CHAPTER II
MATERIAL AND METHODS

The Sagar district lies in the extreme north-west of Madhya Pradesh between 23°91' and 24°27' N and 78°41' and 79°22' E and has an area of more than 3,000 square miles. The region is an extension of Malwa plateau and is separated from the Narmada Valley by the high Vindhyan ranges. It is surrounded on the northern side by Jhansi district of Uttar Pradesh, and Panna, Bijawar and Charkhari regions of former Vindhya Pradesh on the eastern side by Panna and Damoh districts on its south by Narsinghpur district and a portion of Bhopal district, and on the west by the Bhopal and Gwalior districts.

The climate of the district is very moderate in proportion to the latitude. The average monthly maximum and minimum temperature usually ranges from 52° to 77°F in the month of January, 78.5° to 105°F in the month of May, and 79° to 83.5°F in the month of July. The climate is generally pleasant and salubrious.

The diversity in the morphological features of the population of this area is quite great. Here the people are both fair to dark skin, medium short to tall stature and thin to thick lips are found. The texture of the hair varies from
straight to wavy and often curly. This diversity shows that various ethnic strains have contributed to the present diversified physical forms of this population.

The present study deals with the comparative study of the trends of growth among the Jain boys and girls. It is therefore necessary to understand occupation, dietary habits and social structure of this population.

Nearly more than two crores of people are the followers of Jain religion. Majority of them are businessmen and money-lenders. At present Jain are believed to be one of the richest and most prosperous communities in India. They are strictly vegetarian and zealous followers of 'ahinsa'. Even a slight thought of violence to life cause shiver in their virtuous and religious mind. They always drink filtered water and take their food before the night falls. Most of them are extremely particular about their daily routine of ritual life. They visit their 'mandir' (temple) in the morning after bathing and having prayed to God start their routine work.

According to several significant historical records, Jainism originated during fifth or sixth century A.D., but Jain consider this as erroneous and misleading. Recent researches conducted by some enthusiasts prove to be contrary. A brief description of these findings is given in the following manner:
All upper, western, north, central India was then, say 1,500 to 800 B.C., and indeed from unknown time, ruled by Turanians conveniently called Dravida and given to tree, serpent, pholidic worship but there also then existed throughout upper India an ancient and highly organised religion, philosophical, ethical and severely as celestial, viz. Jainism, out of which clearly developed the early ascetical features of Brahmanism and Buddhism. Long before the Aryans reached the Ganges or even the Saraswati, Jains had been taught by some twenty-two 'Thirthankars' prior to the historical twenty-three 'Thirthankars Parva' of the eight or ninth century B.C. (Furtong, 1944).

According to Guimont and Swami (1945), "there is very ethical value in Jainism. Jainism is very original, independent and systematic doctrine. It is more simple, more rich and varied from Brahmanism system and not negative like Buddhism."

In support of the above statement Swami (1945) further says that Jains are not Hindu descendents but Jainism has an origin and history long anterior to the 'Smritis' and commentaries which are recognised authority on Hindu law usage.

It is clear from the above statement that Jainism originated long before Buddhism and Sanatan Dharma came into existence. It is also true due to their long association with
Hindus who formed and adopted many of the customs even ceremonies strictly observed by the Hindus pertaining to Brahmanical religion.

SOCIAL STRUCTURE OF JAINS

Jain community can be divided into four schools of thought:

(1) Digambar;                  (2) Shvetambar;
(3) Yapnig;                     (4) Ardhya Sphalak.

The last two schools became extinct and there are no followers of these schools.

DIGAMBAR:

This school is divided into following Sanghs: (1) Nandi; (2) Deo; (3) Sen; (4) Singh; (5) Dravid; (6) Kusta; and (7) Mathur. A Sangh is divided into Gans. These Gans are further divided into Gachch. This division can be clearly understood from the following chart:
Sagar is one of the biggest centres of Digambar Jains. According to the Census Report of 1971, their number amounts to sixteen thousands seven hundred and fifty-three. Intermarriage is strictly prohibited. Dowry system among Jains is prevalent to a great extent.

The kinship relations of the Jains have a significant role in their society. The system is strongly patrilineal and virilocal. Three types of family are available amongst them: nuclear, extended dispersed and extended single compound. Kinship relationships within the extended family are more or less typical of those found in Hindu society. There is a pattern of overall male dominance with segregation of sexes in social activities and religious context.

To study the trend of growth the sample is drawn amongst the Digambar Jains of Sagar district. The various schools and colleges lying within a radius of 5 to 20 miles were visited during the month of November to May 1978. Measurements were made on 600 male and 600 female Jain children, aged 6 to 17 years (Table 2.1). The individuals constituting the sample were in general of normal health and good physique. Subjects with abnormalities and suffering from chronic diseases were excluded in the present study. In order to ascertain the age, the school records were consulted. In some cases, the date of birth was further checked from other available records.
TABLE 2.1

Age-wise distribution of data of Jain male-female children of Sagar town (M.P.).

<table>
<thead>
<tr>
<th>Age Group (yrs.)</th>
<th>Absolute No. of boys</th>
<th>Percentage</th>
<th>Absolute No. of girls</th>
<th>Percentage</th>
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<td>6</td>
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<td>17</td>
<td>50</td>
<td>8.33</td>
<td>50</td>
<td>8.33</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>600</strong></td>
<td><strong>99.96</strong></td>
<td><strong>600</strong></td>
<td><strong>99.96</strong></td>
</tr>
</tbody>
</table>
Cross-sectional data on children from schools and colleges in a class-wise manner were collected.

Jains are economically well placed as compared to the other castes of this area. This influences their nutritional standard, therefore it can be said that the population is less effected by malnutrition. The main staple food is wheat and the types of pulses consumed are green gram, Bengal gram, arhar, etc. Vegetables include brinjals, potatoes, peas, beans, lady's finger, chilli, pumpkin, snake gourd, cabbage, carrot, radish, beet root and all the leafy vegetables and so on. Milk, curd and butter milk are consumed daily. Ground nut oil (sweet oil) and ghee are used for cooking purposes. This community is strictly vegetarian.
METHODS OF GROWTH STUDIES

Human body growth is studied by three different methods: cross-sectional, semi-longitudinal and longitudinal methods.

Cross-sectional Method:

The simplest, the most common and the least time-consuming method is the cross-sectional method, which yields results quickly and is comparatively cheap (Falkner, 1962).

Cross-sectional studies examine population for certain factors at certain ages and information obtained can be perfectly adequate and reliable for some problems. In this method, measurements are taken only once on the child population covering the full range of growth. This method is appropriate for use in population surveillance, for example, of nutritional state. Clinical standard for height attained by healthy children at various ages can be constituted from purely cross-sectional data (Tanner, 1958; Tanner and Whitehouse, 1959). To determine the average growth performance of a particular population the cross-sectional method is more practicable. The great limitation of this method is that the detailed growth pattern of children cannot be studied.
**Longitudinal Method:**

The measurements are repeated on certain individuals from birth to maturity at regular intervals. This method is very time-consuming and to obtain complete information sufficient time is needed. However, longitudinal studies are appropriate for the study of growth of individual children, but it is difficult to get the co-operation from the children and their parents.

**Semi-Longitudinal Method:**

A combination of the above two methods is known as semi-longitudinal or mix longitudinal method. In this method, children are measured at least twice but fail to last for specified period and others who enter the period of measurement are included (Tanner, 1962).

The present study is based on the cross-sectional method.
ANTHROPOMETRIC MEASUREMENTS

According to Comas (1960), from biological point of view all body segments and all measurements are important, but some have greater practical interest. "All studies should be designed carefully to answer specific question, not as an open ended collection of data, which, it is hoped, will sometimes answer questions, not yet answered" (Sontag, 1962). Taking an account of their facts, twenty-four measurements (sagittal, circumferential and transverse body measurements) and four skin fold measurements have been selected. The measurements have been taken following the recommendations of Martin (1928) and Singh & Bhasin (1968).

Definitions of each anthropometric measurement and a brief description of the technique employed are given below:

(1) **Head Length**: The distance between glabella and opisthocranion point was taken with spreading caliper.

(2) **Head Breadth**: This was determined with spreading caliper by measuring the distance between the two euryon points.

(3) **Head Circumference**: This was taken with the steel tape, passing over the sides of the head, touching glabella, eye-brows and most protruding point on the back of the head.
(4) **Bizygomatic Breadth**: The most lateral points on the zygomatic arch was determined with spreading caliper.

(5) **Bigonial Breadth**: The distance between the two gonia was measured with spreading caliper.

(6) **Physiognomic Facial Height**: The distance between trachion to gnathion was measured with sliding caliper.

(7) **Upper Arm Length**: The distance between acromion and radiale was recorded by the first segment of anthropometer.

(8) **Fore Arm Length**: It was taken in the same manner as that of upper arm length, but the two points were radiale to stylion.

(9) **Upper Arm Circumference**: The steel tape between the acromion and radiale was fixed around the arms. Care was taken not to compress the soft tissue. Direct readings were obtained.

(10) **Fore Arm Circumference**: This measurement was taken with steel tape almost under the elbow joint with the hands hanging freely by the side.

(11) **Hand Length**: The straight distance between the midpoint of a line joining the stylion and dactylion of the middle finger was measured with sliding caliper.
(12) **Hand Breadth:** It was taken with sliding caliper and the straight distance between metacarpel radiale to metacarpel ulnare was recorded.

(13) **Chest Breadth:** The most laterally placed points of the ribs at the height of mesosternale measured with rod compass using moderate pressure with hands hanging freely.

(14) **Chest Depth:** The distance from mesosternale to the horizontally placed point on the vertebral column was measured with rod compass.

(15) **Chest Girth Normal:** This was measured with the tape perpendicular to the vertebral column at the level of axilla when the subject was made to breathing normally.

(16) **Bi-ilio Breadth:** It measures the straight distance between the two anterior iliospinale measured by rod compass.

(17) **Bi-Trochanteric Breadth:** This was recorded with rod compass taken in between the most lateral points on the trochanteria.

(18) **Hip Girth:** The circumference of the hips at their widest portion was measured with steel tape.

(19) **Calf Circumference:** The maximum circumference of the leg below the knee was recorded, in the erect position with steel tape.
(20) **Foot Length**: The straight distance between pteryon to acropodion was recorded with rod compass.

(21) **Foot Breadth**: This was determined with sliding caliper between metatarsal tibiale to metatarsal fibulare.

(22) **Body Weight**: The subject was weighed in normal clothing without shoes. Weight was taken on a machine which was graduated.

(23) **Height**: It was taken with the anthropometer. The subject was told to stand erect, feet together and the back of the heel, upper back and occiput touching the anthropometric rod, the head being held in the horizontal position. The sliding arm of the anthropometer was gradually with the vertex. Direct reading was noted.

(24) **Sitting Height**: The subject was seated in an erect position on a table with legs hanging freely. The back was straightened and the head was positioned in Frankfurt plane. The measurement was taken from the vertex of the head to the table.

Apart from the above-mentioned measurements, skinfold measurements were obtained at four different sites:

(1) **Calf**: Parallel to the long axis of the leg, a fold was picked up on the widest portion of the calf and the measurement was taken with skinfold caliper.
(2) **Subscapular**: Parallel to the natural cleavage line of the skin, just below the angle of the scapula a fold was picked up and the measurement was taken with the skin fold.

(3) **Triceps**: A fold over the triceps muscle was lifted with the thumb and index finger, with its axis parallel to the long axis of the arm. The skin fold was kept at a place where two sides of the fold were parallel to each other. A uniform pressure of 10 gm/mm² was exerted and the reading was taken to the nearest 0.1 mm.

(4) **Biceps**: In the same manner, the skin fold measurement over the biceps muscle was obtained.

After studying the measurements incorporated in present study it has become essential now to ascertain the trend of growth, which can be calculated by the following method.

Absolute growth is obtained by subtracting the mean value of the lower age group from the successive higher age group.

For calculating the percentage growth rate the following formula is used:

\[
\text{Absolute growth} \times \frac{100}{\text{Mean value at the lower age group}}
\]
The data thus analysed are further subjected to statistical treatment. The tests employed for this purpose are briefly described here as follows:

**Standard Deviation:**

It is essential in statistical investigations to calculate the variability of the size of items around an average to throw more light on the composition of a series. This variability is best measured with the help of standard deviation.

Standard deviation could be defined as the square root of the arithmetic average of the squares of deviations measured from the mean.

Symbolically \[ \sigma = \sqrt{\frac{\sum d^2 x}{n}} \]

where, \( \sigma \) stands for the standard deviation.

\[ \sum d^2 x = \text{the sum of the squares of deviations measured from the actual arithmetic averages.} \]

\[ n = \text{number of items in the series.} \]

However, if we want to compare the dispersion in two series, we cannot use the absolute dispersion which we get as in above. But we have to calculate the relative dispersion which is
free from the unit of measurement. Thus in a comparison of the
variability of two or more series, it is the relative dispersion
that has to be taken into account, as the absolute dispersion
may be erroneous or unfit for comparison if the series are
originally expressed in different units. For this purpose we
shall have to take the help of coefficient of variation.

Correlation Coefficient:

Correlations is the relationship between two interdependent
variables. In order to find out the amount of correlation or
the degree of correlations that exist between these two
interconnected variables. Karl Pearson's Coefficient of
correlation is generally employed.

Symbolically, \[ r = \frac{N \sum{xy} - \sum{x} \sum{y}}{N \sum{x^2} - (\sum{x})^2} \]

where, \( r \) = the coefficient of correlation.

\( \sum{xy} \) = sum of products of deviations of \( X \) and \( Y \) series
taken from mean.

\( \sigma_X \) = standard deviation of \( X \) series.

\( \sigma_Y \) = standard deviation of \( Y \) series.

\( N \) = number of pairs of observations.
The value of the coefficient of correlation vary between two limits that is +1, if \( r = +1 \), there exists a perfect positive correlation between the two variables on the other hand, if \( r = -1 \) a perfect negative correlation is implied. These two extremes, however, do not often occur in natural phenomena because of the reason that an event is influenced by several factors. Therefore, we expect a value of correlation coefficient between +1.

Regression:

Comparison between two or more variables can be studied by regression. It is a measure of average relationship between three or more series and speaks about the probable change in a dependent variable as compared to a certain change in the other variable. The regression forms the basis of correlation analysis.

If there is a perfect correlation between the two series there are two regression equations; one of X on Y and the other of Y on X. From the equation X on Y the most probable value of X for given value of Y can be determined. From the second equation Y on X the most probable value of Y for given value of X can be determined.
Regression co-efficients:

\[ X \text{ on } Y \text{ or } B_{XY} = r \frac{\bar{X}}{\sigma_X} \frac{\bar{Y}}{\sigma_Y} \]

\[ Y \text{ on } X \text{ or } B_{YX} = r \frac{\bar{Y}}{\sigma_Y} \frac{\bar{X}}{\sigma_X} \]

Regression equations:

\[ X \text{ on } Y \]

\[ (X - \bar{X}) = r \frac{\sigma_X}{\sigma_Y} (Y - \bar{Y}) \]

\[ Y \text{ on } X \]

\[ (Y - \bar{Y}) = r \frac{\sigma_Y}{\sigma_X} (X - \bar{X}) \]

where, \( \bar{X} \) = Mean value of \( X \) series.

\( \bar{Y} \) = Mean value of \( Y \) series.

\( \sigma_X \) = Standard deviation of \( X \) series.

\( \sigma_Y \) = Standard deviation of \( Y \) series.

\( r \) = Co-efficient of correlation.