better in females than in males for both children and adults. This is contrary to the general observation in South Asian populations, which reveal that the health and nutritional status of females is worst as compared with males. There are two major implications with respect to these findings. The first implication is concerned with the hypothesis of the “biological fragility” of males as compared to females (Kraemer, 2000). Our study may have certain implications with respect to the observation that boys are more vulnerable than girls to adverse conditions, such as infections and/or nutritional deprivation (Tanner, 1962; Stinson, 1985; Worthman, 1996). The second implication is related to the role of cultural diversity in regulating health and nutritional inequalities. It is often argued that discrimination against females is very high in South Asian populations because of the patrilineal system of societies. However, our recent analysis on the nutritional status of the adolescents in both patrilineal and matrilineal societies did not confirm such an observation (Khongsdier et al., 2005). It is observed that the nutritional status is better in females than in males in both matrilineal and patrilineal societies. It is, therefore, suggested that the regional variation in biological and cultural characteristics should be taken into consideration to understand this problem. For example, discrimination against females may not exist everywhere in India, but varies from one society to another depending upon different socio-cultural conditions. As for the present study, we failed to observe such sex discrimination, although sex preference may arise in the case of the question on lineage continuity and old age security.

6. Another important implication of the present findings is that socio-economic inequality in health and nutritional status. On average, our findings confirm the general observation that the health and nutritional status is better in the higher socio-economic classes than in the lower socio-economic ones (Tables 6.2 and 6.3). From the anthropological point of view, the question arises whether or not being in a poor socio-economic condition is also indicative of being the victims of natural selection? Natural selection is a blind natural force that preserves the beneficial variations and eliminates the injurious ones. The process of preserving
the beneficial variations is also known as the *survival of the fittest* in the *struggle for existence*. According to Malthusian and Darwinian points of view, the struggle for existence, or competition for survival, is due to the increase in population beyond the means of subsistence. The short supply of resources, therefore, increases competition in different forms including social stratification in which “members of the privileged class may own even up to or over 10,000% of what a poor person owns” (Cohen, 1998). The high prevalence of malnutrition and infections is a clear evidence of poor access to adequate nutrition and health amenities among the lower socio-economic classes. From this point of view, one may argue that social stratification mediates natural selection in human populations in the form of malnutrition and infections, which ultimately lead to higher morbidity and mortality in the lower strata of social stratification. However, this argument is based simply on differential survival or *survival of the fittest* due to limited resources mediated by social stratification. There is no evidence that the operation of natural selection in the lower socio-economic strata of the society is genetic in nature (Khongsdier, 2006). Therefore, equality of economic opportunity in a society, for example, enables a man to choose any occupation, which is most suited for him by his abilities and willingness to strive for his survival and well-being.