Chapter – I

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1.1 Introduction on Growth and Development

The term ‘Growth’ refers to any change/increment in size and shape of an organ/organism; on the contrary ‘Development’ refers to change in form and functional maturation of an organ/organism. Growth studies can be used as a powerful tool as they provide enough information on the health and nutritional status of an individual or a population as a whole. ‘A remarkably high rate of low birth weight among Indian new born is determined by a major factor of maternal size. Majority of poor and rural mothers are short stature and markedly low in weight, this may be due to malnutrition, cultural influence, socio-economic factors, medical and educational factors’ (Rohdel, 1993). Physical growth and development of the child is influenced by a series of factors like race, family history, economic status, health care, nutrition, birth order, heredity, endocrine balance, emotions and so on. Growth standards for Indian children have been provided by Indian Council of Medical Research in the year 1972, which are of more than forty years old; still there is a lacuna in the Indian anthropometric data because of the change in socio-cultural and economic standards of the people from time to time. So it is the need of the hour to make a comprehensive growth study among the Indian children considering various bio-cultural aspects. Early in the nineteenth century, Villerne placed great emphasis on the poverty and under nutrition as the main determinants of growth (Eveleth and Tanner, 1976).

Growth has been defined in different ways by many scientists. The term ‘growth’ means an increase in physical size of the whole or any part of the body. According to Schultz (1956), physical anthropologists study human growth with a view to understand constantly changing ontogeny condition and their highly varying tempos at various periods of life. Being seen as a qualitative dimension of the process of development it obviously results in the increase in size (Montagu, 1960; Carter, 1980; Bogin, 1991). Growth is the increase in size of the various parts and organs of the body and this increase is limited to pre-established constitutional hereditary factors and influenced by exogenous factors (Comas, 1960; Frisancho et. al., 1973).
Garn (1952) says ‘the term growth and development as used in physical studies refer to the processes common to all living organisms, process intimately linked to time but partially independent, unquestionably genetically determined yet uniquely susceptible to environmental modification’. Many researchers studied the growth pattern of the children of different communities individually or collectively in different parts of our country as well as abroad. Tanner (1961) pointed out that ‘the growth and development occupy a central place in the study of individual differences in structure and function within human species’. It has been emphasized by many scholars that individual growth standards for each endogamous population are required because of the genetic determination of growth pattern and their modification by particular environment and nutritional habits of such populations (Tanner et. al., 1965).

The growth of individuals is to a large extent determined by their genetic potential. However, if nutritional and environmental conditions are unfavourable, the genetic potential cannot be fully developed. It is believed that under favourable conditions the growth potential of populations of young children is similar across populations. Consequently, the growth rate of a population can be used as an indicator for nutritional status (ACC/SCN, 1994). Growth is not a linear process, but different phases occur during childhood and adolescence (Karlberg et. al., 1994). Physical growth during infancy is rapid and growth rate declines with increasing age until puberty (Forman et. al., 1990; Hesse et. al., 1991; Adair et. al., 1993; Zheng et. al., 1989). Puberty starts with an increased rate of growth, and after the age of peak height-velocity has been reached, a deceleration is noted until growth ceases (Marshall and Tanner, 1986; Karlberg et. al., 1994). With respect to children in developing nations, linear growth velocity may begin to fall off as early as three months of age (Waterlow et. al., 1980; Waterlow, 1988). Use of height and weight data for comparing the nutritional status of groups of children under the age of 10 years was presented by Waterlow et. al. (1977), the recommendations are only for the analysis of data collected on a cross-sectional basis. The basic indices recommended are height for age and weight for height. In terms of centiles using standard deviation scores, Mercedes de Onis et. al. (2007) had developed a new and appropriate growth reference for school aged children and adolescents (5 - 19 years age group).
Studies of physical growth of people of different regions led to efforts to subdivide human populations into different ethnic groups or breeds that were distinct from one another since time immemorial. Stature, head form, shape of nose, skin colour, eye colour, facial characteristics, hair characters, body build, body types, etc. were all used as criteria of variations. The continental and intra-continental differentiation between two groups of population e.g. Japanese and Indians, African and Europeans, Indonesians and Polynesians, Dravidians and Indo-Aryans are striking examples. However, there are gradations of phenotypic characteristics and skin colour from intra-tropical Africa – Europe – China – India in a transitional way. Environmental factors, genetic constitution, food habits, psycho-socio-economic conditions, nutritional intake, ecological barriers, etc. are directly responsible for those transitional changes.

1.2 History of Growth and Development

Most of disciplines begin with a sort of descriptive phase. Growth and development of human being is no exception. The earliest statement about human growth appears in a Greek elegy of the 6th century B.C. when Solon (594 – 593 B.C.) in his poem dealt with the division of the human life span into successive periods each of seven years duration.

Hippocrates (b. 460 B.C.) writes in *Airs, Water and Places* that puberty is attained late in districts with a cold wind, with a water supply which is hard, old and brackish. Growth as manifested in stature and strength of the adult, the chief controlling factors are the variability of the weather, the type of country and the sort of water which is drunk. Early in the nineteenth century, Villerne placed great emphasis on the poverty and under nutrition as the main determinants of growth (Eveleth and Tanner, 1976).

Aristotle (386 – 322 B.C.) had noted that, ‘man when young, has his upper part larger than the lower, but in due course of time reverses this condition’ (*Historia animalium*, Thompson’s translation, 1910). To his opinion, ‘in about five years, the body seems to gain measurement’.
Anthropometry was born not of medicine or science, but of the arts, impregnated by the spirit of Pythagorean philosophy. Leon Battista Alberti (1404 – 1472 A. D.) and Johann Sigismund Elsholtz (1623 – 1688) began the process of measurement by making the rod of the height of the subject and from a scale. This technique presumably precluded the accurate measurement of the subjects. It was Elsholtz who invented the term ‘anthropometry’. Polyclitus, in the 5th century B. C., the founder of the Greek rule probably, made actual measurements on subjects. Leonardo da Vinci (1452 – 1519 A. D.) first time made accurate drawings of the foetus by dissecting a seven month old foetus and stillborn full-term infant without taking measurements. It was Luca Paccioli (1445 – 1510 A. D.) who rediscovered the ‘golden section’ in Greek texts and described it in De divina proportione published in 1509. With the help of Paccioli’s geometer Albrecht Durer (1471 – 1528 A. D.) devised a method of geometric transformation to rendering accurate proportions of the human head and face and also applied his method to drawings of men, women and children. This type of methodological work was an innovation in the era of human study, since most of the artists followed the techniques of Cennino Cennini (c.1400) who mentioned that women do not have any set proportion (Boyd, 1981). In his doctoral thesis De Proceritate Corporis Martin Weise (1726) had given hydraulistic explanation of growth. Later on, he too confused between catch-up growth and the adolescent growth. Martin Schurig (1656 – 1733) and Rall (1669), in De generatione animalium, were of the opinion that girl’s maturation could be accelerated by sorts of sexual encounter. Demoil (1731) believe that growth is faster and clear in hot climates.

The first longitudinal study was made by Count Philibert Gueneau de Mountbeillard (1759 – 1777) of France upon his son, and was published by his friend Buffon in his Histoire Naturelle (Scammon, 1927) and noted the seasonal variation in rate of growth. Based on the data from Mountbeillard’s son, Buffon noted the seasonal variation in rate of growth and daily variation in stature. Adolphe Quetelet (1796 – 1874) made discovery that human stature is distributed in many populations according to the law of error. Quetelet constructed (Quetelet, 1869) a table of the rate of growth from birth to twenty years and found out that the girls were taller than boys. Boas (1895) published a series of papers describing the variability in growth and rate of development between migrants to the United States and their children. He
demonstrated the importance of calculating growth velocities from the measurements of individuals rather than from sample means. With this, the modern era of growth measurements and analysis began. D’ Arey Thompson’s book *On Growth and Form* (1942) is the by product / combination of natural philosophy and geometry with modern biology and mathematics to understand growth, from evolution of plants and animals (c.f. Choudhury, 1978).

Growth in its context is the enterprise of anthropology. Therefore, it can be taken as an important manifestation of the genetic, environmental and psychological well being of a person. Study of growth pattern of different parts of human body is important for understanding the totality of human beings. Growth studies are important to assess the potentiality of health or physique as Indian population, both physically and culturally, varies from each other.

The process of growth is an intrinsic property of living organism, involving a series of changes to generate systematic changes in size and shape. These changes are manifold and complex in nature which cause broad spectrum of multidimensional modification in physique of living human being. Not a single definition of growth has been accepted ubiquitously though everyone is interested in the field of growth attempts to define and describe the same in some quantitative terms to focus on the ‘essence of growth’ particularly in terms of some anatomical and physiological changes (Dasgupta, 1988). Study of somatic or physical growth attempts to describe or measure sequences of morphological changes at successive ages within a certain environmental condition under which an individual grows up from infancy to adult size (Johnston, 1978). According to Tanner (1963) growth is a self-regulated process to the point that a conceptual model of the operation of the internal agents involved may be developed.

The infancy-childhood-puberty (ICP) growth model breaks down growth mathematically into three additive and partly superimposed components – infancy, childhood and puberty. This model represents linear growth during the first three years of life by a combination of a sharply decelerating infancy component and a slowly decelerating childhood component, the latter starting from the second half of the first post-natal year. From about three years of age to maturity, linear growth is
represented by the sum of the infancy and childhood components and a sigmoid-shape puberty component operating throughout adolescence. The mid-growth spurt, a short-lived acceleration that has been observed in about two-thirds of healthy children occurs, when detectable, at about 7-8 years of age and may be emphasized by a dip in velocity before puberty (Stanley J. Ulijaszek et. al., 1998).

Lejarraga (2002) discussed about the mid-childhood or juvenile growth spurt through the velocity curves – the plateau in growth velocity occurring between five and ten years of age is interrupted between six to eight years among both boys and girls by a growth spurt called the mid-growth or juvenile growth spurt. Horacio mentions that some authors claim that this spurt is present only in boys but Gasser, T. et. al. (1985), Molinari, L. et. al. (1980) and Tanner and Cameron (1980) found it to occur in both sexes at similar ages and magnitude. The spurt is relatively small in linear dimensions, such as height, but is larger and more pronounced in dimensions relating to volume such as weight or skinfolds.

Tanner and Cameron (1980) in their study on mid-growth spurt in calf circumference velocity among London children, illustrates clear mid-growth spurts in both the sexes and then there is only minor sex difference in the timing but not the magnitude of the mid-growth spurt

Growth, therefore, is the study of changes in organism. Growth is a complex phenomenon which is interwoven by many internal and external factors of an organism. Growth is a web of socio-economic condition, nutritional status, psychological stress, ecological barriers, environmental factors, physiological activities, health and hygiene and genetic constitution. It is a regular and gradual process. The study of growth is important from the mechanism of evolution and morphological characters which bring about changes in the pattern of body development and its structure. It also plays an important role in understanding the individual differences. Growth is generally considered to be an important tool in physical anthropology and is a good indicator of health. The body build of an individual represents the growth and development of its physique. Growth of different dimensions at different areas of the body occurs at different rates. These differential growth velocities are responsible for the change of shape from infants to the adult and
show morphologically a remarkable difference in body forms and body types in both sexes. Differential growth rates creates two forms – first the external form, through growth rates which vary from the part of the body to another and one tissue to another, and the second the internal form, through the series of time entertained events which build up in each cell the specialized complexity of its particular function (Jelliffe and Jelliffe, 1979).

Growth depending on hereditary factors is indicated by the differences found in the amount and/or rate of growth between children and adults of different nationals or geographic backgrounds living in the same or very similar environments. The genetically control of body shape is much more rigorous than that of size (Tanner, 1978). Stern et. al. (1975) reported that genetic factors contributed to the difference in height between the Mexican-Americans and white American adults living in three northern California communities and found that the former were significantly shorter than the latter.

Population differences in body size including variation in amounts and rate of growth are due to wide range of hereditary and environmental factors (Comas, 1960; Frisancho et. al., 1973; Tanner, 1978; Garn, 1980; Bogin, 1991), not acting singly but interacting largely so that genetic factors may predispose an individual or group to have greater sensitivity to some environmental factors that may not affect other children in the same manner. Ashcroft and Lovell (1964) and Ashcroft et. al. (1966) reported that the Chinese children from four to seventeen years of upper middle to upper socio-economic status were significantly shorter and lighter than the children and youth of European, African, Afro-European, living in Kingston and Jamaica. Rona and Chinn (1986) studied both the children aged 5 to 11 years of Afro-Carribean, Indian-Pakistani and European belonging to low socio-economic status in England and found that the Afro-Carribeans were taller than the national sample of the British children, whereas the Indian-Pakistani and European children were shorter than the national sample. In England the population differences in height for children of lower socio-economic status have shown parallel values for the average height of Africans, Europeans and Asians living on their native continents (Eveleth and Tanner, 1976). This suggest a major hereditary differences of stature between human groups in the average value for size, body proportions and body composition are due to an interplay between genetic and physical growth and development.
According to Bogin (1991), the environmental factors influencing human growth and development are – nutrition, altitude, climate, migration, and urbanization and socio-economic status. Montagu (1960) is of opinion that the environment is a complex condition, each of the condition acting with different degrees of intensity upon the organisms at different times. According to him, an individual is exposed to five different factors – genetic, development during maternal uterine environment, family environment, socio-economic conditions and physical environment.

The physical dimensions of the body are much influenced by nutrition particularly in growing children. Nutritional anthropometry is concerned with the measurement of the variations of the different dimensions and composition of the human body at different age levels and degree of nutrition. Selected body measurements can, therefore, give valuable information concerning certain types of malnutrition in which body size and body composition are affected.

Body composition attributed to assess general health of any individual is commonly studied from the point of epidemiological, clinical and population studies. Therefore, study of body fat and fat distribution is important to evaluate the pattern of nutrition of population. Earlier investigations have emphasized the accuracy of newer method using different techniques for measuring body composition, however, anthropometry is still the most widely used method and it has recently been used to estimate fat distribution (Goran et al., 1998; Moreno et al., 1997; 2001, 2002; McArdle et al., 1986; Bolzan et al., 1999; Musaiger, 2000).

Studies on anthropometry especially measurements of fatness and body composition among children in India are limited. Weight, height, body mass index are the common indicators usually used to assess nutritional status of the children (Naidu and Rao, 1994; Reddy, 1998; Zsoffay et al., 1998; Vishweswar Rao et al., 1991; Khongsdier, 2001; Talwar and Maninder, 2001; Gaur, 2002; Urade et al., 2004).

For better interpretation of growth and body composition, arm areas and indices are used (WHO, 1986; Malina et al., 1988). Body mass index (BMI), per cent body fat (per cent BF), upper arm fat area (UAFA), upper arm muscle area (UAMA) and sum of skin fold thickness are responsible indicators of adiposity in
adults and children (Moreno et. al., 2002). BMI, triceps skin-fold and upper arm fat area are indicative of the child’s calorie reserves (Cole, 1986; Rolland-Cachera, 1993). Anthropometry has been used to estimate fat distribution (Goran et. al., 1998; Moreno et. al., 1997, 2001). BMI is positively correlated with weight, triceps, MUAC and UAFA (Garn et. al., 1986; Young and Sevenhuysen, 1989; Deurenberg et. al., 1990; Rolland-Cachera et. al., 1991; Walker et. al., 1996). Upper arm muscle area was employed by several authors to evaluate organic protein pool (Frisancho, 1974; Sann et. al., 1988; Bagenholm et. al., 1990; Hall, 1990; Daley et. al., 1994; Urade and Chakravarthy, 2012).

Effects of malnutrition on anthropometric measurements are demonstrated in the lower weights and heights of European school children in Paris (Gounelle et. al., 1942; Laporte, 1946), when the dietary restriction was put after the war. Conversely, due to improving nutrition, the stature and weight of the children and adults have increased progressively over the past hundred years in both North America (Meredith, 1941) and Europe (Clements, 1953) and recently in Japan (Mitchell, 1962) and Jamaica (Ashcroft and Lovell, 1964).

Growth and physique can also be affected by bacterial, viral and parasitic infections. One of the principal forms of severe protein-calorie malnutrition of early childhood is called kwashiorkor. This condition is almost never exclusively dietary in origin, but rather the result of other cumulative stresses as well, including the nutritional ill-effect of intestinal helminthes, bacterial and viral infections (such as T. B., whooping cough and measles), persistent malaria and psychological trauma associated with weaning (Patton et. al., 1963).

Pre-school children are more sensitive to environmental insults than school children (Scrimshaw and Behar, 1965; Stini, 1971; Yarbrough et. al., 1975). Environmental stress particularly nutritional deficiencies and associated infections reduce childhood growth rates and delays maturation (Eveleth and Tanner, 1976). The WHO (1986) stated that a deficit in growth is not necessarily the most sensitive indicator inadequate nutrition. Malnutrition has been defined as a pathological states resulting from a relative or absolute deficiency or excess of one or more essential nutrients (Jelliffe, 1966). Gupta (1991) stated that the problem of malnutrition always comes in conjunction with physical, socio-cultural and socio-economic factors. Gopalan et. al. (1971) says that the malnutrition aggravates the clinical course of
many infectious diseases. Malnutrition during infancy and early childhood is believed to have long term repercussions on both physical growth and intellectual performance in later life (Stoch and Smythe, 1976; Srikantia and Sastry, 1972; Cravioto and De Licardie, 1979). Under nutrition continues to be a cause of ill-health and premature mortality among children in developing countries like India (Yadav et. al., 1999). According to Choudhury and Rao (1984), non-nutritional factors too have an important role in mental performance of children.

Questions have frequently been raised about the validity of the US based NCHS reference standards for populations from other ethnic backgrounds. Available evidence suggests that until the age of approximately 10 years, children from well-nourished and healthy families throughout the world grow at approximately the same rate and attain the same height and weight as children from industrialized countries. The NCHS/WHO reference standards are available for children up to 19 years old but are most accurate when limited to use with children up to the age of 10 years (Cogill, 2003).

Because of the extreme genetic diversity of the populations and disparities of socio-economic conditions, the children from different geographical region, various social classes and different ethnic groups should not be included in a growth study (Garn, 1958). He suggests the inclusion of genetically uniform subjects and controlling of nutrition by limiting the study to a particular socio-economic group. This might help in bringing out the sharpness of changing rates and pattern of growth even from a cross-sectional study. Tanner (1973) is also of the same opinion that in countries where the population is not genetically homogeneous, social class and ethnic origin are related and malnutrition is rampant, standards should not be constructed from a random sample of the population but it should be based on a sample of the population that is environmentally fusing the best since these individuals represent the currently attainable ranges of desired norms for the population as a whole. He also suggested for having standards separately for each ethnic group. It has been emphasized that individual growth standards for each endogamous population are required because of the genetic determination of growth pattern (Tanner, 1977) and their modification by particular environment and nutritional habits of such populations (Roberts, 1960; Prader et. al., 1963; Tanner, 1966; Garn and Rohamann, 1966; Hiernaux, 1968). Thus growth studies have an important place in the study of individual differences in from and shape.
Hereditary influences on growth cannot be denied and thorough study is needed to establish this fact. To support this, Vandenberg and Falkner (1965) have suggested that the hereditary influence appears to be of greater importance for decelerations of the growth rate but not statistically significant for the initial status. A relative effect of genetic constitution, ethnic composition, hormonal and climatic conditions on children’s growth remains to be studied on homogeneous population from small area (c.f. Urade and Chakravarthy, 2012).

1.3 Review of literature

Growth pattern of the children of different communities individually or collectively in different parts of our country as well as abroad was studied by many researchers.

The pattern of growth curves reflects accelerated growth at early childhood and at adolescence followed by a period of slow rate of increment (Boas, 1930, 1932; Barker and Stone, 1936; Garn, 1957; Krogman, 1941; Meredith, 1935; Sontag and Reynolds, 1944; Tanner, 1962, 1963 and others). Hooton (1932) describes this as a rhythm of growth with a wide variation of individuals and groups. The differences are more marked during the period of adolescent spurt beginning in boys at about 11 years and in girls about 9 years of age.

Some of the researchers have reported the detailed studies on male puberty and growth (Ellis, 1946; Schonfield, 1943). Mills (1942) and Ellis (1950) pointed out that pubescent and adolescent growth seems to be faster in temperate climate and retarded in warm and moist tropical Africa. Michelson (1944) and Hogben et. al., (1948) were of opinion that the ethnic differences in rate of growth are different in similar socio-economic and climatic conditions. Secular trend in adolescent growth suggested by Mills have been supported by Tanner (1962, 1969) stating that the children with earlier adolescence are heavier and taller in Europe and America for last 105 years, but the trend is less clear in the male. Takahashi (1984) had shown a depression of growth in Asia during Second World War. Mavesh (1972) failed to show a secular trend of earlier maturation.
According to Kaul and Nyamongo (1990) there are several factors responsible for growth variation; they are for instance hereditary factors, environmental factors, and factors influencing nutritional status with reference to traditional diets. The environmental factors strongly regulate growth in body size and composition and the rate of biological maturation (Fiawoo, 1975; Malcom, 1975 cited by Samvit, Kaul and Nyamongo (ibid.). However, in contrast, genetic determinants of body shape and proportion are reported to be more resistant to the environment; while environment components pertaining to growth with reference to shape can be demonstrated, as the body proportion of some ethnic groups seem to maintain themselves across a range of environmental conditions. To portray the importance of environment, several studies have been made using different designs. Habicht et. al. (1974) being one of the earliest analysed the differences between mean height and weight of pre-school children from a number of published studies.

Johnston et. al. (1976) reported on a longitudinal analysis of the growth in height of a sample of Guatamelan children. All subjects were from the highest level of Guatamelan society. The sample was sub-divided into individuals of Guatamelan ancestry and those of the European and North American heritage who lived in Guatamala for their primary and secondary school years. A third group, taken from literature, consisted of children of North American ancestry. Of all parameters, differences were found in only two, growth during childhood and during adolescence. The Western European / North American children growing up in Guatemala differed from their genetically similar U. S. peers in the amount of growth during adolescence. Johnston et. al. (1976) interpreted these results as supporting study of Habicht et. al. (1974) indicating that growth during childhood at that SES level was regulated by environmental factors. However, population genetic factors seemed to predominate during adolescent phase (cited by Kaul and Nyamongo, 1990).

Lohman (1989) made an attempt to assess the body composition in children. Leung et. al. (1998) had developed body mass index reference curves for Chinese children. Similarly, McCarthy et. al. (2001) had developed waist circumference percentiles for British Children aged 5 – 17 years. Cole et. al. (2000) made an international survey for establishing a standard definition for child overweight and

Michael J. Duncan et. al. (2013) has made a study on Body Shape Index, Body Mass Index and Waist Circumference as a measure to risk of blood pressure in Portuguese adolescents and concluded that BMI and WC significantly predict resting BP in adolescents, use of Body Shape Index has a greater amount of the variance in BP. Wickramasinghe (2013) has studied the metabolic markers among 5 – 15 year old children from an urban area of Sri Lanka and concluded that children were detected to be non-obese through anthropometric measures. Ruth Chan et. al. (2013) made a study on primary school students belonging to a minority ethnic group of Yao in China and inferred that Yao children were relatively short statured when compared to Han Chinese children in Hong Kong, may be because of genetic and differences in nutrient intake. Brannsether et. al. (2013) through his study on Norwegian children aged 4 - 16 years presented a new reference values for triceps and subscapular skinfolds. The reference value of triceps skinfold and subscapular skinfold are presented in percentiles. The study also showed positive correlation between both skinfolds and BMI. For all ages together a cut-off of 1.0 SDS gave a sensitivity of 76 per cent of subscapular skinfold and 70 per cent of triceps skinfold to detect overweight with a corresponding specificity of 92 per cent for both.
1.4 Growth studies in India

Some of the growth studies in India reveal that, Macfarlane (1937) measured the height and weight of 700 Mukkuvan children, a non-vegetarian fisher folk of Trivandrum, Kerala between 3 to 17 years of age and compared with vegetarian and mixed diet children of Trivandrum, Malyalam Tamil children, the Goanese Mahrattas, Portugese children and the English children and showed the growth spurt in height and weight between 12 and 13 years. Patwardhan (1961) has shown the rates of growth of 4448 boys and 2309 girls between 5 and 15 years. The results showed that the children from urban centre are heavier and taller than those in rural areas of the same age. Similarly, Majumdar and Bahadur (1951) made a systematic anthropometric survey of 1120 boys from 7 to 24 years of age from education institutions in Lucknow from all income groups and social classes of various castes and communities. The study revealed that students coming from lower income group are shorter in stature and lower in other measurements than those belonging to the higher income groups. Kaul (1975) reported the growth study from Kashmir valley relating to Kashmiri Pandit school-going boys on three important measurements where the samples were drawn from 7 to 16 years. In the I.C.M.R Report of (1971–72) on the consolidated results of the All India Study on growth and development of children some attention has been given to the problem of growth at adolescence in this country as a whole. The studies by Charlotte et. al. (1969) pointed out that Indian children of wealthy or comfortable families do attain western absolute measurements and follow the growth courses of U. S and England (cited by Bhowmik, 1993).

Bhowmik (ibid.) studied a cross-sectional and first growth data relating to boys and girls of Medinipur. The study was conducted on three endogamous populations viz. Brahman, Mahishya and Sadgope belonging to 12 – 16 years of age, to know about the inter-group variation as well as sex difference in growth processes for each of the morphological traits that have been studied, with a view to yield base line information which will help to understand secular trend at a later date.

Khongsidier (1999) analysed the data on growth of children of two economic groups among the War Khasi, viz. lower income group and higher income group. The boys belonging to higher income group are heavier and taller than those in the lower income group. It is found that the girls in the higher income group are significantly
heavier and taller than those in the lower one. In contrast, 9 – 11 years old girls in the lower income group are heavier and taller than those belonging to the higher income group, though the differences between them are not statistically significant.

In India studies on human physical growth and certain physiological characteristics started around the year 1930. Mukherjee and Gupta (1930) studied height, weight, body surface area, pulse rate, respiration, blood pressure and vital capacity in a sample of 18 Bengali subjects to study basal metabolism. Some studies were also conducted by Krishnan and Varred (1932, 1933), Mason and Benedict (1931), Mason (1932), Eleanor and Francis (1931), Risley (1931), Rahman (1936), Aykroyd and Raja Gopal (1936), Macfarlane (1937), Wilson and Mitra (1938), Shourie (1939) and Nandi (1933-34) studied children born in Calcutta hospitals and classified the data according to the social status of mother.

Chatterjee (1938) studied 33,151 students in Calcutta taking height, weight, chest circumference and strength of grip. Wilson and Widdowson (1942) had collected data on height and weight of 5,969 children of the Punjab and 2,599 children in Madhya Pradesh and Orissa between the ages of 5 and 15 years. The Punjabi children represent a wheat eating community; those of Madhya Pradesh and Orissa represent rice eaters. Wilson and Widdowson (ibid.) pointed out that the Punjabi Hindu children were lighter and shorter than Muslims and Sikhs of corresponding ages. They believed that the differences are racial. On the other hand, the comparative figures given by them for wheat eating Hindus of Punjab and rice eating Hindus of Madhya Pradesh and Orissa showed no significant differences in height and weight. Majumdar (1949) studied the boys in Bihar between 7 and 15 years. Prasad (1949) studied the nutritional value of school going children of Lucknow. Patwardhan (1961) showed the rates of growth of girls between 5 and 15 years and reported that the children from urban centre are heavier and taller than those in the rural areas of the same age.

Sarkar et. al. (1959) studied the Kadar children from Kerala between the age group of 5 and 14 years. Rao et. al. (1961) studied height and weight of the boys and girls from 15 to 16 years of age in North Arcot district, Tamilnadu. Sarkar et. al. (1963) showed the growth of head from of the new born Bengali infants. Sharma
(1964) showed the nature of growth of children of both sexes at different age levels. Sharma (1970) studied 812 children of both the sexes from 0 to 21 years of the Maharashtrian parentage from Bhopal and Gwalior of Madhya Pradesh and had shown different rate of growth for different body organs. Several authors studied different ethnic groups from different areas such as Das (1971, 1973), Das and Das (1965, 1972) Das (1971) studied the Kalita, the Baishya, the Assamese children and Hazarika (1974) the Ahom of Assam from 6 to 18 years, Das (1977) studied the Assamese and Rajasthani boys, Bansal (1969) Punjabi boys and girls from 6 to 18 years of age, Singh (1972) the Khatri boys from 11 to 18 years, Kaul (1975) studied the Kashmiri Pandit boys from 7 to 16 years. Singhrol and Mitra (1984) studied the Saryupari Brahmin girls of Chhattisgarh, Mitra and Verma (1987) studied the trend of growth in height and weight among the Bison Horn Maria children of Bastar. Mitra and Singhrol (1982) studied the Chhattisgarhi girls aged 6 to 16 years from Madhya Pradesh. Singh et. al. (1987) made a study on growth performance of Punjabi children aged 6 – 12 years. Vijaykumar (1993) studied the Kamar children from Madhya Pradesh.

Satyanarayana et. al. (1989) made an adolescent growth spurt on height among the rural Indian boys in relation to their childhood nutritional background and the report is based on 18 year longitudinal study. Choudhury et. al. (1992) reported that the Assamese children were least stunted, the Bengali boys and girls were least wasted and found a positive correlation between growth and nutritional status in these three populations. Naidu and Babu (1992) made a comparative study of caste and tribal populations of Andhra Pradesh and found that the caste people were relatively taller and heavier than the tribal people. Begum (1995) reported the adolescent period of 13 to 15 years among the Assamese Muslim. Choube and Dey (1996) reported that the adolescent spurt occurs at different ages for different measurements among the Soni children of Sagar. Ratnawali et. al. (1997) studied the trends of growth and maturation among school going children of Ranchi and reported that the girls were ahead in attaining growth spurt and maturity than the boys. Singh and Kulkarni (1999) reported that majority of the Warli children were undernourished and fall under CED-III. Reddy and Rao (2000) reported that the Sugali children were shorter and lighter than the well-to-do Indian standard. Patni et. al. (2001) observed that the onset of adolescent spurt varies from 11 to 14 years among the Kayastha girls of Sagar. Reddy
et. al. (2001) reported growth differentiation and gradients among the Bhil boys of Rajasthan from 11 to 19 years. Talwar and Maninder (2001) reported that the Bania girls were shorter and lighter having low fat in subcutaneous area. Dharma Rao and Busi (1993, 1994, 1996, 1997, 1998), Dharma Rao et. al. (1997) and Busi and Dharma Rao (2003) studied various tribal groups of Andhra Pradesh and reported the results to be used as local standards for the respective tribal groups. Rao Balaji (2005) studied growth and nutritional status of Yanadi, a Scheduled Tribe from Andhra Pradesh and inferred that children are suffering with severe chronic energy deficiency.

Children living at high altitude were taller and heavier than the low altitude (Malik, 1976; Malik and Singh, 1984; Gupta and Basu, 1981; Duara, 1985; Malik and Hauspie, 1986). Newman (1953) found that the colder climatic people tend to be heavier with relatively large trunk and shorter legs, while in hot climate people tends to be relatively longer legged. The children of upper middle socio-economic level groups were significantly taller, heavier with earlier skeletal and sexual maturity than those of lower middle socio-economic groups (Majumdar and Bahadur, 1951; Swaminathan, 1964; Prasad et. al., 1971; Sharma and Kaul, 1970; Sidhu and Phull, 1974; Deka and Rath, 1979; Singh et. al., 1987; Rao and Balkrishna, 1988, 1990; Sharma, 1991; Malik and Singh, 1991; Naidu and Rao, 1994; Bharati, 1989; Reddy, 1998).

The ICMR Report (1971 – 72) of All India Study on Growth and Development of Children has limited application in view of environmental and genetically variations in Indian population. Phadake (1968) studied the Maharashtrian boys and suggested a lower growth rate and were lighter and shorter than the British and American.

A number of growth studies were conducted from time to time on children of different populations of India by various anthropologists. Some of the studies are Chopra (1982), Sharma (1970), Singh (1970), Kaul (1971), Ghai (1979), Bansal (1968, 1969), Nath (1969), Rizvi (1977), Kaul and Shori (1982), Mukherjee and Kaul (1970), Mitra and Guha (1979), Sidhu and Kaul (1977), Kshatriya et. al. (1981), Mukherjee et. al. (1982), Rao and Singh (1970), Dharma Rao and Busi (1994, 1995). Studies on nutritional status of some populations in India have been conducted by
different Universities, ICMR, different Regional Centres of Anthropological Survey of India and National Institute of Nutrition, Hyderabad. Number of growth studies has shown the effect of various environmental factors. In India where a great socio-economic diversity exists, the studies of growth of different children belonging to different ethnic groups have been carried out. In the Union Territory of Delhi, the well off children was found to be higher in body dimensions than the lower class children (Datta Banik *et. al.*, 1972). Similar pattern were reported by Majumdar and Bahadur (1951), Swaminathan (1964), Prasad *et. al.* (1971), Sharma and Kaul (1970), Sikri (1972), Agarwal *et. al.* (1974), Datta Banik *et. al.* (1970), Sidhu and Phull (1974), Deka and Rath (1979), Garg (1978), Singh *et. al.* (1987), Rao and Balkrishna (1988, 1990), Sharma (1991), Malik and Singh (1991), Bharati and Basu (1990). Eveleth and Tanner (1976) were of the opinion that as far as child growth in India is concerned dissimilarities are brought about mainly by socio-economic differences rather than ethnic variation. Michealson (1944) and Hogben *et. al.* (1948) were of the opinion that the rate of growth of different ethnic groups is different in similar socio-economic and climatic condition. Choudhury and Begum (1995) conducted a study on 3 linguistic groups (Assamese, Bengali and Hindi speakers) of age ranging from 3 – 10 years of Guwahati city and revealed that Bengali children are shortest and lightest of all the children. The Assamese children showed a higher mean value at all ages than their counter parts.

Badaruddoza and Sidhu (2000) had found a significant influence of socio-economic status on the growth patterns of Uttar Pradesh and Punjabi children in the age group of 6 – 11 years. Badaruddoza (2001) had reported the effects of consanguinity on anthropometric measurements of Muslim children in the age group 6 – 11 years.

Gaur and Parul Sharma (2003) studied nutritional status of 6 – 11 years old Backward Class children of Naraingarh area of Haryana and found the mean stature and weight of boys and girls fall below the 20th percentile of the NCHS reference data. Gaur *et. al.* (2002) carried a study on Rajput children in the age group of 5 – 14 years in Solan district of Himachal Pradesh and found the mean stature and weight of children falls between 5th to 20th percentiles of NCHS reference data.
Singh et. al. (2003) evaluated physical growth performance of Punjabi urban boys and made assessment of malnutrition based on BMI and Weight for Height. Bhalla (2003) observed the growth attainments of well off Chandigarh 134 boys aged 9-17 years and 109 girls aged 9 – 16 years. The study was based on mixed longitudinal study for body weight and height pattern wise. The study was compared with American and British counterparts and found that Chandigarh children were lighter and shorter.

Chand Manocha (2004) made a cross sectional study on male children in the age group of 6 – 20 in different agro-climatic zones of Haryana and found they are lagging behind in weight and height when compared to ICMR standards. Sidhu and Uppal (2004) studied growth and nutritional status of pre-school children of scheduled caste community of Punjab. Sankhala et. al. (2004) had seen the impact of intervention feeding trial on nutritional status of 6 – 10 years old malnourished children. Also mentions that age 6 – 10 years is a period of growth which lays foundation for adulthood. Nutritional deprivation during this period influences the adult size and capabilities of the individuals at later stage of life. Khanna and Kapoor (2004) made an attempt to see the secular trend in stature and age at menarche among Punjabi Arora residing in New Delhi. Adak et. al. (2006) studied Body Mass Index and Chronic Energy Deficiency of adult males among Central Indian Populations. Raj et. al. (2007) made a study on obesity in Indian children and its relationship with hypertension.

Saheb and Rajendra Prasad (2008, 2009) had studied the growth status of the Lambadi children (6 – 10 years) and found about 30 per cent of the children are affected with fluorosis. The extent of malnutrition among the Lambadi children was evaluated through BMI, Weight deficit for age and height deficit for age classifications. Laxmaiah et. al. (2008) attempted a study to know the factors affecting prevalence of overweight among the adolescents in Hyderabad and inferred that low levels of physical activity, more hours of watching TV, consuming unhealthy foods are associated with prevalence of overweight. Prevalence of overweight was significantly higher among the adolescents of high socio-economic status.
The Anthropological Survey of India undertook growth studies among children in the age group 6 to 10 years with an approach on bio-cultural perspective among the Ahir of Haryana, Yadava of Uttar Pradesh, Oraon and Poundra Ksh triya of West Bengal; Kaibarta of Assam, Lushai of Mizoram, Nicobarese of Andaman & Nicobar Islands, Ghase Mali of Maharashtra, Mala of Andhra Pradesh, and Dangi of Rajasthan (Sharma, 2009).

Ravi and J. S. J. S. Rao (2009) made a detailed study on the Ahir of Haryana, the study was based on the bio-cultural aspects. Clinical signs revealed that niacin and vitamin B-complex deficiency. Impact of various socio-cultural factors over growth has not showed a clear picture. Based on the anthropometric indices, the nutritional status of the children was also assessed.

Narendra Singh (2009) made a study among the 4 and 5 year children for estimating the prevalence of malnutrition and its extent using anthropometric indices among the Warli tribal children of Maharashtra. He had inferred that majority of the children were under nourished for weight for age and weight for height classification. Based on BMI they showed severely malnourishment. Kaur et. al. (2009) compared the growth performance of Punjabi girls studying in private and Government schools of Ludhiana based on their socio-economic conditions and found that children from private schools were taller and heavier than their coevals studying in Government schools, highlighting the effect of socio-economic background on physical growth performance. Prabhjot and Sidhu (2009) made an attempt to study the prevalence of hypertension among children of 6 – 11 years in various schools of Amritsar. Girls showed significantly higher prevalence rate of hypertension than boys. Awasthi (2009) studied the health status of poor children (6 month to 6 years) in Lucknow city and inferred that children visiting to ICDS were better than non ICDS in respect of their health status.

Srivastava and B. R. K. Shukla (2009) did significance of somatic measurements in understanding mental retardation in the age range of 6 – 21 and summarized as mentally retarded individuals showed lesser mean values for various anthropometric measurements in comparison to normal healthy controls.
Sonowal (2010) studied factors affecting the nutritional health of tribal children in Maharashtra. Hemlata Dewangan et. al. (2010) had made cross sectional growth study among the Abhujhmaria children (6-18 years) living in Naryanpur Ashram School of Chhattisgarh, India. A sample of 550 boys and girls were taken with least sexual dimorphism. Significant differences between sexes were noticed after 12 years only. Abhujhmaria children were significantly taller and heavier than Indian as well as other regional tribal children. Urade and Chakravarthy (2012) reported on ‘Nutritional anthropometry among Khaire Kunbi: Impact of socio-economic factors on growth of school going children in Maharashtra’.

Ganguly et. al. (2012) had studied the nutritional status like stunting and underweight among 8 – 18 years tribal school children of Paschim Medinipur district of West Bengal. Parimalavalli (2012) studied Velala children (1 – 18 years) living in small size families of Semmanatham village of Yercaud taluk of Salem district of Tamil Nadu. Mean height, weight and food intake of the selected tribal children were less than reference values. More scaly skin and hypo pigmented vitamin A disorder were seen between 16 – 18 years. High magnitude of tribal children has been suffering from maladies of malnutrition.

Dutta (2013) made a study of growth of head circumference and arm girth among the Kaibartta children of Dibrugarh, Assam. Swaminathan et. al. (2013) had clustered diet, physical activity and overweight in parents and offspring from 325 individual aged 8 – 12 years in South India. BMI correlated significantly with the BMIs of both the parents. Offspring physical activity level correlated significantly with mother but not the father.

In a recent study Rao and Papa Rao (2013) made a pre-adolescent growth studies among the Ahir children of Haryana. The study was conducted on both boys and girls in the age of 6 – 10 years. The children were mildly malnourished based on weight for age, height for age and mid upper arm circumference classification. Rao (2013) has elsewhere discussed the physical growth and nutritional status of the Labana children of Himachal Pradesh. The study was made on boys and girls in the age group of 6 – 10 years. Both boys and girls are lighter when compared to ICMR Punjabi children, while they were taller than to ICMR children. BMI reveals that most of the Labana children fall under Normal and CED - I category.
1.5 Methods of Growth studies

Growth can be studied in three ways – longitudinal, mixed longitudinal and cross-sectional.

In a longitudinal growth study each individual is measured at a constant interval during a year to see the changes in any segment of body that take place in a given period. The major demerit of this method is the time it takes to complete and the relatively small number of subjects that can usually be followed (Eveleth and Tanner, 1976). By this nature, this study is a troublesome affair as one has to be more meticulous especially in maintaining to obtain measurements on the same individual(s) and receive co-operation from subjects. It is, therefore, imperative that the highest standards of accuracy should be maintained in collecting and recording the date and that the methods of analysis used should be those appropriate to the methods of study, yielding the maximum and most accurate information concerning individual growth (Tanner, 1951).

Mixed longitudinal study is basically a compromise of cross-sectional and longitudinal designs (Tanner, 1951). In mixed longitudinal study, groups of children are selected into the study at specific ages (age cohorts). Each child is then followed longitudinally at regular intervals and during the course of the study the age cohorts overlap. With special statistical treatment data are fitted between cohorts and thus the whole growth period is covered in a much shorter time period.

In cross-sectional study, subjects of different age categories are measured at once who provide an important clue about changes that take place during the successive ages by means of looking at variability. To explore this variability, any measurement on an individual could be obtained at random basis. This is the easiest and simplest method of growth study under which a maximum sample can be studied in a short period. This method is adequate enough for studying different body dimensions of different individuals at different age groups enabling to construct standards of growth attained. In this way the cross-sectional method is preferable because of its easy and rapidity in obtaining adequate results from large sample in less period than the longitudinal one. It gives a clear idea about individual increments from one year to the next, i.e., the rate of growth.
1.6 Stages of Growth and Development

The stages of growth and development are the framework within which the study of growing child is placed. These are four-fold with sub stages:

1. Prenatal period (Beginning of life)
2. Infancy
3. Childhood
4. Adulthood

Each stage is further classified into various categories for easy convenience of growth studies:

| New born: | Up to 12 hours after birth |
| Infancy: | First 2 years after birth |
| Early Childhood: | From 2 years to 6 years |
| Later Childhood: | From 2 years to 6 years |
| Puberty – | |
| Girls: | From 10 years to 13 years |
| Boys: | From 13 years to 15 years |
| Adolescence – | |
| Girls: | From 10 years to 18 years |
| Boys: | From 10 years to 20 years |
| Maturity – | |
| Girls: | After 18 years |
| Boys: | After 20 years |

Watson and Lowrey (1967) had given the following division of growth periods:

<table>
<thead>
<tr>
<th>Growth Period</th>
<th>Approximate Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neonate:</td>
<td>First 4 weeks after birth</td>
</tr>
<tr>
<td>Infancy:</td>
<td>First year</td>
</tr>
<tr>
<td>Early childhood (pre-school):</td>
<td>From 1 to 6 years</td>
</tr>
<tr>
<td>Late childhood (pre-pubertal):</td>
<td>From 6 to 10 years</td>
</tr>
<tr>
<td>Adolescence –</td>
<td></td>
</tr>
<tr>
<td>Girls:</td>
<td>8 or 10 years to 18 years</td>
</tr>
<tr>
<td>Boys:</td>
<td>10 or 12 years to 20 years</td>
</tr>
<tr>
<td>Puberty –</td>
<td></td>
</tr>
<tr>
<td>Girls:</td>
<td>13 years</td>
</tr>
<tr>
<td>Boys:</td>
<td>15 years</td>
</tr>
</tbody>
</table>
1.7 Statement of the problem

Growth and development is a vital aspect in all the living organisms. The status of well being of an individual or a community as a whole is assessed through the anthropometric measurements and it also accepted as an important tool for the assessment of nutritional status particularly in children. Body composition attributes to assess general health of any individual. It is a known fact that the pattern of physical growth and development, though genetically determined, is strongly influenced by socio-economic and nutritional status. Growth and development of children are not only concerned with physical growth but also with mental and social development and formation of personality of the child. Physical environment such as sunshine, good housing, lighting, ventilation, sanitation drainage system, drinking water facility, primary health care centres and economic factors indicating standard of living connected with nutrition and the life style of the people influence the growth and development. Other factors like education and occupation of parents, nature and size of family, food habits, etc. will also influence on the growth of children. Keeping in view the above facts the study is designed to carry out in rural areas of two Other Backward Communities (OBC) of Haryana and Himachal Pradesh.

1.8 Scope of the study

It has been proposed to study two agricultural communities, the Ahir and the Labana. The study was conducted on Ahirs in the Mahendragarh district of Haryana. The area is reported to be relatively backward due to lack of adequate irrigation facilities through canals of the major rivers, as it is seen in other districts such as Rohtak, Sirsa and Ambala. Secondly, to have a comparative study a similar community, the Labana, was selected from a different ecological zone of the Sub-Himalayan region. The Labana are concentrated in Solan, Sirmour and Mandi districts of Himachal Pradesh. As there were no reported anthropological studies in these areas and on these communities, it has been decided to study the growth and nutritional studies of children in the age group 6 to 10 years.

The normal growth of individual is greatly influenced by nutrition and this influence can be estimated through anthropometry. In a developing country like India where more than three-fourth proportion of growing children are malnourished with low BMI and are suffering from chronic energy deficiency (CED) and many of them suffers from Marasmus syndrome.
The present study provides input through various types of nutritional indices where anthropometry serves the very purpose of human variation that varies from region to region within individuals and groups as such.

1.9 The population

The Ahir are an agricultural community who are mainly concentrated in the districts of Mahendragarh, Rewari and Gurgaon of Haryana. They claim to be the descendants of Lord Krishna of Mathura. According to Sangwan (1994), ‘The Ahir, Hir, Yadav, Raoji, Rao Sahib are the different names which are used for this particular caste’. It is mentioned in the District Gazetteer of Gurgaon (pp. 101-2) that ‘Ahirs are chiefly found in the northern parts of the Gurgaon tehsil. Though various other folk etymologies are current, the name Ahir, according to H. A. Rose (1914) is derived from the Sanskrit Abhira, a milkman. As to their origin, a number of traditions are current. The Ahir own a tradition as mentioned by Rose is that: “a Brahman once took a Vaisya girl as his wife and her offsprings were pronounced amatt-sangya or outcaste; that again a daughter of amatt-sangyas married a Brahman, and her offspring were called Abhirs (i.e. Gopas or herdsmen), a word corrupted into Ahir…”’. In the District Gazetteer of Rohtak-Haryana (pp. 42-43) it is mentioned, ‘The origin of Ahirs is even more doubtful than the Jat. Like the Jat they are keen on joining the armed services and also make good farmers’; while in the District Gazetteer of Mahendragarh (p. 67) it is mentioned that ‘the Ahir form a majority of the population. The traditional view about the origin of the community is that Lord Krishna was an Ahir and they claim to be his descendants. Besides, Ahirs, they call themselves Yadavs or Yeduvanshis, the clan to which Krishna belong. They are good cultivators and are of the same social hierarchy as that of the Jats and the Gujjars. A very large number of them are in defence services. They are good agriculturists and herdsmen of the first order’.

The Labana as observed by Rose (1914) are almost wholly confined to the montane districts of North West Province and Kangra. ‘They are carriers and hawkers of the hills and are of Banjaras. The term Labana is supposed to have been derived from term ladna (to load) ... To Rose (ibid.) the term Labana appears to be derived from lun (salt) and bana (trade)...they are great salt carrying and trading caste’. According to Singh (1996) the Labana, Lobana or Lavana is said to be an
offshoot of the Banjara of Mewar (Rajasthan) who probably entered Himachal Pradesh around two centuries ago. As per the legend, a Banjara known as Lakhi Banjara, who had one lakh cattle used to trade in sendha namak (Indus salt) and so received the name of Labana. They are distributed in Bilashpur, Hamirpur, Mandi, Solan, Sirmur and Kangra districts. Now, the Labana are practicing agriculture and some of them are employed in government/private services and also in various industrial estates.

1.9.1 Language

The Ahir speak impure Hindi or asudh Hindi, the dialectical variation of which occurs for every 12 kosh / koss (3 Kms = one kosh / koss). Some others say that they speak Haryanvi, while the local people in Mahendragarh district say that they speak Ahirwalia boli as the area is numerically dominated by the Ahir. However, the script being used by them is Devanagari.

The characteristic dialect of the Labana is that they speak among themselves which is similar to Marwari of Rajasthan, which indicates their migration from that region in the past. They, however, know Hindi and Bilaspuri (kehluri) dialect of Western Pahari and use Devanagari script.

1.9.2 Social organisation

The Ahir may broadly be divided into three divisions (vansh or khamp) namely Goalvanshi, Yeduvanshi and Nandvanshi, which are endogamous in nature. Each vansh is further divided into a number of got (clan) which are exogamous in nature. The Ahir of the villages under the study, i.e., Seehma, Khampura / Khampra, Khaspur and Deroli Ahir belong to the Yeduvanshi division. The Yeduvanshis of this area form a territorial group of 26 villages locally called Chabbis kheda. The villages under the study namely Seehma, Khampura / Khampra, Khaspur and Deroli Ahir come under this territorial group. It is interesting to note that among the Ahir a woman even after marriage will not be considered to be a member of the got of her husband. She would retain the got of her father. However, her children, both male and female, will be considered to be the member of her husband’s got.
While, in Labana they have 11 got as listed by Ibbetson (1916) and Rose (1919), viz. Ajrawat, Ghotra, Datla, Pilia (Peliye), Parwal, Khabriya, Gojalia, Gujar, Tatra (Tadra), Wamial (Mathuan) and Narowal. Of late, two more got are added like Nalhajalha and Kalia. They avoid got endogamy. Their social position in the Hindu varna system is not certain but they are taken as Savarna and are placed below the Lohar in the local social hierarchy even though they claim an equal ranking with them. The Labana in general face a caste crisis and are not comfortable with their Sudra varna status (Singh, 1996).

1.9.3 Food habits

The staple food of the Ahir is unleavened bread (roti) made of wheat flour and roti made of bajra. They take pulses such as red gram (chana) and green gram (moong) grown in their cultivable lands. They also take arhar and black gram dal (urad dal) purchased from the market. Some of the men take alcoholic drinks purchased from the market while some of them who are working in the armed forces get from C. S. Ds. Smoking of Hubble bubble (hooka) is the general practice among the men. Some of them also smoke bidi and cigarette. By and large the Ahir are vegetarian. Only some members from the working class take non vegetarian food occasionally. Among the younger generation consumption of egg is common, but it is allowed outside their dwellings only. They take vegetables such as potato (alu), green peas (matar), brinjal (baingan), bottle gourd (gia or louki), ridge gourd (thori), cucumber (kola), cauliflower (phool gobi), cabbage (patta gobi), carrot (gajar), beetroot, radish (shalagam), etc., and green leafy vegetables such as spinach (palak), fenugreek (methi), chana bathua, mooli ka pattha, carrot leaves (gajar ka pattha), coriander leaves (dhaniya), etc.

The Ahri take enough milk and milk products such as lassi and curd (dahi). Children were also given enough milk and milk products. At least a cow or a buffalo would be maintained in every household. The people perceive that milk is complete food. The milk produced in these villages contains 4 to 8 per cent of fat. On casual questioning of how much milk can a person consume at a time, it is informed that a person may drink as much as two litres of milk at a time. Clarified butter (desi ghee)
and butter (makhan) are also used along with unleavened bread (roti) of wheat as well as bajra. Mustard oil (surson ka thel) is also extensively used next to desi ghee as cooking medium. Roti made of wheat flour and of bajra are taken during summer and winter respectively. Rice is occasionally used for preparation of a sweet dish (kheer). Other sweet dishes such as suji ka halwa, churma (made of unleavened wheat bread – roti, khand / kachi shakkar and desi ghee) and sattu (made of desi ghee, edible gums and resins and khand) are generally taken during winter occasionally.

The staple food of the Labana is unleavened bread (roti) made of wheat flour and roti made of maize supplemented by rice. By and large the Labana are vegetarian. Only some members take non vegetarian food occasionally. They consume all types of local roots and tubers, pulses and fruits depending upon their seasonal availability. The cooking medium is mustard oil or vegetable or desi ghee. They take milk and milk products such as lassi and curd. Children are given milk and milk products. Most of the houses own a cow or a buffalo. The consumption of milk and milk products by the Labana are not to the extent of Ahirs. The Labana are fond of liquor and consume self made alcoholic beverages made of gur. They also purchase country liquor. Women also sometimes consume alcohol and some old women smoke tobacco/bidi as well.

1.10 Physiographic features of the area under the study

The four Ahir villages under the study namely Seehma, Khampura / Khampra, Khaspur and Deroli Ahir come under Ateli Development Block, Narnaul tehsil and Mahendragarh district which lies between 27° 47’ to 28° 26’ North Latitude and 75° 56’ to 76° 51’ East Longitude. The first three villages namely Seehma, Khampura / Khampra and Khaspur are located on the road side between Narnaul town and Kanina Block headquarters, while Deroli Ahir is located in between Narnaul and Mahendragarh towns.

The Mahendragarh district lying to its south, west and eastern sides is surrounded by parts of Rajasthan while the districts of Bhiwani and Rewari respectively of Haryana surround the northern and northeastern part. The district
Mahendragarh comes under semi arid or semi desert area and it is almost a flat surface area. The climate is very hot during summer and cold during winter. Being a semi desert area, the sand is coarse in some places while in other places it is very fine. The location particular of the studied area is shown in Map – 1.

Map – 1: Location map showing the study area of Ahir in Mahendragarh district of Haryana
The four Labana villages under the study are Dhaulakuan, Kolar, Sukhchainpur and Bharapura of Sirmur district which lies between $77^0 01' 12"$ and $77^0 49'40"$ East Longitude and $30^0 22'30"$ and $31^0 01'20"$ North Latitude and three other villages such as Baddi, Haripursandaoli and Nannowala of Solan district which lies between $76^0 42'$ and $77^0 20'$ East Longitude and $30^0 05'$ and $31^0 15'$ North Latitude. Except Baddi, the rest of the villages are covered under agricultural land, while Baddi is an industrial area. Being a low altitude zone of Himachal Pradesh, the climate is moderate during summer and very cold during winter. The location particulars of the studied area are shown in Map – 2.

Map – 2 : Location map showing the study area of Labana in Solan and Sirmour districts of Himachal Pradesh
1.11 Sanitation in the villages

The villages lack proper drainage system. The water used for bathing, washing clothes and utensils are let out in the streets which becomes totally wet with lot of pot holes in between causing inconvenience to the pedestrians. The pot holes on lanes provide breeding places for mosquitoes and flies which may ultimately lead to the spread of Malaria, Typhoid and other diseases. The houses do not possess soak pits.

Most of the houses are devoid of latrines. Open defecation is very common in all the studied villages.

Tube wells have been introduced for every mohalla (locality) with overhead tanks by the village panchayats. However, the surroundings of the tube wells are not cleanly maintained. Water gets stagnated around the tube well, which speaks of poor sanitary / drainage conditions. The surroundings of the tube wells as well as the overhead tanks get water logged with green patches of algae which make the pedestrians inconvenient to walk and also help mosquitoes and flies to breed.

1.12 Health and hygiene

The analysis on health and hygiene among the Ahir and Labana reveals that only few households had reported that some of their household members are suffering from diseases. Most of them avail health facilities following allopathic system of medicine. Almost all the households have been availing of immunization programme. In all the households it was reported that breast feeding is being done regularly by their children.

1.13 Objectives of the study

The objectives of the present study are:

1. To study the pattern of growth among the Ahir and Labana children in the age group of 6 – 10 years by taking several anthropometric variables.
2. To evaluate the extent of malnutrition among these children through the use of nutritional anthropometry.
3. To see the sexual dimorphism of growth spurt.
4. To estimate the frequency of various common nutritional deficiency signs.
5. To compare the differential rate of growth in different ecological zones.
1.14 Hypotheses

Growth among children is influenced by factors like hereditary, environmental and nutritional status with reference to traditional diets. The environmental factors strongly regulate growth in body size and composition and the rate of biological maturation. With the above facts, the status of growth of the Ahir and Labana children are studied through anthropometry and nutritional deficiency signs. It was also a major concern to see whether Environment has got any impact across the two communities.

1.15 Limitations of the study

It is not feasible to study the entire population because of its geographical and technical difficulties. Therefore, a sample survey was made with a view to study the pattern of growth and compare the intergroup difference with more or less similar socio-economic background. The study is limited to preadolescent stage to find out mid-childhood or juvenile growth spurt, a short-lived acceleration at about 7 – 8 years of age and may be emphasized by a dip in velocity before puberty as reported by Stanley J. Ulijaszek et. al. (1998), and Lejarraga (2002). Many researchers have reported low to moderate polygenic effects along with larger environmental influence on BMI (Annest et. al., 1983; Bouchard et. al., 1988). Twin studies reported larger polygenic rather than environmental influences on BMI (Austin et. al., 1987; Selby et. al., 1990). There may be changes in both the morphology and genetic component variances with age. However, these changes could not be tested in the present study.

1.16 Research outline and development of chapters

With the above brief introduction on growth and development, review of literature, area and population under the study, objectives of the study, hypothesis and limitations of the study that were discussed in the present chapter. Further details like methods of data collection, analysis, results and discussion and finally the outcome of the study, i.e., the extent of growth, malnutrition and ecological differences among the Ahir and Labana children are detailed in the successive chapters – II, III and IV.

The Chapter II describes about the material and methods that were adopted for sample selection, data collection, statistical analysis of various anthropometric measurements, nutritional assessment of the Ahir and Labana children. The growth of
the children was assessed based on bio-social aspects of the studied households. Body composition of the children were analysed through certain indices. Besides these, the dental pattern was examined and analysed for permanent tooth eruption as per the age. Clinical signs for various nutritional deficiencies were recorded and analysed.

The **Chapter III** gives the picture on growth of Ahir and Labana children through anthropometric variables based on the statistical inferences detailing tables and graphs. Nutritional assessment was also described through anthropometric indices. The inter group and sex differences of Ahir and Labana were elucidated in this chapter. The eruption of permanent tooth according to the age had been detailed for Ahir and Labana children and compared with the groups thereof. Clinical signs were also assessed through various nutritional deficiency indicators. Finally, the results of some of the important anthropometric variables of Ahir and Labana children were compared with international and national standards and also with the data of neighbouring communities that are available.

The last chapter (**Chapter IV**) summarizes the growth of Ahir and Labana children inhabiting different ecological zones. The results showed that the children from plain area are showing better growth than the low altitude children, but the juvenile growth spurt was noticed among the Labana girls by the age of 9 years while it is not clear among the Ahir girls. Finally, it is concluded with few suggestions for overall improvement of growth of the children in general and for the children in the studied area in particular. It is also emphasised for the requisite of national standards for the better understanding the health/nutritional status of Indian children in different ecological zones.