CHAPTER II
REVIEW OF LITERATURE

Health is a function, not only of medical care but for the overall integrated development of socio-cultural, economic, education, social and political. Each of these aspects has a deep influence on health which in turn influences all these aspects. Hence, it is not possible to raise the health status and quality of life of people unless such efforts are integrated with the wider effort to bring about the overall transformation of a society. Good health and good society go together (Basu, 1992). The health status of Indian population is directly related to the ecology, human settlements and amenities available. The natural life support systems of land, water and air have been weakening over time as a result of the pressure of population and certain demands made by economic growth (Bhasin and Bhasin, 1994). In the present chapter, we shall make a review of related literature with special reference to those works carried out in Indian populations. The review of literature is far from being complete and exhaustive, but its main purpose is to get an insight into certain aspects which is affecting the nutritional and health status of the population.

DEMOGRAPHY

In the beginning, demography was concerned only with the enumeration of population. Gradually it began to study population from empirical, statistical and mathematical viewpoints. Today it studies the size, the composition and distribution of population.
Demographic study of population is an integral part of anthropological research. Demographic variables such as fertility and mortality are very important to understand the genetic and social structure of human population (Basu, 1969; Khongsdier, 2005a). The growth of population depends upon fertility, mortality and migration. The environment, both the physical and cultural setting, influences elements of population growth, yet there have been few studies in which the effect of the environment on population is considered. Such consideration should be part of any study, plan, or policy on population. In addition to growth, environmental factors are often responsible for the distribution and density of population. These factors cause some areas to remain unsettled while others are overpopulated. In the overpopulated areas, environmental degradation results when the capacity of the land to support the human and animal population is exceeded. On one hand, demographic variables are largely influenced by various socioeconomic factors and on the other hand they can affect the genetic composition of human population. The relationship between population growth, resource depletion and environmental degradation has been a matter of debate for decades. Demographic parameters are, therefore, very vital for understanding not only the genetic structure, but also the socio-economic condition of a population in a particular area or environment. In the present study, we are not concerned with the genetic structure of the population, but we shall look into certain socio-economic factors that may influence fertility and mortality of the population.

**Fertility and Mortality**

Fertility and mortality are fundamental determinants of population growth in order to understand the changes in the genetic structure of a population and also essential in the
understanding of human society. Fertility is a complex process responsible for maintenance of the society, while mortality determines the survival index. Fertility pattern influences the demographic profile and development status of the community. By fertility is meant the actual bearing of children (Park, 2005). Biological as well as socio-cultural factors are responsible for the differential fertility and mortality among human populations (Elizabeth et al., 2000; Emma et al., 2007; Mostafizur Rahman et al., 2008). The biological factors consist of heredity, general health conditions, age, location, sex drive, fecundability, diseases, sterility, etc. Similarly, some of the socio-cultural factors are age at marriage, absence of spouse, widowhood or widow-remarriage, polygamy and postpartum sexual abstinence during certain seasons or ceremonies and permanent celibacy by some members of the population, etc. which also affect the population growth (Reddy, 2005). Research studies repeatedly emphasize that biological and socio-cultural variables like age at menarche, age at marriage, type of marriage, economic levels, education and birth control methods have significant influence on the fertility and mortality of a population (Meerambica et al., 1999; Das and Goswami 2004; Hammami 2005; Al- Kandari 2007; Bosch et al., 2008; Koc, 2008). Along the lines of Subbarao and Raney (1995), Dreze and Murthi (2001) empirically found that female education is the most important determinant of fertility. Studies (Brookins and Brookins, 2002, Dreze and Sen, 2002; Dreze and Murthi, 2001) found the role played by female education in fertility reduction. It is also widely accepted that fertility and mortality are influenced by a large number of biosocial factors like maternal age, parity, education, religion, economic conditions and so on (Caldwell, 1979, 1982; Nag, 1981; Kost and Amin, 1992; Bicego and Boerma, 1993; Feeny and Feng, 1993; and others), in addition to conception control
practices and attitudes (Elamin and Bhuyan, 1999). For example, demographic transition from high to low levels of fertility and mortality is considered to be associated with the economic development of a population, or rising in the income of a household. However, recent studies have also suggested that the effect of economic condition is rather slow in comparison with other social variables like education, particularly female education (Murthi et al., 1995). For example, Kerala recorded the lowest fertility rate in India during the 1980s, though the per capita income in the state was lower than that in many other states. In addition, the fertility decline that is the source of the changed age structure may act directly to induce greater female labour supply (Bailey, 2006) and increase attention to primary education and health (Joshi and Schultz, 2006). The studies in Bangladesh by the World Bank (Cleland et al., 1994) have also indicated that the lower fertility in that country with low per capita income is mainly because of the efficient implementation of family planning programmes. Low income group couples shows high fertility and mortality than middle and high income group couples. The per capita annual income has considerable impact on mortality status both at prenatal and postnatal life. Mortality decreased with better income level. (Reddy and Sudha, 2010). Similarly, the effect of education on fertility rate varies from one population to another depending upon other socio-cultural factors. It was found that the acceptance of contraception increased as the age increased (Pushpa et al., 2011). Studies shows the certain positive effects of maternal grandmothers with respect to survival of offspring (Lahdenpera et al., 2004; Leonetti et al., 2005, 2007; Mace and Sear, 2005). Also, the rates of infant and child mortality have been found to be considerably higher in rural areas than in urban areas (Pandey, 2009).
Age at marriage

Age at marriage is an indirect factor which affects the rate of fertility (Reddy and Sudha, 2010). The negative effect of age at marriage on fertility has been reported in many studies (Mahadevan, 1979; Patnaik, 1981; Choudhury, 1984; Bharati and Dastidar, 1990; Freeny and Feng, 1993; Sengupta and Gogoi, 1995; Verma et al., 1999; Khongsdier, 2005c; Adhikari, 2010 and others.). Factors such as type and place of residence, religion and ethnicity have been found to be important in explaining variation in the timing of marriage (United Nations, 1990, Choe et al., 2004). Age at marriage determines the reproductive life span of women and has a direct bearing on fertility as it delays exposure to the risk of conception (Durch, 1980; Yadav and Badari, 1997). Early marriage is almost always associated with early childbearing, especially in settings such as South Asia, where marriage is virtually universal and where strong social sanctions exist against childbearing outside of marriage (Caldwell, 2005). Early marriage and childbearing have numerous negative social and health consequences; they have been identified as an abuse of girls’ human rights (UNICEF, 2001) as well as a cause of morbidity and mortality during pregnancy, labor, and delivery (Zabin and Kiragu, 1998) and of infant and child morbidity and mortality (Casterline and Trussell, 1980; Zabin and Kiragu, 1998; Ikamari, 2005). They also contribute substantially to rapid population growth (Bongaarts, 1994).

Gangadharan and Maitra (2001) find parental education to be associated with higher levels of education and later ages at marriage among daughters in Pakistan. Women with higher levels of education are able to invest more time and resources per child because they tend to have delayed and lower fertility (Hobcraft, 2000). High levels of maternal education are associated with a slower transition to marriage among daughters in rural
Bangladesh, but that the size and significance of the association diminish when the full set of covariates are included (Bates et al., 2007). Women who marry early will have, on average; a longer period of exposure to the risk of pregnancy, often leading to higher completed fertility. Zathar (1988) has observed that the “Initial rises in mean age at marriage of women to around 18 in Pakistan may lead to higher marital fertility owing to the higher fecundity and other factors which seem to lead to very spacing between consecutive births”. It is generally observed that women who marry late have significantly lower fertility as compared to those who marry at younger age (Kono, 1986; Mahadevan and Sumangala, 1987; Arora, 1990; Kinfu, 2000). Therefore variation in age at marriage helps explain differences in fertility across populations and also helps explain trends in fertility within a given population over time (United Nations, 1990; Ezeh and Dodoo, 2001). Delay in age at marriage directly affects completed fertility by reducing the number of years available for childbearing. Later marriage permits women to complete their education, build labor force skills, and develop career interests. These career interests may, in turn, motivate women to limit family size and/or widen the birth spacing (Amin, 1995; Jensen and Thornton, 2003). Anderson (1998) has shown that higher age at marriage for British women was a powerful determinant of very low fertility. A negative relationship between age at marriage in Britain has also been reported earlier by Peel (1970). A similar observation has also been reported by Freeny and Feng (1993). Increases in the percentage of births to mother under age 18 years was associated with higher neonatal mortality and increase in percentage of births to women above 35 years was associated with higher neonatal and infant mortality rates (Rutstein, 2000).
Increase in age at marriage is associated with major social-structural changes such as educational attainment, urbanization, and the emergence of new roles for single women (Lesthaeghe et al., 1989, Kaufman and Meekers, 1998). Cohen (1993) identified later marriage and greater use of modern contraception as being the driving forces behind the African fertility declines. Letamo (1996) suggests that in Botswana, rising age at marriage contributed to the fertility decline by increasing the proportion of never married women who have lower fertility compared to those married or living with a partner. As summarised by Lesthaeghe and Jolly (1995), the increase in the proportions of single women in the age-group 15–19 contributes to a lowering of overall fertility, in as much as it is only partially offset by an increase in premarital teenage fertility. Zathar (1988) has observed that the “Initial rises in mean age at marriage of women to around 18 in Pakistan may lead to higher marital fertility owing to higher fecundity and other factors which seem to lead to very spacing between consecutive births.” Any increase in the age at first marriage constitutes an important demographic event (Eltigani 2000).

It may however be noted that age at marriage is also associated with different socio-economic factors. Husain (1970) has suggested that age at marriage has an inverse effect on fertility, but educational status of the mother exerts in turn a great influence on age at marriage. Some studies also show that age at marriage is associated with socio-economic conditions thereby it is difficult to assess its direct impact on fertility (Gulati, 1969, 1988). Nevertheless, it is obvious from the findings on other populations that age at marriage has significant inverse association with fertility rate. In the North-Eastern region, the age at marriage was found to be relatively high whereas it was relatively low in the central region because of the influence of Hindu culture (Sinha, 1986). It was
further observed from research investigations that the frequency of abortions, miscarriages, and still-births were found to be much higher in younger mothers below the age of 19 years. The major life threatening complications for very young mothers were pregnancy induced high blood pressure, anaemia and difficulty in delivery due to disproportion between the pelvic-size and the head of the baby.

Many studies conducted in India have also revealed that fertility rate declines with the increasing mean age at marriage (Agarwala, 1962; Driver, 1963; Gulati, 1969; Raman, 1973; Patnaik, 1981, Bharati and Dastidar, 1990; Verma et al., 1999; Khongsdier, 2005; and others). Women getting married at an early age naturally experience more years of reproductive span and tend to have more children when they reach menopause. The reverse is true for women getting married at a later age (Sharma and Abdul, 1990; Muthrayappa, 1998). Syamala (2004) suggested that postponement of female age at marriage to 20 years delays the onset of childbearing. Chaudhury (1984) pointed out that age at marriage is of the most important variable affecting fertility behaviour. According to him late age at marriage can affect cumulative marital fertility by shortening the duration of marriage within the reproductive span. A number of studies conducted in different parts of the world have also revealed the influence of maternal age at delivery on the health and survivorship of children (Stockel and Chaudhury, 1973; Adlakha, 1973; Feeney, 1980; Hobcraft et al., 1985). It is suggested that very young mothers are likely to have chances of pregnancy related complications, and she may not be able to provide good care for the infant. Women who give birth or become pregnant before they attain full physical growth tend to have greater risk of complications during pregnancy or child birth (Govindasamy et al., 1993), whereas children born to mothers
aged 35 and over are likely to have elevated risk of mortality because risk of pregnancy complications increases with age of women due to increasing inflexibility of the female reproductive organs (Visaria, 1988; Jain, 1988). Mosley (1983) also observed that higher risk of infant death is biologically associated with child bearing at very young age. He further pointed out that maternal age is associated with higher frequency of anomalies while both extreme ages are associated with higher risk of birth trauma. Dabral and Malik (2004) in their study among the Gujjars of Delhi reported that younger married women tend to have higher infant mortality. It is also observed that younger mothers are at greater risk of pregnancy wastage, whereas babies of older mothers are at greater risk of congenital malformations. Recent studies show that as in other countries, undergoing economic development, age at first marriage has risen in India (Ravichandran, 2002; Shenk, 2008). Increased associated parental investment in child health, also leading to greater height, is expected to occur concurrently as insurance against loss (via child mortality) of educational investment (Kaplan et al., 2000). Economic development also tends to reduce extrinsic child mortality risks, and so productive delays are potentially less costly (Quinlan, 2007).

Most studies in North east India have revealed that fertility rate decreases with the increasing mean age at marriage (Khongsdier, 2005; IIPS and Macro, 2000). Barua and Sengupta (2001) reported that the mean conception and live births declines with the increase in age at marriage and the incidence of abortion and stillbirth is relatively high in mothers who got married and experience conception at relatively young age among the Ahom of Assam. It was also pointed out that higher infant mortality are associated with mothers who married at young age, decreases gradually with advancing age at marriage
up to 21 years, after that a sudden increase in infant mortality rate from the preceding category is observed. Gogoi (2002) observed that the mean number of conception and live births decrease as the age at marriage increases. Further there is an inverse relationship between the age at marriage and number of pregnancies. Mukherjee (2002) also reported the effect of age at marriage in influencing fertility rate in the population. Khongsdier et al. (2001) also revealed the influence of age at marriage on the number of live births. It may however be noted that age at marriage is also associated with different socio-economic factors. Nevertheless, it is obvious from the findings on other populations that age at marriage has significant inverse association with fertility rate. Thus, it is imperative on the part of not only demographers but also the anthropologists to look into this problem in order to have a better understanding of the fertility trend in a population.

SOCIO-ECONOMIC CONDITION

Education

Maternal education has been considered to be the most important determinant of fertility behaviour and its effect in lowering the number of children a women desire has been observed in many studies (Breierova and Duflo, 2004; Handa, 2000; Kim, 2004; Uchudi, 2001; National Research Council, 1999; Cleland and Rodrigue, 1988; Jejeebhoy, 1995; Toroitich-Ruto, 2001; Adhikari, 2010). Education, especially female education, is an essential pre-requisite of all round development of individuals towards better quality of life. Education makes a difference through a multitude of mechanisms in order to influence service use, including increasing female decision-making power, awareness of health services, changing marriage patterns, greater self-confidence and creating shifts in
household dynamics. Mother’s education seems to be directly related with the health of a child (Mondal et al., 2009). Better educated women are more aware of health problems, know more about the availability of health care services, and use this information more effectively to maintain or achieve good health status. Mother’s education may also act as a proxy variable of a number of background variables representing women’s higher socioeconomic status, thus enabling her to seek proper medical care whenever she perceives it necessary (Chandrasekhar et al., 2007). It is also closely related to demographic variables and other indicators of health and socio-economic conditions of a population, or a nation as a whole. Educating girls also has a functional importance in terms of benefits for the next generation, as the socioeconomic status, actions, and choices of more educated mothers during pregnancy and child rearing can have a large impact on children’s nutritional status, well-being, and survival (Frongillo et al., 1997, Pelletier 1998; Webb and Block 2004). Educated members of society are more likely to be the agents of changes that will encourage the diffusion of an innovation such as fertility limitation (Weeks, 2002). It has been suggested by many authors (Jejeebhoy, 1995; World Bank, 2000; Ashford, 2001) that women schooling improve women’s autonomy and that this leads to lower fertility. Female education has been claimed to alter household power relations making women more autonomous and giving them greater control over various dimensions of their lives (Jejeebhoy and Sathar, 2001). This greater control could be reflected in the independent decisions educated women take in adoption of family planning. Angeles, Guilkey and Mroz (2003) examined the relevance of increases in female education as a driving force for lower fertility. They suggested that many women with higher levels of education were likely to have low fertility. However,
in the case of the matrilineal Khasis, although high female autonomy does empower women to take decisions on their own, especially decisions regarding their own health care and reproduction, but this does not necessarily mean that these decisions will reduce family size. The study suggested that social norms and values in the traditional tribal societies wield a stronger influence than individual values in determining the fertility behaviour in those societies (Saikia et al., 2001). Education can affect preferences for fertility timing and outcomes, raise female autonomy, increase contraceptive use and raise the opportunity costs of childbearing (Jejeebhoy, 1995; Kravdal and Rindfuss, 2007; Skirbekk et al., 2004). Jain (1981) and Gustavsson (2006) argued that education can reduce fertility strongly if opportunity costs increase with schooling, which for example could be the case when labour force participation rates correlate with educational levels.

Scientists focusing on cultural issues often interpret fertility differentials among women at different educational levels as a consequence of the greater range of possible lifestyles and other choices increasingly available to women with greater educational attainment (Lesthaeghe, 1983; Van, 1987; 1996; Surkyn and Lesthaeghe, 2004; Lappegård, 2002). It is also argued that women lower their preferences for children as they proceed with their education (Rindfuss et al., 1996) and thus a higher rate of childlessness among more educated women, which in part can be attributed to their longer stay in education. Empirical studies (Rindfuss and Bumpass, 1976; Rindfuss et al., 1980; Kravdal, 2001; Gustafsson, 2001) have found that prolonged education may therefore lead to a postponement of childbearing to a later age, when biological factors may make it more difficult to conceive. Also the desire for having children is likely to decline when women have greater range of options (Jan et al., 2006). The fertility levels
of any population are very much influenced by the levels of childlessness (both voluntary and involuntary) in the population and it plays an important role in determining the levels and differentials of fertility (Roberts, 1972). The evidence in the past has suggested that the decline in impaired fertility leads to an increase in the Total Fertility Rate (Larsen, 1996). Education, especially female education, is an essential pre-requisite of all round development of individuals towards better quality of life.

Female education is believed to have a great influence on the maternal and child health as it enhances the knowledge and skills of the mother concerning age at marriage, contraception, nutrition, prevention and treatment of diseases (Mosley and Chen, 1984). This also means that the higher infant and child mortality rates among the poorly educated mothers are due to their poor hygienic practices and lack of connection with the modern medical facilities. Moreover, maternal education is related to child health because it reduces the cost of public health programmes relating to information on health technology, increases household income and productivity of health inputs (McIntosh and Finkle, 1995). Thus it is suggested that the best health development agenda for the developing countries is to increase investment in formal education, particularly female education (Caldwell, 1979, 1982; Cochrane, 1983; Bicego and Boerma, 1993). In fact, the 1994 International Conference on Population and Development (ICPD) in Cairo has strongly recommended that all countries should take immediate steps to achieve the goal of universal primary education before the year 2015, and to ensure that girls and women should get the widest and earliest possible access to secondary and higher levels of education (McIntosh and Finkle, 1995; Knodel and Jones, 1996). It is argued that about 75 per cent of 960 million illiterate persons in the world are women. India is one of the
best examples of such a country with sex disparity in literacy rate till the last census, despite research evidences of the important role of female education in regulating demographic transition and other socio-economic parameters. Besides, several studies have revealed that female education is more important than paternal education in exerting a negative effect on fertility, though the influence of the latter is also significant in certain studies (Murthi et al., 1995). Khongsdier (2003) has summarised the following reasons why female education is expected to reduce birth rates: First, educated women are likely to have more voice with regard to lightening the burden of repeated pregnancies because they have more control over household resources and personal behaviour. Second, educated women are likely to be less dependent on their children as a source of social status and old age security, thereby leading to a reduction in a desired family size. Third, educated women have higher aspirations for the better achievements of their children, which is conducive to a reduction in a desired family size. Fourth, educated women often have a higher age at first marriage, which is in turn affecting fertility rate. Fifth, educated women often have higher rate of adoption of family planning method, despite certain contradictory results.

Although the relationship between fertility and level of education varies among countries and it is not always linear or monotonic, women with more than primary education have substantially lower fertility than women with no education in all surveys (Jejeebhoy, 1995; Rutstien, 2003). This relationship is associated with other factors such as family income, rural-urban residence, and husband’s education. After controlling for such factors in multivariate analyses, the effect of wife’s education remains statistically significant and it is more powerful than the effect of husband’s education or the family’s
economic status (Jejeebhoy, 1995). Moursund and Kravdal (2003) concluded that women who spend some years at school will be more inclined to restrict their childbearing. They also confirmed that frequent use of contraception among women with some education reflects both a stronger desire to stop childbearing and better implementations of this intention through contraceptive use, and the higher level of general knowledge among the better educated are better able to absorb information from media, health institutions or other sources. Most women do not like to have children before the end of education, and the longer the education the later they have children. Important reasons for this is that many women prefer financial security before having children, including getting a job with long term prospects and rights for child support, as well as being able to afford adequate accommodation (Blossfeld and Huinink, 1991; Skirbekk et al., 2004). Higher education of women has also been associated with the more effective use of available contraceptives due to greater access to information and greater specialized knowledge of effective contraceptive practices, regardless of the method chosen (Kasarda, 1979; Wolfe, 1980).

Educated women may also influence other uneducated women or neighbors in the village. Kravdal (2002) also show in a recent analysis that women's birth rate was strongly influenced by the average education of other women. Such community effects had also been reported by Hirschman and Guest (1990). Analyzing the data for 22 sub-Saharan countries, Kravdal (2002) found that besides the effect of individual women’s education on fertility, there exists a spillover effect of the average educational level in a village or a community. However, he also reported that such negative effects of community education do not appear consistently when the data is analyzed for each
country separately (Kravdal, 2000). Breierova and Duflo (2004) used the Indonesian school construction program to identify the effect of education on fertility and child mortality; it shows that female education is a stronger determinant of age at marriage and early fertility than male education. Moursund and Kravdal (2003) also reported that husband's education has a much weaker effect than wife's education, especially for secondary education, and inclusion of husband's education has almost no influence on the estimated effect of the women's own education. On the whole, models that have included both partners education have suggested that husband's education is the less important (Cleland and Rodriguez, 1988), but this conclusion is not very strongly supported empirically. In a report based on Demographic and Health Survey (DHS) data for many countries, it was shown that husband's education was more important than wife's education for cumulated fertility in two of the three South Asian Countries (United Nations, 1995). An increase in a woman's marriage age may lead to a more than proportional change in her education attainment (Field and Ambrus, 2005).

Studies in India have also revealed that education, especially female education is very important factor in influencing fertility rate. Steady decline in fertility rate with increasing educational level has been reported by Driver (1963), Bharati and Ghosh Dastidar (1990) who reported the existence of negative relation between maternal education and fertility. Instances of such evidence can be seen from the state of Kerala, where dramatic reduction in the growth rate of population is achieved through cent percent female literacy and adoption of contraception. Social scientists have put forth many explanations for the spectacular decline in Kerala's fertility. Factors like high female literacy, agrarian reforms, matrilineal customs, better health and educational
facilities, government sponsored welfare measures and political consciousness are believed to be responsible for the rapid and unusual demographic transition in Kerala. The state is also known for its notable achievements in the social sector, particularly in literacy and primary health care (Sekher et al., 2001). In other words, fertility decline in Kerala is due to high literacy of women there. A very strong negative impact on fertility has also been reported by Dreze and Murthi (2001) and Bhat (2002) who showed that the expansion of education has been responsible for a considerable part of the country's recent fertility decline. However, Bhat's study also demonstrated that the decline in fertility within each educational group and especially among the uneducated has been much more important than the decline associated with the increase in educational level. Better-educated couples are more likely to know about and use of contraception, and they tend to have smaller families than people with less education. In addition, women's education contributes to lower infant mortality besides its influence on fertility behavior (Sudan, 2004). Das Gupta (2004) suggested that educated women not only gets more exposed to new ideas and innovation but tends to have more favourable attitude towards them as well. Education also generates higher ambitions, desires for upward mobility as well as economic and social freedom which are responsible for a small family. Apart from all these, education also affects other determinants of fertility (Singh, 1990; Singh et al., 1993). It is positively related to age at marriage and further it improves condition of infant and child survival, effects family size, preference and the structure of demand of child and enhances contraceptive practices. Education also opens economic opportunities for women; it is also expected to create greater intimacy between spouses and better communication between them, which includes matters relating to family planning. It is
interesting to note that, even a small amount of education has significant negative effect as far as higher number of births is concerned (Singh et al., 2002). Educated women are more likely to be aware of their family size and they know consequences of more births on their health and burden of increased cost of children. Husain (1970) also has suggested that parents with higher educational status are likely to limit their family size as they are more aware of the socio-economic and well-being of their children. However, there is still little quantitative evidence in support of a strong mediating factor between education and fertility which has not been convincingly established (Basu, 1996). The effect that is estimated may capture also the effect of her husband’s education, which may operate through many of the same factors as her own education given that husband’s and wife’s education are positively correlated (Basu, 2002).

Like fertility, infant mortality is also influenced by a number of factor such as parents education particularly that of mothers (UN, 1994; Bhasin and Kshatriya, 1990; Hobcraft et al., 1984; Mahfouz et al., 2009). Maternal illiteracy was reported to be associated to higher offspring mortality in developing countries (Hussain et al., 2001). Several studies have also suggested that child mortality in developing countries is associated more closely with maternal education than with any other socioeconomic factor (Behm, 1983; Hobcraft et al., 1984; Caldwell et al., 1990; Gupta, 1990). Some studies have suggested that maternal education is associated with greater emphasis on child quality i.e. being healthier, better educated, more affluent, and emotionally better developed (Levine et al., 1991). A number of researchers (Hobcraft et al., 1984; Pandey et al., 1998) have noted that even a small amount of education is usually associated with improved chances of child survival and that gains generally increased with higher levels
of education. It has also been suggested that the best health development agenda for the developing countries is to increase investment in formal education, particularly female education (Cochrane, 1983; Bicego and Boerma, 1993). Maternal education is related to child’s health because it reduce the cost of public health programmes relating to information on health technology, increases household income and productivity of health inputs (Mckintosh and Finkle, 1995). A number of researches augmented direct causal relationship between mother’s literacy and infant mortality. However, there are some studies which revealed that mother’s education is just an indicator of socio-economic factors that affects the infant mortality directly (Koenig, 1992; Khasakhala, 2003). Maternal education child survival relationship has been found to be weak in Sub-Saharan African countries (Hobcraft, 1993). In developing countries like India, mother’s education has been considered to have a strong effect on mortality of young children (Das and Devamoni, 2003; Khasakhala, 2003; Rama Rao et al., 1997). Educated mothers are more likely to ensure healthy environment, nutritious food and they have better knowledge of health care facilities for their children. As a result, literate mothers give birth to healthier babies because they themselves tend to be healthier than the mothers who are not educated, and they are likely to experience lower mortality among their children at all ages. Mothers empowered with education are more likely to perceive their children’s illnesses and seek healthcare (Pokhrel and Sauerborn, 2004).

In North-east India, few studies have been carried out on the effect of education on fertility and mortality rates (Khongsdier, 1993; Sengupta and Gogoi, 1997; IIPS and Macro, 2000; Singh, 2006 etc.). Barua and Sengupta (2001) reported that fertility level declines considerably with an increase in the educational level of
the mother. Similarly, Singh (2006) reported inverse relationship between fertility and educational level in Manipur. According to him, higher the literacy rates lower the number of live birth and illiterate mothers have highest average number of live births. Rajan and Nair (2000) also link high fertility and mortality to low levels of female literacy and educational attainment. It is also observed that infant and child mortality rates are lower for households with higher levels of education. High influence of education on fertility is also reported by Gogoi (2002). Education may also affect fertility through the use of contraceptive methods. NFHS (1998-99) has revealed that the pattern of use of different contraceptive methods varies substantially by education at the state level (IIPS and Macro, 2000). The survey revealed that the current contraception use increase with the rise in educational level of women in every state. Among the Lois of Manipur, Chanu (2007) reported that mothers without education or with lower educational levels are likely to have a higher prevalence of reproductive wastage. Gangte (2009) also reported that maternal education is important in regulating fertility differentials. The findings of the National Family Health Survey (NFHS, 1999) have revealed that education of the mothers are inversely related to fertility and mortality rates in some states like Mizoram, Arunachal Pradesh and Tripura, though it is not clearly perceptible in the states of Meghalaya and Nagaland. In Meghalaya, a recent micro-study among the War Khasi has indicated that education has no significant effect on the fertility after controlling other factors like maternal age and household income (Khongsdier, 2002). Mukherjee (2002) also observed that education of mothers does not play a significant role in regulating the fertility rate among the Muslim and Christian Khasis, although it is important among
the Niam Khasi women. However, Gangte (2009), found a close relationship between education of both maternal and paternal on fertility.

Economic Condition

It is theoretically believed that economic development is associated with the decline in fertility and mortality rates (Guzman, 1994; Pritchett, 1994). Recent studies in China and Taiwan have clearly indicated that the decline in fertility rate is associated with the economic development in these two countries (Poston, 2000). In fact, many studies have revealed that economic variables like household income and occupation are negatively associated with fertility rate in many developing countries (Mahadevan, 1986; Kost and Amin, 1992; Bicego and Boerma, 1993). Low income group couples shows high fertility and mortality than middle income group couples (Reddy and Sudha, 2010). A women’s fertility behaviour depends on the household’s economic status as indicated by the couple’s participation and positions in the labour market. For a woman, her status is influenced both by her husband’s and her own position in the productive process and earning structure of the society (Uchudi, 2001). Employment influences fertility through delaying marriage, increasing opportunity costs of women’s time within marriage, and increasing the cost of children as aspirations increase (Diamond et al., 1999). Employment in the market also brings women into contact with new role models and new ideas and values that enhance a women’s self-worth and autonomy and exposes them to knowledge of women with small families and practicing modern family planning (Uchudi, 2001). In Bangladesh, low socio-economic groups were more likely to adopt sterilization as compared to high socio-economic groups and women who have professional jobs are more likely to use periodic abstinence (Kamal et al., 2007). Studies
also showed that the use of contraceptives increases as household income increases (Khan and Khan, 2010). Billari et al. (2000) reported that employment hastens a man’s marriage but delays that of a woman, because once married a wife has to undertake nearly all the housework and childcare, this makes it hard to work and have a large family. Empirical evidence shows that women committed to continuous employment are more likely to delay the onset of childbearing compared to their non-working counterparts (Dewit, 1991). Besides bringing women into the economic mainstream, participation in the paid labour force gives women prestige and security in the family and the community. By this standard, economic visibility is a crucial measure of progress for woman. It has also influence on family size, though the link varies according to occupation. Mother’s occupation is also associated with nutritional status of their children (Mondal et al., 2009). Mother’s occupation outside the home provides exposure as well as interaction to acquire knowledge and develop self confidence among women to take decision (Buvinic et al., 1992). Retherford et al. (1996) also suggested that many of the more important value changes affecting fertility are bound up with major educational and job gains by women, which have led to greater economic independence and increasing emphasis on values of individualism and equality between the sexes. The empowering effects of employment for women are likely to depend not only on their nature of occupation, but also by the continuity of their workforce participation and the extent to which they earn and control their income. Thus, it is argued that women who work at a regular are more likely to be empowered than those unemployed women (Sen, 1990; Mahmood and Jhonson, 1994). However, there is evidence that the decision to have a
second child depends less on the wife's characteristics as compared to those of the husbands (Kreyenfeld, 2002).

Studies in India also show that women, who were engaged in professions and higher jobs, had significantly lower fertility than those who were either unemployed or lowly employed (Desai and Jain, 1994; Bardhan, 1985). A study on the relationship between women's occupation and fertility patterns by the United Nations Population Division, based on the findings of the World Fertility Survey, suggests that “women who work in the modern sector tend to have lower fertility than women who work in the traditional agricultural sector and women who do not work” (Sudan, 2004). Das Gupta (2004) also observed that women, who are engaged in highest occupations such as professions, tended to reproduce lesser number of children because their roles as professional women come in direct conflict with that of their role as a mother. However, there is also considerable literature suggesting that standards of living as reflected in basic measures of social welfare like level of education and health care can be more relevant to fertility than the degree of economic prosperity and modernization (Freedman, 1982; Malhotra et al., 1995). Jain (1975) also suggested that effect of income particularly that of occupation on fertility is “fragmentary and inclusive”. Thus, it is necessary to carry out further studies on the relationship between fertility and economic condition of the populations especially in Northeast India where there has been a lack of such studies (NFHS, 1999).

With respect to mortality, improvement in socio-economic status such as income and occupation is generally considered to be essential for improvement in children's health condition, thereby reducing infant and child mortality (Wagstaff, 2000).
Household income may serve as an indicator of children’s consumption of goods and services that affect their health. A higher household income is expected to be associated with low child mortality risks. This assumption is based on the premise that children in higher income households will consume more health enhancing goods and services per capita than will children in lower income households. Among the economically advantage populations of all countries, infant and childhood mortality rates are generally lower (Kuate Defo, 1994). A low income groups are also believed to have lesser resources to combat illness and environmental hazards resulting in higher infant mortality. This association is well documented (United Nations, 1985; Das Gupta, 1990).

It is reported that infant and child mortality has been declining in many developing countries from the mid 1980s and throughout the 1990s. Rutstein (2000) suggested that such a trend in infant and child mortality is no doubt associated with improvement in socio-economic status along with the improvement in a number of factors like nutritional status, environmental health condition, breastfeeding and the use of health services. The relatively few studies focusing on the relation between infant mortality and income at the household level in developing countries found consistently negative associations. It may also be mention that these studies vary only in terms of explanatory powers attributed to income in relation to other factors (United Nations, 1985). Despite the availability of numerous studies of the relationship between income and mortality, the interpretation of such relationship is not straightforward.

In India, it is also suggested that income is an indicator of children’s consumption of calories and nutrients, and the accessibility to health care facilities (Pandey et al., 2004). On the other hand, children born in households belonging to lower standard of
living index are more likely to have higher exposure to diseases than those born in households with higher standard of living. However, Murthi et al. (1995) have suggested that the relationship between mortality and poverty may deserve careful examination. They have observed that the association between poverty and child mortality is rather weak in India. “The question remains whether poverty has a strong effect on mortality or fertility after controlling for other explanatory variables”. The general opinion is that infant and child mortality is associated with many socio-cultural and environmental factors (Mosley and Chen, 1984). The above suggestion given by Murthi et al. (1995) may be taken into consideration with a view to having a better understanding of the effect of family income on infant and child mortality.

In North East India, Singh (2006) reported that women engaged in manual labour work give birth to higher number of children, however, among the labours, those engaged in agriculture give birth to highest number of live births. He further pointed out that the prevalence of highest fertility among the labours is due to the reason that they need more working hands and children become assets for them. Mukherjee (2002) observed that the mean number of live birth tends to decrease significantly with the increasing of income level of the mother for all the religious groups. Such a trend is also observed among the Lois of Manipur (Chanu, 2007). It was reported that the effect of household income on live births is significant even after adjusting for other factors and this significant effect of the household income on fertility rate is likely to be related to the contention 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 such facilities (Mukherjee, 2002; Varte, 2006). NFHS (1998-99) pointed out that contraceptive use increases with the rise of the standard of living index in every state of Northeast India (IIPS and Macro, 2000). In the study among the Lotha of Nagaland it is mentioned that the infant mortality rate deceased with increasing in income level (Murry et al., 2005). Hemam and Reddy (1998) also observed that high-income group had considerably lower child mortality in all the three subsistence categories, indicating reduction in child mortality with improvement in household income level. In Northeast India there has been lack of information about such type of study except those given by the IIPS and Macro (2000) and few researchers (Sengupta and Gogoi, 1997; Singh, 2006; Saikia et al., 2001; Khongsdier, 2002).

PHYSICAL GROWTH

Human growth studies have been an essential part of anthropological research since the birth of the discipline itself. Growth assessment best defines the health and nutritional status of children, because disturbances in health and nutrition, regardless of their etiology, invariably affect child growth and hence provide an indirect measurement of the quality of life of an entire population (De Onis et al., 1993). Early anthropologists, especially Franz Boas are well known for their contribution to growth studies. Growth is defined as a regular process of quantitative increase in size or mass of different tissues and organs of the body especially from conception to adulthood. For example, the growth in height and weight can be measured from one age group to another or the number, weight and size of cells can be used to measure the growth of body organs like liver and kidney from one stage to another. On the other hand, Development consists in the “progression of changes” in form and function, thus, it can be defined not only as a
change in functional capacity due to increase in size or mass, but also as a unified network of the differentiation and modification that translates a single fertilized egg into a complex-multicellular individual of mature state (Bogin, 1999). For example, the development of skills and functional capacity to stand up and walk on two feet due to increase in size of locomotion parts of the body, or the development of an embryo into fetus, or the development of reproductive organs plus their functions, and so on. Thus, according to Bogin (1999), development refers to the “progression of changes, either quantitative or qualitative, that leads from an undifferentiated or immature state to a highly organized, specialized, and mature state.”

The study of human growth is also essential to understand not only the health and nutritional status of a population, but also the interaction between biology and culture. For example, the pattern of human growth is indirectly influenced by several socio-economic factors through their direct influence on nutrition and infection. Several studies have revealed that children belonging to different socio economic groups have shown differences in their growth pattern (Tanner, 1962, 1966; Garn, 1966, 1980; Eveleth and Tanner, 1976; Frisancho, 1978; Musaiger et al., 1989; Hazzaa, 1990; Terrell and Mascie-Taylor, 1991; Hauspie et al., 1992; Misuraca et al., 1995; Edward et al., 1996; Russo and Toselli, 1997; Das Gupta et al., 1997; Milani et al., 1999; Reddy and Rao, 2000; and many others).

Nutrition

Eveleth and Tanner (1990) have shown that populations living under chronic low dietary intakes have a pattern of growth characterized by (1) slow growth during childhood and
adolescence, (2) late adolescence growth spurt and (3) a prolonged period of growth. Adequate nutritional intakes are generally considered to be necessary for normal growth and development as well as for prevention of deficiency diseases (Mitchell et al., 1976; WHO, 1986). Inadequate intake of protein and other nutrients during the preschool age period had an adverse effect on the child, leading to retardation in both physical growth and mental development (Jelliffe, 1966; Galler et al., 1990; Stinson, 1998). In Kenya, Ogeri (1975) has suggested that malnutrition, particularly protein calories, is a common cause of poor growth in preschool children. Hertzig et al. (1972) have observed through a controlled study of children in Jamaica that malnourished children were shorter, and had lower intelligence and smaller head circumference than controlled children in the same school or their sibs. In fact, small body size of children in developing countries is largely due to effects of poor diet and frequent infection (Martorell and Ho, 1984).

Greulich's (1957) study on Physical growth and development of the American born and the native Japanese children has revealed that those children brought up in the United States were taller and heavier than their counterparts in Japan because of improved standard of nutrition and physical environment. Data from Malaysia (Chong et al., 1984) have also shown a positive effect of protein energy malnutrition on growth pattern of the pre-school and primary school children. In Nigeria (Antinmo and Hart, 1980; Nnanyelugo, 1983) have indicated that malnutrition in primary school children could be attributed to low nutrient intake, low socio economic conditions and unfavourable environmental factors. Lampl et al. (1978) have reported that among the New Guinean school children, protein supplement has contributed largely to a faster
growth and malnutrition. Similar observation has been made by Addo et al. (1988) while studying the school children of Nigeria.

Turning to Indian situation also, Rao (1961) pointed out that the pattern of growth was strongly influenced by dietary intakes. Easwaran et al. (1972, 1974), observed that boys and girls in the ‘better fed’ groups were heavier and taller than those in ‘poorly fed’ ones. Bisai et al. (2011) found that the prevalence of underweight was significantly found to be higher in boys than in girls. In India and most developing countries, undernutrition is prevalent in almost all the states in India and reports have stated that it has risen in recent years (Chatterjee, 2007; Som et al., 2006.). Recent studies have studied the problem of undernutrition among rural children in different parts of India (Rajeram et al., 2003.; Medhi et al., 2006.; Bose et al., 2007.; Mitra et al., 2007.; Tiwari et al., 2007.; Das and Biswas 2005; Griffith and Bently 2001; Malhotra and Passi 2007; Singh et al., 2006; Vashisht et al., 2005). A study conducted by Satyanarayana et al. (1980) has indicated that the main cause of growth retardation among the pre-school boys in rural Hyderabad is nutritional deficiencies. However, it is suggested that in a vast and multiethnic country like India, the extent and type of malnutrition among children varies from region to region, depending upon the geography, socio economic factors, food habits, level of literacy, climate, and religious cultural practices (ICMR, 1972; Gopalan, 1988; WHO, 1989). In developing countries, undernutrition continues to be a primary cause of ill-health and premature mortality among children in developing countries (Nandy et al., 2005).
Economic condition

Socioeconomic status plays a dominant role in determining growth and physical development of children as it has a positive relationship with nutritional intakes. Many studies have revealed the association between physical growth and socio economic condition of a population (Garn et al., 1984; Johnston, 1986; Lasker and Mascie-Taylor, 1989; Rao et al., 1990; Terrell and Mascie-Taylor, 1991, Hauspie et al., 1992; Khongsdier, 1993; Misuraca et al., 1995; Mockus et al., 1995; Post et al., 1997; Milani et al., 1999; Bogin 1999; and many others).

Bransby et al. (1956) observed that children from homes defined as ‘poor’ were consistently smaller and lighter than those from ‘good’ homes. Some studies suggest that within a given country children from economically advanced areas are taller and heavier than children belonging to the economically underprivileged areas (Ferro-Luzzi, 1967; Ferro-Luzzi et al., 1979). In American children, height and weight were found to increase with increasing annual income or educational level (Hamill et al., 1972). In Cambodia, a study has shown that the prevalence of child stunting declines with increasing household wealth (Miller and Rodgers, 2009).

According to Tanner (1986), growth may be described as “mirror of the conditions of the society” and height as a proxy for health. It is observed that growth retardation, or delay in growth appropriate for an individual or a population, takes place even in some sections of the populations in developed countries due to deprivation, illness, psycho-social stress and increased family size (Norgan, 2000). Growth retardation due to inadequate nutrition and infection is reported to be common in developing countries especially in the early stages of growth and development. It is generally agreed,
on the basis of data from different continents, that variation in growth pattern of children in developed countries of Europe and North America on one hand and in the developing countries of Asia, Africa and Latin America on the other are mostly due to differences in their socio-economic status, and not because of genetic differences (Habicht et al., 1974, Stephenson et al., 1983; Eveleth and Tanner, 1990; Gopalan, 1992).

Abraham et al. (1975) also observed that in the United States, the boys and girls aged 1-17 years of above poverty level were taller, heavier and greater in skinfold thickness than those belonging to the below poverty level group. Rona et al. (1978) reported that children of unemployed fathers were shorter on average than those of employed ones. In England, it has been reported that children, belonging to the middle and upper classes are taller than those belonging to the unskilled working class (Goldstein, 1971). Amirhakimi (1974) conducted a study among the Iranian school children and found that the children of better economic condition are heavier and taller than those with low economic status. A similar observation has also been made by Lampl et al. (1978) while studying the New Guinean school children. Groenewold and Tilahun (1990) have observed the effect of income and father's occupation on weight for age and weight for height of Ethiopian children. A study conducted on Malaysian children by McKay (1969) has also revealed that the mid upper arm circumferences of the higher income group children are greater than those of children with lower socio economic status. In developing countries such as Bolivia, low socioeconomic status of the family, poor nutrition and vigorous physical activity are seen as major factors affecting children growth (Beall et al., 1977; Stinson, 1980, 1982; Yip et al., 1988). Post et al. (1997)
carried out a study among the high altitude Bolivian children and suggested that nutritional intake was influenced by socioeconomic status, but not by altitude.

Although many studies have suggested the positive effect of socio-economic status on growth pattern of children, there are also certain controversies which need to be better understood through further studies. For example, Rona and Chin (1982) have suggested that father’s social class and mother’s education are not related to the variation in triceps skinfold thickness and weight for height of the children. Similarly Sukkar et al. (1979) have also observed that weight and height of the children have hardly changed owing to improvement in economic condition. The rural Zapotec children living in the valley of Oaxaca (Mexico) have similar height and weight to the well nourished U.S. children (Malina and Himes, 1978). Lindgren (1976) have also found that, in Swedish urban area, the girls from the lowest socio-economic status have more weight for height than the higher strata. Mockus et al. (1995) have reported that there is no correlation between socioeconomic status and height or weight. The negligible prevalence rates of wasting and low hemoglobin levels suggests that acute undernourishment in preschool children of Libya is not related to economic deficiency but to nutritional habits on the part of the caretaker (Bredan et al., 1984). Therefore some studies have also revealed that there are less difference between socio-economic groups in respect of growth rate.

Studies using household-level data have found mother’s education to be positively associated with a number of measures of infant and child health and nutritional status (see, for example, Wolfe and Behrman, 1982; Thomas et al., 1991, Bicego and Boerma, 1993; Hobcraft, 1993; Miller and Korenman, 1994; Desai and Alva, 1998; Waters et al., 2004; Boyle et al., 2006). Results pointing to the importance of socioeconomic status
indicators such as mother's education to children's nutritional status are consistent with findings in Yip et al. (1992) that poor growth status among Asian children—as measured by low birth weight, low height-for-age, and low weight-for-height is mostly associated with nutritional and health determinants rather than genetic factors. At the macroeconomic level, higher female literacy rates are a positive predictor of lower infant and child mortality, with the implication that educating women and girls in low-income countries is associated with reduced child mortality (Bhargava, 2006). Empirical work has also shown that education can serve as a means of adopting new health beliefs, gaining general knowledge, and applying specific knowledge about health and nutritional practices that promote child health (Glewwe, 1999). Furthermore, women's education can also affect child health because more education is linked with higher household income, which in turn strengthens families' abilities to handle adverse economic or environmental shocks, finance health care needs, and afford more nutritious food. Studies have also shown that individuals that migrate from poor to developed countries are usually characterized by better growth patterns than their same-ethnicity counterparts who do not migrate (Yip et al., 1992; Duggan and Harbottle, 1996; Mei et al., 1998; Nguyen et al., 2004; Tarozzi, 2008.)

In India, some studies have shown that within the same community children from the well-to-do sections had higher values of height and weight than their counterparts in poor economic groups (Mitra, 1939; Mukherjee, 1951; Dutta Banik et al., 1970; Bharati and Basu, 1990). Rajyalakshmi (1981) has also observed that the children of higher income groups are heavier and taller than those of lower income groups. The Indian Council of Medical Research (ICMR, 1972) has also reported that height, weight,
subcutaneous tissue and other anthropometric variables are positively associated with socio-economic status. Similarly Vijayaraghavan et al., (1974) and Rao (1980) reported that the arm circumference and fat fold at triceps of Indian children belonging to low socio-economic groups were considerably smaller than those of well to do children of corresponding ages. The effect of socio-economic condition on growth pattern of Indian children also been revealed in other studies (Rao and Sastry, 1977; Satyanarayana et al., 1980; National Nutrition Monitoring Bureau, 1980; Bharati and Basu, 1990). Several studies (Chaterjee, 2007; Graitecr and Gentry , 1981; Serenius, 1988; Dugdale et al., 1994; Loka et al., 1994; Quinn et al, 1995; Mei et al., 1988.) have shown that dietary and environmental constraints are the major determinants of differences in growth performance between children of developed and developing countries.

In North-east India, many growth studies have been published for the populations of Assam (Das, 1969-71, 1972; Hazarika, 1974; Das 1973, 1974; Choudhury et al., 1992; Das and Choudhury, 1992; Begum and Choudhury, 1999; see reviews Khongsdier and Ghosh, 1998; Choudhury and Begum, 2003). Some studies have been published for other populations of Northeast India (Gaur and Singh, 1995; Talwar and Singh, 1995; Khongsdier, 1996, 1999; Singh and Singh, 2000; Khongsdier and Mukherjee, 2003a, 2003b; Khongsdier et al., 2005). Most of the growth studies in Northeast India are concerned with the physiological changes and variation between populations. Only some studies used growth as an indicator of the nutritional status, and very few studies deal with the relationship between growth and socioeconomic conditions of the populations. Recently, it has been shown that growth and nutritional status of the Khasi children was greatly influenced by economic condition and by the intermixture with other populations.
(Khongsdier and Mukherjee, 2003a, 2003b). In another study, an attempt has also been made to assess the sex differences with respect to the nutritional status in the context of patrilineal and matrilineal systems of society (Khongsdier et al., 2005). It is suggested that sex discrimination in Northeast India is not as strong as in other parts of India, although sex preference may exist in terms of lineage continuity. More growth studies are needed to carry out in populations of Northeast with a view to understanding the nutritional status of children in relation to socioeconomic condition and morbidity patterns. Contrary to other findings in other parts of India, Rao et al. (2004) based on NFHS-II data found that nutritional status of female children of North-east children have a nutritional edge over male children. Studies based on the NFHS -II shows that Meghalaya had the highest percentage of stunted (44.6%) and children with wasting (14%) in comparison with children of other north-eastern region (Rao et al, 2004).

**ADULT BODY DIMENSIONS**

Several studies have revealed the association between adult anthropometry or adult body dimensions and socio-economic conditions (Shapiro, 1939; Eveleth and Tanner, 1990; Naidu and Rao, 1994; Visweswara Rao et al., 1990, 1995; Nube et al., 1998; Reddy, 1998). For example, Rothammer and Spielman (1972) have suggested that socio-economic condition has a great influence on variation in adult body dimensions which are in turn a reflection of health and nutritional status of an individual, or a population. In India, Bharati (1989) has observed that almost all anthropometric measurements and indices considered under the study are higher in the higher income groups among the Mahishyas of West Bengal. Similarly, Rao et al. (1990) have found that both male and female adults belonging to the upper middle income group are taller and heavier than
those belonging to the lower income groups. Recently, similar observation has been made among the south Indian population (Reddy, 1998). In Northeast India, there are hardly any studies on the relationship between adult anthropometry and socioeconomic conditions (Khongsdier, 1997, 2002, 2005c). Thus, it is quite imperative on the part of physical anthropologists to carry out such a study with a view to understanding the nutritional and socioeconomic status of the different populations of this part of the country.

ADULT NUTRITIONAL STATUS AND MORBIDITY

The nutritional status of a population depends fundamentally on the interaction between genetic, environmental, and socio-political factors (Infant and Cordeo, 1997). Nutritional status is defined as the physical expression of the relationship between the nutrient intakes, or bio-availability of nutrients, and the physiological requirements of an individual (Brown, 1984). Nutritional status is the state of body in relation to the consumption and utilization of nutrients. Adequate nourishment in terms of quantity and quality is necessary for sustainable life (Kumar, 2006). According to Swaminathan (1982), good nutrition is a function of both economy and education. Ronzio (2004), revealed that women are usually vulnerable to malnutrition for both social and biological reasons, throughout their life cycle. There is an increasing interest of epidemiologists on the socio-economic inequality and its relation with health of a population. It is the most robust and well documented findings in social science (Wilkinson and Peckett, 2006). There is consistent evidence throughout the world that individuals belonging to lower SES experience higher level of morbidity (Saul and Payne, 1999; Marmot et al., 1991) and mortality (Lantz et al., 1998; Subramaniam et al., 2006) in almost every category of
disease than their better-off counterparts. It is also found that socio-economic status strongly affects health even when controlling for economic resources and access to health care (Lynch et al., 2000; Ross et al., 2000).

One of the major health problems in many developing countries is the widespread prevalence of under-nutrition and infectious diseases (WHO, 1990). Also, an increasing dual burden of under nutrition and over nutrition is being faced in many developing countries (Popkin et al., 2001). Inadequacies in nutritional intake, or under-nutrition, can be considered a major scourge of many adverse effects on growth and health of individuals (Gordon et al., 1968; Chandra and Newberne, 1977; Chen et al., 1981; Chandra, 1981, 1983; Martorell and Ho, 1984; Mitra, 1985; Mascie-Taylor, 1991; Edmundson et al., 1992). It is generally reported that the basic causes of under-nutrition and infections in developing countries are poverty, poor hygienic conditions and little access to preventive and health care (Mitra, 1985; WHO, 1990). Hence, assessment of the nutritional status of population has attracted the attention of not only the nutritionists and other biological scientists, but also the economists and other social scientists with a view to understanding the health and socioeconomic status of the population (Osmani, 1992). Nutritional status was found to be positively related with education of respondent, education of husband, household standard of living (Rout, 2009). There are various parameters for assessment of nutritional status but anthropometry is considered as one of the most reliable and practical tool to assess nutritional status (Ghosh et al., 2001, Khongsdier et al., 2005, Bhardwaj and Kapoor, 2007). Of the different methods, anthropometry is generally used for measuring the magnitude of under-nutrition both at individual and population levels. Anthropometric measurements and indices like weight,
height, mid upper arm circumference, skinfold thickness, weight for age, height for age, weight for height and indices of upper arm circumference (Jelliffe, 1966; Frisancho, 1990) are commonly used for assessing the nutritional status of children. In the case of adult individuals, Quetelet or body mass index (BMI = weight in kg/height in m\(^2\)) and upper arm muscle area are widely accepted as one of the best indicators of the nutritional status of adult individuals and/or populations (James et al., 1988, Ferro-Luzzi et al., 1992; Shetty and James, 1994). It is suggested that the BMI may be more nutritionally than genetically related (Rolland-Cachera, 1993), despite the fact that there is a wide variation between human populations in weight and height (Eveleth and Tanner, 1990; Majumder et al., 1990). Thus, the use of BMI as an anthropometric indicator of nutritional status may be more appropriate in a country with diverse ethnic groups like India (Khongsdier, 2001). It is also reported that BMI is closely associated with morbidity and mortality (Garrow, 1981, 1988; Garrow and Webster, 1985; WHO, 1990; Shetty and James, 1994; Henry, 1994). BMI is the most established anthropometric indicator used for assessment of adult nutrition status (Lee and Nieman, 2003, Pirlich and Lochs, 2001) and also found to be inexpensive, non-invasive and suitable for large scale surveys (Ferro-Luzzi et al., 1992, James et al., 1994; Tyagi et al., 2004, Sinha et al., 2007, Tungdim et al., 2008). Thus, BMI not only is widely accepted as one of the best indicator of nutritional status in adults (James et al., 1988, Ferro-Luzzi et al., 1992, Shetty and James., 1994, Naidu and Rao, 1994: Lee et al., 2003; Bailey et al., 2005) but also the socio-economic condition of a population, especially adult populations of developing countries (Ferro-Luzzi et al., 1992; Shetty and James, 1994; Nube et al., 1998; Khongsdier, 2002, Adak et al., 2006, Kapoor et al., 2009,). However, literature on
BMI of adult Indians is concerned mostly with populations in south India (Shetty, 1984; Ferro-Luzzi et al., 1992; Shetty and James, 1994; Naidu and Rao, 1994; Visweswara Rao et al., 1990, 1995; Reddy, 1998), but it was very limited in the Northeast region of the country (Bharati 1989; Khongsdier, 1997). Khongsdier (2001) used the anthropometric data published by the Anthropological Survey of India for 12 populations of Northeast India. The results indicated that the majority of adult males in Northeast India were lean or thin in body composition as indicated by body mass index. Almost all of the 12 populations are characterized by a high prevalence of chronic energy deficiency. It was also observed that the prevalence of CED was lower in the tribal populations than in the Hinduized and Caste groups. It is suggested that further researches are needed to know about the morbidity and health status of the populations in Northeast India.

Further, it has been shown that MUAC is particularly effective in the determination of malnutrition among adults in developing countries (James et al., 1994). MUAC is a simpler measure than BMI requiring a minimum of equipment and in practice has now been found to predict morbidity and mortality as accurately as deficits in weight (Breind et al., 1989). James et al., (1994) after an extensive study of 8 countries (Mali, India, Senegal, Zimbabwe, Somalia, Ethiopia, Papua New Guinea and China) suggested that MUAC could be used for simple screening of nutritional state. Several recent investigations have studied the relationships of socio-economic status with BMI and CED among different populations (Delpeuch et al., 1994; Ahmed et al., 1998; Reddy, 1998; Khongsdier, 2002; Pryer et al., 2003; Monteiro et al., 2004; Clausen et al., 2006; Mahmud et al., 2006).
As for the relationship between morbidity and nutritional status, several studies in
developed countries have revealed the relationship between obesity and
morbidity/mortality (WHO/FAO, 2003). It is also well documented that mortality risk
increases with the increase in BMI values (Garrow, 1981, 1988; Garrow and Webster,
1985; WHO, 1990). With regard to the lower value of BMI, a number of studies have
suggested the higher mortality rate in individuals with low BMI (Waaler, 1984; Harris
et al., 1993). Henry (1994) has suggested that BMI below 13.0 kg/m^2 in adult males and
11.0 kg/m^2 in adult females may be considered the lowest thresholds of mortality risk. Of
course, it has been reported that the relationship between BMI and mortality is U-shaped
(Troiano et al., 1996). However, it is not yet clear whether the BMI<18.5 kg/m^2, which is
suggested as the cut-off point for screening CED individuals (James et al., 1988; Ferro-
Luzzi et al., 1992; Shetty & James, 1994; WHO, 1995), is also associated with morbidity,
especially in developing countries. In Bangladesh, it has been suggested that morbidity
rates among adult males increases when the BMIs are below 17.0 kg/m^2 (James et al.,
1988). Using Probit analysis of data collected by IFPRI and the World Bank from four
developing countries, viz., Philippines, Kenya, Pakistan and Ghana, Garcia and Kennedy
(1994) have observed that the increase in morbidity is not consistent with the CED grades
of BMI, although it is perceptible in Pakistan. However, a report from Brazil has
indicated that there is a marked increase in morbidity among adult individuals with BMI
below 18.5 kg/m^2 (de Vanconcellos, 1994). Also, Strickland and Ulijaszek (1993) have
observed that the symptoms of self-reported illness are negatively associated with BMI
among the Iban tribe of rural Sawarak. In the Indian subcontinent, less is known about
such a relationship, although data from a South Indian population have revealed that mortality rate tends to increase with the decrease in BMI (Shetty and James, 1994).

In Northeast India, one study was conducted on the relationship between BMI and self-reported morbidity among the War Khasis (Khongsdier, 2002, 2005c). The results indicated that there was no significant relationship between BMI and morbidity, but morbidity was significantly influenced by poor socioeconomic condition. However, when BMI was separated into two components body fat mass index and fat free mass index the results indicated the significant relationship between self-reported morbidity and fat mass index but not with BMI (Khongsdier, 2005a). More studies are needed to carry out among populations in Northeast India in order to understand the relationship between anthropometric indices especially BMI and morbidity.

NUTRITIONAL ANAEMIA

Nutritional anaemia due to iron deficiency is a global problem and it affects more than a billion people in the entire world. Anaemia can occur in children, adolescent and adults, although it is more common in females. Studies show that in both men and women, the prevalence of anaemia was highest among those with severe undernutrition (ACC/SCN, 2000). In the developing world alone, 370 million women suffer from anaemia (Vijayaraghavan, 2007). Anemia is a widespread public health problem associated with an increased risk of morbidity and mortality, especially in pregnant women and young children. In the adult population, anaemia is a risk factor for cardio-vascular health and early death. In addition, it also causes fatigue and leads to negative impact on cognitive and physical functions as well as on the quality of life (Gabrilove, 2005). Most of the existing studies (Gillespie and Johnston, 1998; Toteja et al., 2006) point out that anaemia
among women causes increased risk of low birth weight, inadequate iron stores for the newborn, higher risk of maternal morbidity and mortality as well as a decline in mental concentration and physical activity. The consequences of anaemia are reduced levels of energy and productivity, impaired immune function, reproductive failure (miscarriages, still births, prematurity, low birthweight, peri-natal mortality etc.) and maternal death during childbirth (Levine et al., 1993). Numerous studies have demonstrated that anaemia is not only detrimental to the health status of women themselves (UNICEF/UNU/WHO/MJ, 1999), but it can have negative effects on their pregnancy outcomes (Allen, 2000). In both men and women, prevalence of anaemia was found to be highest among those with severe undernutrition (BMI <16 kg/m2). Among the numerous factors, both nutritional (such as vitamin and mineral deficiencies) and non-nutritional (such as infection and hemoglobinopathies), that contribute to the onset of anemia, iron deficiency and malaria play an important role (Kraemer and Zimmerman, 2010). According to the WHO Scientific Group (WHO, 1968), nutritional anemia is a “condition in which the haemoglobin content is lower than normal as a result of a deficiency of one or more essential nutrients, regardless of the cause of such deficiency.” At a global level, anemia prevalence is a useful indicator to assess the impact of widespread or highly effective interventions and to track the progress made towards the goal of reducing anemia in pregnant women and preschool children by one third that was adopted by the UN Special Session on Children in 2002 (UNCIEF, 2004). Thus, it is suggested that data on haemoglobin content are very helpful in understanding the health and nutritional status of a population (Garn et al., 1977). The WHO Scientific Group has recommended that the normal values of haemoglobin content should be 13g/dl and 12g/dl for adult males
and female, respectively. In the case of pregnant women the normal value is 11 g/dl. The
prevalence of anemia as a public health problem is categorized as follows: <5%, no
public health problem; 5–19.9%, mild public health problem; 20–39.9%, moderate public
health problem; M40%, severe public health problem (Ramakrishnan et al., 2002).

Iron deficiency is the main cause of anemia, especially in developing countries
(Khusun et al., 1999). As stated by the World Health Organization (WHO), “the numbers
are staggering: 2 billion people over 30% of the world’s population are anemic with
about 1 billion suffering from iron deficiency anemia. In many developing countries one
out of two pregnant woman and more than one out of every three preschool children are
estimated to be anemic” (WHO, 2007) It has been reported in many studies that the
differences in haemoglobin level are associated with nutrition, socioeconomic conditions,
age, sex, etc. (Vijayalakshmi and Devaki, 1976; Gam et al., 1977, Das and Mukherjee
1978; and others). Vijayalakshmi and Devaki (1976) have found higher level of
haemoglobin content among those individuals who belong to the higher socio-economic
strata than those in the lower ones. Bharati (1983) has found a similar trend in the case of
Mahishyas males of West Bengal but in case of females, the lower economic groups have
higher haemaglobin level than those belonging to the higher economic group. Das and
Mukherjee (1978) have reported that there is a gradual rise in haemoglobin level with the
rise in age of males and females.

In Northeast India, little is known about such relationship between haemoglobin
content and socio-economic conditions. One study among the War Khasi of Meghalaya
has revealed that haemoglobin level is positively associated with the economic levels
(Khongsdier, 1997).
As noted earlier, the review of related literature given above is far from being exhaustive, but it is obvious that there is an urgent need to carry out research relative to health and nutritional status of a population, especially in understanding the relationship between health and socio-economic factors. Such studies are very limited in Northeast India in general and in Meghalaya in particular.