CHAPTER I
INTRODUCTION

Growth is a fundamental and common property of life. Its course is governed by certain fundamental laws. Human body growth is a complex process which has been defined by Garn (1952) as a change in magnitude, increments in the size of the organs, increases in the thickness of tissue or change in the size of an individual as a whole. Macy and Kelly (1957) defined it as the biochemical metabolic relationship between physical and chemical composition of the body.

Human body growth is governed by certain factors, such as nutrition, climate, socio-economic condition, diseases and genetic factors. The most important among these is nutrition for growth. Available data in this field suggest that sub-optimal nutrition during infancy and early childhood delays and even stunt growth. Jackson (1966), Woodruff (1966), Behar (1968) and Tanner (1962) states that when adequate diets of children were supplemented with nutritious food the rate of growth improved. Children born to mother on sufficient nutrition, enriched food regarding proteins, vitamins during pregnancy were better in general health than the children born to mothers on poor diet.

Thus it can be concluded that the most important factors
for growth is nutrition. Gomez et al. (1955), Shah and Udani (1968), Earwatt et al. (1972), Garn and Rahmann (1966), Gurneg and Jalliffe (1972) suggest that the environmental conditions affect the growth rate.

Sollberger (1969) commented that "climatic factors may or may not synchronize. If they do, they may reinforce each other, counteract each other or drive independent system in the organism." Several investigators suggest that seasonal periodicity in sun light may act on the endocrine system of the child so as to synchronise changes in sunlight availability (Marshel and Tanner, 1970).

Nylin (1929) experimentally tested this hypothesis on a small sample of Swedish boys and found that during the period of treatment (sun lamp treatment), the experimental group averaged one and half centimeters more growth in height than the control group. Vincent and Dieridex (1960) found that healthy children living near equator grew more rapidly in the dry season than in the rainy season.

A relationship between light and growth has been known for nearly 60 years. In 1919, it was discovered that ultraviolet light could cure rickets, a disease of bone growth. A few years later the relationship between a newly discovered dietary substance Vitamin D, and normal bone growth was
demonstrated (Causins and Deluca, 1972). Today it is known that cholecalciferol, Vitamin D₃ is synthesised by the skin when exposed to ultraviolet light (Ramusen, 1974). The physiological action of Vitamin D₃ is to increase the intestinal absorption of calcium and to control the rate of skeletal remodeling and the mineralisation of new bone tissue (Ramusen, 1974). Vitamin D₃ is essential for normal bone growth and thus growth in height.

Tanner (1962) has mentioned that besides environment genetic factors are also responsible for growth. The growth of a child at a particular age is a product of both genetic and environmental factors. Certain environmental conditions may be favourable to a particular genotype and they may be unfavourable to the other genotype. It can also be further added that the children of different ethnic groups may not possess the same potentialities because of variation in their genetic constitution.

Height is basically a genetic characteristic and its growth is governed primarily by genetic or ethnic factors. However, it is also influenced by nutrition and other living conditions. In fact, the genetic potentialities of growth in height are fully exploited by adequate nutrition and other environmental factors. Children of richer parentage have been known to be larger than those of the poor; for example, in England (Clements, 1953), United States (Hathway, 1957).
Nigeria (Collins, 1962), India (Udani, 1963), Hong Kong (Chang et al., 1963) and Jamaica (Ashcroft and Lowell, 1962) state that growth is influenced by biological determinants, including sex intrauterine environment, birth order, birth weight in a single and multiple pregnancies, pre-natal size and genetic constitution.

According to Tanner (1962), the influence of socio-economic status on growth performance of children basically could be due to multifactors, such as adequate sleep, proper exercise, proper nutrition and home environment. Nutritional status is clearly associated with growth difference among groups of genetically related children (Freizen et al., 1967; Malcolm, 1970) and public health workers have long known that children from low income groups show rate of growth patterns than north American whites because of nutritional difference (Malcolm, 1973). Udani (1963) compared children belonging to high income groups with those from low and middle income groups and found that the growth rate of high income groups was obviously superior to low income group.

Tanner (1962) states that when adequate diet of children were supplemented with nutritive food the rate of growth had remarkable improvement. He also mentioned that the growth of the child at a particular age is the product of both genetic and environmental factors, which could be favourable for a child with a specific set of genes and could possibly be
unfavourable for another.

Diseases are the other important environmental factors which influence growth. Howett et al. (1955) noticed that retardation in height and skeletal maturity is depended on the degree of severity of illness. Swaminathan et al. (1964) observed cases of sharp decline in weight which was very often attributed to frequent and prolonged illness, inadequate treatment and poor caloric malnutrition.

The studies so far available are pertaining mostly on post-natal growth. From these studies the trends of growth can be ascertained. For studying this trend in human population information regarding several biological variables is commonly used; the important among these are height, weight, sitting height and certain width and girth measurements. These parameters provide valuable information about the rates and patterns of growth.

Boas (1911), Guthe (1918) and various other workers have shown that there are changes in head form, i.e., head length and head breadth with increasing age migration, nutrition, etc. Fischer (1936) stated that with increase in height the skull becomes somewhat more elongated and since height of an individual is partly conditioned by nutritional and other factors during growth period this may result in the decrease or increase of cephalic index, corresponding to the increase or decrease in height.
Growth changes in head and face by anthropometric, craniometric and roentgenometric investigations, various investigators have shown that with the increasing age, changes are found in head form. This is also affected by nutrition and admixture. The important work in this direction are of Steggedra (1928-29), Pievenge (1942), Notschale (1961). The other studies dealing with the head dimension by Goldstein (1939), Meredith and Knot (1962) and Miklashevskaya (1966).

According to Tanner (1962), the growth changes partly in bizygomatic breadth and in morphological facial height show a different trend than that of the dimension of the head. The former have the visceral growth type and the neural one. The growth of the cranium is vigorous during first or two years of life afterwards it decreases considerably (Watson and Lowrey, 1956). The cranium attains 90% of its adult size at the age of 4 or 5 years and slowly reaches to adult proportion at the age of 10 to 12 years. Head height as compared to the head length remains more or less constant throughout 21 years, however, head breadth decreases in relation to head length (Sharma, 1964).

Physical dimensions, such as height, sitting height and bicristal diameter, are basically controlled by genetic factors and are also influenced by diet and other environmental factors. One great difference in body weight and other
measurements is that the former is influenced to a much greater extent by diet and other living conditions, whereas the latter, such as height and sitting height, are influenced, to a comparatively lesser degree, of nutrition. Height and weight provide information about children’s growth. The linear growth and total body mass can be ascertained by these parameters. Recently sufficient literature is available on the growth of height and weight. (Dleming, 1957; Hathway and Tord, 1960; Stoudt et al., 1960; Tanner and Koef, 1962; Malcolm, 1969; Hamill, et al. 1970; and Hamill and Lameshow, 1973).

Bicristal diameter is a measure of skeletal breadth and is generally used to characterise population (Stoudt, 1970) and also along with bi-acromial breadth is used in Tanner's index of androgyny (Tanner, 1951). Stature and bicristal diameter are the two dimensions in estimating body build in man. In young adults, these measurements reflect not only genetic influence but also environmental factors operating throughout the period of growth (Clarke, 1977).

While arm circumference measure three body components, i.e. bone, muscle and subcutaneous fat layer, unlike skeletal measurements, which consider the growth of bone only. An estimate of muscularity can be obtained with simultaneous measurements of skinfold thickness and arm circumference.
(Standard et al., 1959; Jelliffe and Jelliffe, 1960). Its use in assessment of nutritional status of children had been stressed by Jelliffe (1966) and Jelliffe and Jelliffe (1969), and to differentiate weight into its components parts — muscle bone and fat by Lambard (1950).

Adolescent maturation rates can be studied by menarche. It has been proved that climate has a great influence on menarche. The age of menarche of girls in the tropic is much earlier than that of girls in the temperate regions. It is also noticed that socio-economic difference is the most important factor for this phenomenon.

After ascertaining trends of growth of certain components of human body it is now essential to deal about subcutaneous fat. This can be measured by skinfold caliper. Skinfold thickness taken at a variety of body sites are used widely as measure of subcutaneous fatness. In any particular group of men or women, subcutaneous fat is related to the percentage by weight of fat in body (Allen et al., 1956; Mayer, 1959). Body fat varies considerably with nutritional status and its measurements provide an estimate of caloric reserves available to the individual. Skinfold thickness is the only measurement which can be used for study of large populations for prevalence of obesity as well as to provide an additional parameter of under-nutrition. In nutritional state evaluation

According to Tanner (1964, 1965) muscle thickness of different parts of body are related to one another. Among adult sex difference in the body composition has been clearly established through many studies (Comstock and Lindsay, 1963; Chen et al., 1963 and Steinkamp, 1965). The relationship of body composition to maturation rate has been demonstrated by Garn and Haskell (1959). The amount of subcutaneous fat at different points are highly correlated (Garn, 1954; Tanner, 1962; Singh, 1966).

Indices of anthropometric measurements at different age groups during growth can provide useful information about growth of one measurement compare to the other (Singh, 1972). Bigwood (1939) gave in detail the various somatometric indices and discussed their use in assessment of nutritional status of populations. The form and shape of head can be determined from the cephalic index (Bielicki and Welon, 1964; Huizinger and Solab, 1965; Hammer, 1966 have expressed the same). These studies suggest that the length and breadth of the head are the only measurements which give a three-dimensional expression of the head.
Rao and Singh (1966) state that the index of \((\text{weight/height})^2\) X 100 gives a better estimate of under or over nutrition. Indices involving height-weight and sitting height are of major importance in human biology (Stoudt et al., 1970).

So far various parameters pertaining to the trends of growth are dealt. There is now quite a good deal of literature available about various factors affecting the growth of human body. However, much attention is yet to require in this direction. Sufficient attention of the scientists to understand this trend was not paid till 17th century. The first systematic study was conducted by Buffon. It was the study of Count Philvert Gueneande Montbeileard upon his son, the height being recorded at six months intervals (1759-1717). Lambert Quetlet (1796-1874) was the first to conduct an extensive study on height and weight of male and female of varying age groups. The interest in this field is thus increased and Krogman could collect over 2,000 references published between 1914-1940.

The human growth studies in India starts from 1931. This was followed by a number of studies. These studies compared to the western countries are few, therefore, it can be said that the work in this field is inadequate.

Most of the researchers have done work on the trends of growth from the standpoint of nutrition (Aykroyd and
Krishnan, 1937; Wilson et al., 1937; Akroyd et al., 1938; Krishnan, 1938; Rajgopal, 1938; Showrie, 1938; Kamat, 1951; Rao et al., 1954; Ramanathan et al., 1955; Rao et al., 1959; Swaminathan, 1964; Singh, 1966 and Berry et al., 1968). These studies mostly deal with body weight and height with reference to the nutritional and socio-economic status of many populations.

Apart from these studies the Indian researchers are probing further into different growth problems. Some of these studies are of Mahalanobis and Bose, 1940; Majumdar and Bahadur, 1951; Tiwari, 1954; Das, 1955; Biswas, 1956; Gupta and Datta, 1963; Madhavan et al., 1964 and Singh, 1966.

THE PRESENT STUDY

The problem undertaken to investigate in this study is "A comparative study of the trends of growth among the Jain male and female children of Sagar, Madhya Pradesh, India".

Two types of information have been analysed on the basis of comparative auxology:

(i) Variation within population
(ii) Variation between populations.

Precisely, the study here is based on the latter and the
objectives and aims of the present study are:

(1) The physical development and the body growth of the Jain male and female children between 6 and 17 years.

(2) To study adolescent growth spurt in the population under study.

(3) To study and understand difference in all physical characteristics and maturity and rate of growth as seen during childhood and adolescent period between population selected in this study.

(4) Enlightenment on the trends of differences and similarities in the population under study.

(5) To study correlations between the selected anthropometric measurements as well as between skinfold measurements.