CHAPTER 4

DISCUSSION

To study the growth pattern of a community, it is imperative that it undertakes comprehensive examination of the habitat, nutritional status of its people along with various body measurements so as to understand the interaction of the various environmental factors, growth.

1. Nutritional Status

Nutrition is of prime concern to all living organisms. Man derives nutrients required for healthy living through food he eats (Gangulee 1926). The quality and quantity of food available play an important role in determining the health and well-being of individuals. Nutritional needs of energy expenditure vary with age, sex, body weight, body proportions, hormonal and physical activity. In most of the low socio-economic groups malnutrition is encountered as the most important health problem due to inadequate socialization and as a consequence of human attitudes lacking in solidarity in the context of social and economic deprivation. It is a living condition which affects work, productivity and intellectual level. A child’s growth is affected as much by malnutrition as by genetic constitution and hence can not just be considered a family problem but one that concerns society, as the perpetuation of this situation leads to an adverse ecological spiral. All factors that lead to an adverse
stable ecology, that is, to a deterioration of the stable equilibrium between living organism and environment, affect nutritional status.

Carstairs (1955) observed that in Rajasthan, "Cold" foods such as dairy products are preferred although are quite expensive ones. The availability of foods is dependent on the purchasing power of the family as well as on their capacity to produce their own food supplies. Whyte (1974) citing studies in India and Bangladesh, demonstrated that there is a direct correlation between levels of income expenditure and consumption of food. He noted that 70% of the rural people of India were at poverty levels and unable to purchase their minimum calorie requirement and that the lack of protein in the Indian diet was not always the cause of protein deficiencies, but rather that protein was diverted to provide energy in diet deficient in energy sources.

In India food habits vary from region to region and to a great extent guided by religious considerations not caring whether the food the people are consuming, guided by the religious belief, is supplying them enough nourishment or not (Gangulee 1926). An adequate diet should have a calorie value sufficient to provide for the requirements of the basal metabolism, the stimulating action of the food stuffs, loss in the feces and urine of unutilised derivatives of the food stuff, and the needs of varying degree of muscular and external work. It
must have adequate amount of protein (essential amino acids), fats, carbohydrates, water and salts (ions) all in suitable proportions, and an ample vitamin content. In children adequate precision must be made for additional tissue formation and illness (Wright 1961).

The dietary habits and other related modes of life are often suited to the best advantage of the people and provide adequate nutrition under existing conditions. Each food in the Indian diets, although contains a wider range of nutrients, serves as a major source of one or two major nutrients.

In the present study, Rajput children born and brought up in arid conditions of Rajasthan desert belong to low socio-economic group. Their complete 24 hours food intake along with examination of deficiency signs has been recorded. The diet analysis of various food items such as fat, protein, carbohydrate and vitamins is based on standard tables of nutritional composition provided by National Institute of Nutrition (ICMR, 1989). It shows that the staple diet of these children, essentially vegetarian, is very simple but at the same time contains all the essential nutrients. The diets are based predominantly on cereals as they are cheaper and easily available. Wheat and bajra cereals alone provide 70 to 80 per cent of daily energy intake, about 75 per cent of protein, 75 per cent of fat, more than 80 per cent of minerals and
carbohydrate, about 40 per cent of calcium and more than 90 per cent of iron. The pulses provide quite a good amount of protein, carbohydrate and phosphorus. Oilseeds and nuts also provide rich protein and a high level of fat. Tubers like onion and potatoes provide carbohydrates, energy and calcium. Milk and milk products which form an essential part of diet especially of infants are good sources of calcium and phosphorus.

However, despite their high intake of cereals and milk products, the total consumption of kilocalories, proteins, fats, calcium and iron is not sufficient for their respective ages according to the recommended dietary allowances for Indians (NIN, 1989) except for the intake of protein, fat and calcium during first 6 years of age when the consumption of these two nutrients is more than the recommended dietary allowance as the diets are primarily based on goat’s milk. The intake of all the essential nutrients in the rest of the age groups, however, is far less (50 to 80 percent) than the recommended values for Indian children. The diets of these children up to the age of 7 years are based on milk and milk products and the intake of cereals is less, but as the consumption of cereal increases with age the intake of milk decreases.

Due to such an imbalanced diet, these children suffer from deficiency diseases. More than 36 per cent boys and 10 per cent girls suffer from vitamin deficiency during 1 to 6 years of age. Vitamin B deficiency is common between 7 and
11 years of age (25 percent girls and 20 percent boys). Anemia is prevalent at almost all the ages, but its incidence is higher in females particularly between 7 and 15 years, as the consumption of iron is very low. More than 60 percent females and 30 percent males suffer from anemia during this period. Children between the age of 9 and 14 years show marked deficiency in calcium. Gastrointestinal infections are also common between 1 and 4 years due to unhygienic conditions. Vijaya Raghavan and Swaminathan (1971) in their cross-sectional study of heights and weights of normal healthy children subsisting on adequate diets from 14 public schools in different parts of India and 8 schools in Hayderabad city catering to the needs of low income group found that more than 20 per cent of the children of low socio-economic group had one or more nutritional deficiency signs while children belonging to well-to-do groups exhibited no deficiency signs.

Evaluation of nutritional status of the children of the present study, based on Gomez’s classification using Harvard Standard Tables by Stuart and Stevenson (1969) shows that 31 percent of the children are normal; 58.5 percent of the children fall in Grade I malnutrition (that is, marginally malnourished), 10.5 percent come under Grade II malnutrition (that is moderately malnourished) and none of the children fall under Grade III malnutrition (that is, severely malnourished). All the children, however, fall below the 50th percentile of Harvard Standards. The causes of
malnutrition are multiple and interdependent. In adverse ecological situation the effects of malnutrition on the community develop rapidly. Under these circumstances there is an increase in the morbidity and mortality rates and susceptibility to infectious and parasitic diseases. In the present study socio-economic factors as well as unhygienic condition of living play an important role in causing malnutrition. Besides, bacteriological contamination of food inadequate sanitary equipment, feeding habits and a large number of family members also lead to inadequate and imbalanced distribution of food.

2. PHYSICAL GROWTH OF RAJPUT CHILDREN

The size of an individual and in particular that of a growing child is influenced by environment. Recent works tend to suggest that environmental influences, especially nutrition, are of greater importance than the genetic background or other biological factors. Aschroft and Lovel (1964) have shown that in Jamaica the potential height of African race is as great as that of Europeans there, meaning thereby, that environment is the key factor in exploiting growth potential. According to Dugdale et al. (1970), the genetic factors set a ceiling on growth but become effective only when nutritional and other factors reach an optimum level. Shantha Madhavan et al. (1967), Ramchandran et al. (1968), Shah and Udani (1968), Parhlad Rao et al. (1969) in their studies have
shown that the reason for lower income group children lagging behind the well-to-do groups in growth is that they are exposed to severe nutritional, social and environmental strain. The growth retardation that is observed among average Indian children is more nutritional than of genetic or racial origin.

**ABSOLUTE BODY DIMENSIONS**

Different parts of the human body grow at different times and at different rates attaining their mature size at their own specific time (Mitschell, 1962; Tanner, 1962; Stuart and Stevenson, 1963).

The growth pattern of the Rajput children shows that boys and girls show similar trend in the growth of stature, sitting height vertex, trunk length, arm length, upper arm circumference, lower limb length and biacromial diameter. The growth spurt in most of the measurements is experienced between 11 and 12 years in girls and a year or two later in boys. However, the mean values of these measurements are much higher in boys compared to girls. Sex differences in the growth are well marked after the age of 14 years in almost all the measurements. The rate of growth of these measurements is higher in boys compared to girls. However, the growth of the hip breadth does not follow similar trend in boys and girls. The rate of growth of this dimension as well as that of the upper arm circumference is higher in girls than in boys. The rate of growth of muscle circumference however, is higher in boys than girls.
Stature increases by 50 percent by 8 years, sitting height vertex increases by 50% by the age of 7 years, trunk length increases by 50 percent by the age of 6 years, arm length by 7 years and biacromial and hip breadth by 10 years in boys. In girls stature, sitting height and hip breadth increase by 50 percent by the age of 9 years, trunk length and total arm length increase by 50 percent by 8 years and biacromial diameter by the age of 12 years. The chest circumference and the upper arm muscle circumference increase by 50 percent by the age of 14 and 12 years in boys and 10 and 13 years in girls respectively.

Skin Folds

The deposition of fat as indicated by the skinfolds is significantly different in boys and girls. In both the sexes the distance curves of various skinfolds show steep rise till the age of 8 years after which the sex differences become prominent. While in boys the growth of bicep, tricep, subscapular, suprailliac and calf skin folds becomes more or less stationary between or after 8 and 10 years with minor fluctuations, the growth curves for girls show continuous rise. By and large the rate of deposition of fat is higher in girls compared to boys throughout during adolescence.

Bone Diameters

Though the growth curves show similar trend in both
the boys and girls, the mean values for boys are higher than those for girls. The rate of growth of wrist, knee and ankle diameters is somewhat faster in boys compared to girls.

However, the rate of growth of the elbow diameter as revealed by the regression equation is almost the same in both the sexes.

Body Proportions

During the process of growth, changes occur in body proportions and contours and characteristic sex differences in body forms emerge. Differences in the degree and timing of growth of different segments of the body change in body proportions with age (Schultz, 1929, 1956; Thompson, 1956; Tanner, 1962, 1964; Watson and Lowery, 1967 and Hiernaux, 1969, Sharma 1970).

The growth of sitting height vertex with respect to stature is almost constant in girls after 5 years of age whereas in boys this ratio fluctuates considerably at different ages. Girls show somewhat faster rate of growth of sitting height with respect to stature compared to boys. The percentage ratio of trunk length to stature remains more or less constant in both the sexes after the age of 3 years. The growth of arm length with respect to stature, however, shows a highly fluctuating trend in both the sexes.
The ratio of biacromial diameter to stature in boys decreases initially and then increases rapidly till 6 years after which it falls and rises gradually. In girls also, the ratio decreases rapidly till 6 years after which it increases gradually in the beginning and steeply later on. The rate of growth of biacromial diameter in relation to stature is more or less the same in both the sexes. The growth of hip breadth with respect to stature shows more or less the same trend till 8 years in both the sexes, after which the ratio continues to rise in girls and remains almost constant in boys. The rate of growth of this dimension is higher in girls as compared to boys.

The percentage ratio of trunk length with respect to sitting height follows more or less a fluctuating trend in boys whereas in girls this ratio continues to increase till the age of 11 years where after it decreases. The growth of arm length with respect to trunk length shows similar trend in both the sexes. The rate of growth of trunk length with respect to sitting height and that of the arm length with respect to trunk length is almost the same in both the sexes. The growth of biacromial diameter with respect to trunk length shows a wavy trend in boys while in girls it decreases till 6 years of age where after it increases gradually. The rate of growth of biacromial diameter with respect to trunk length as revealed by the regression equation is same in both the sexes. Both the sexes have similar trend in the growth of hip breadth with
respect to trunk length though the rate of growth of hip breadth relative to trunk length is higher in girls than in boys. The growth of hip breadth with respect to biacromial diameter shows continuous increase from 1 to 18 years in girls. In boys it decreases till 6 years where after it shows a continuous rise. The rate of growth of hip breadth with respect to biacromial diameter as indicated by the regression equation is higher in girls than in boys.

Thus it is apparent that the changes in body proportions during infancy, childhood and adolescence and later arise as a result of differential rate of growth of various body dimensions at different growth periods.

Every habitat imposes a particular climatic regime on man, as well as on his domestic animals and crops. These regimes vary widely and it is only because man can make appropriate adjustments that he has come to occupy habitats more diverse than those of any other mammalian species (except perhaps the rat (Harrison, 1964). Like all living organisms, the human body is sensitive to many of the elements that go to make up the climate of a place. This sensitivity and responsiveness arises from the need to maintain homeostasis. The climatic factors of primary physiological significance are those which are not having a direct influence on the rate of heat exchange between the body surface (nude or clothed) and the surrounding. Differences in the average physique of different populations are of significance in climatic
adaptation in that they conform to the ecological rules of Bergmann (1847) and Allen (1877) applicable to animal populations in general and it has been demonstrated in several studies that the human body-size and shape too tend to follow these rules.

Growth patterns show some relationship to climatic variation. The fact that linearity of physique tends to be more prevalent in people living in hotter regions fits in with the finding that the growth period is prolonged and maturation somewhat delayed in warm regions. A linear build, e.g., a relatively greater height per unit body weight, is attained by a delayed skeletal (and physiological) maturation (Bayley cf. Harrison et al., 1964) functional advantages of certain body characters is hence natural. These studies indicate that variations in body-shape, size, fat deposition growth pattern, skeletal and physiological maturation are all determined by genetic constitution to a larger extent than by purely environmental factors (Harrison 1964). Allen relation of body-build to climate should occur irrespective of race (Roberts cf. Harrison et al., 1964).

In the present study the weights of the boys and girls are generally greater than those of the boys and girls of all India standard and those of the green belt of Rajasthan. However, during infancy i.e. between 1 and 4 years, the weights of the girls of the three populations are almost the same. The boys of the present study are found to be
taller than the boys of all India standard and those from the green belt of Rajasthan except between 11 and 13 years when the heights are almost the same i.e. the period which coincides with their growth spurt. Overall, the girls of the present study are taller than the girls of all India standard and those from the green belt of Rajasthan except at 8 and 10 years when the girls from the other two populations show higher mean values. For a short period i.e. 9 and 11 years, however, the girls from green belt of Rajasthan are taller than those of the desert area while mean values for the girls of the present study and those of all India standard are almost the same during this period. It is also evident that the girls from the green belt of Rajasthan experience growth spurt a little before the girls of the desert area.

The sitting height of the boys of the present study is less than that of the boys of other two populations initially. However, the mean values of the boys from desert areas and those of the other two populations are almost same from 5 to 15 years. After 15 years the sitting height of the boys from desert region show higher mean values compared to those of the other two populations. The sitting height of the girls of the present study is less than the girls from the other two populations. The people living hotter regions usually have small trunk lengths (Harrison, 1964). Similarly, the chest circumference of the boys of the desert region is less compared to boys from other two popul-
ations except at 4, 5, 8 and 9 years when the mean values of the boys of the present study are higher compared to those of the other two populations. The chest circumference of the girls of the desert area and those from the all India standard is almost the same at 2, 3 and 5 years. The mean values of the girls from the desert region and the green belt of Rajasthan are almost the same at 2, 4 and 5 years. At 1, 3 and 6 years onward the girls from the desert area have larger chest circumference as compared to the girls from the green belt of Rajasthan, and at 1 and 6 years onwards compared with all India standards. The boys and girls of the desert area as expected have long lower limbs from 1 to 18 years compared to children from all India standard and green belt of Rajasthan, which is a typical feature of a desert population.

From the foregoing discussion it is clear that the children of the present study who are natives of desert region of Rajasthan are heavier and taller and have long lower limbs compared with the children from all India standard and those from the green belt of Rajasthan. According to Huss et al. (1985) growth difference between groups reflect environmental factors during childhood, however, during adolescent years, genetic factor play role and adult size result from the blend of hereditary and environmental factors, the environmental factors predominate. Fiawoo (1975) and Malcon (1975) have reported that environmental factors strongly regulate growth in size.
and composition and the rate of biological maturation.

Since the diets of the desert children show that amount of food consumed by them is less than the recommended dietary allowances for Indian children, it is therefore, evident that there being tall, heavy and having long lower limbs with respect to children from the other two populations can not be attributed to their nutritional intake, it could either be genetic or environmental or both. Since the population studied is highly homogeneous as they practice endogamy and have inhabited the desert area over centuries, the genetic factors coupled with responses to environmental stresses could only be taken as a satisfactory explanation for their present growth status and body morphology.