Materials and Methods
2. MATERIALS AND METHODS

Present chapter deals with the methodology and techniques followed to achieve the aims of the present cross sectional study on adolescent and pre adolescent Jaunsari (tribal group) and Garhwali (non tribal group) Rajput females of District Dehradun, Uttarakhand. Both Jaunsari and Garhwali Rajput population groups share a common environment but they are genetically different along with their social economic status and nutritional intake.

2.1 Area and people

Uttarakhand the land of gods and home of Himalayas is truly a paradise on earth. Also known as Dev Bhumi it allures everyone from everywhere. The fresh air, pure water, chilling snow, adversing mountains, scenic beauty, small villages, simple people and a tougher lifestyle is what distinguishes Uttarakhand from rest of the world. Nestled between Nepal and China in north, Himachal Pradesh in the west and Uttar Pradesh in the south, most of the northern parts of the state are part of Greater Himalayan ranges. While the lower foothills were densely forested till denuded by the British log merchants and forest contractors after independence.

Uttarakhand has a total geographic area of 51,125 km² (Coordinates: 30°20N 78°04E / 30.33°N 78.06°E ) of which 93% is mountainous and 64% is covered by forest. Uttarakhand region is traditionally referred to as Uttaranchal in old literature and scriptures, which derives from the Sanskrit for Northern Country. Dehradun is the capital city of the Uttarakhand State. It is located in the Doon valley, 230 kilometres north of India's capital New Delhi. The district is surrounded by the Himalayas in the north, Sivalik Hills in the south, the river Ganga in the east, and the river Yamuna in the west. The water divide of Ganga and Yamuna passes through the city.
The present state of Uttarakhand was earlier part of the United Province of Agra and Awadh, which came into existence in 1902. In 1935, the name of the state was shortened to United Province. In January 1950, United Province was renamed, as Uttar Pradesh and Uttarakhand remained a part of Uttar Pradesh before it came into being on 9 November 2000, the 27th state of India. The state comprises of two regions, the western half known as Garhwal and the eastern region going by the name of Kumaon. The two have different chieftains in history and different lingual and cultural influences due to proximity and neighbourhood of different cultures. The inseparable and complementary nature of their geography, economy, culture, language and traditions, however, has created strong bondages between the two regions. The native people call themselves Garhwali/Kumaoni depending on their place of origin in either the Garhwal or Kumaon region and more than 90% of them
are Hindus, ethnically belonging to the Indo-Aryan group. Most of them identify themselves in the upper castes. Other ethnic communities in the region include Nepali who have arrived over the past century from the neighbouring country of Nepal, and the Tibetan migrants settled called as the Jadh, Marcha and Shauka on the Indo-Tibetan frontier, collectively known as the Bhotia, and nomadic cattle herders known as Gujjar in the southern Terai region.

According to 2011 India census, Uttarakhand had a population of approximately 1,01,16752 (males: 51,54,178 and females: 49,62,574). Kumaoni and Garhwali dialects of Central Pahari are spoken in Kumaon and Garhwal regions respectively. Jaunsari and Bhotia dialects are also spoken by tribal communities in the west and north respectively. The urban population however converses mostly in Hindi. Hindus form the majority of the population at 85.0%, Muslims form 10.5%, Sikhs 2.5% and Christians, Buddhists, Jains and others about 0.5%. It has male-female ratio of 963 and has a literacy rate of 79.63% (males: 88.33% and females: 70.70%).

2.2 Economy

Born out of partition of Uttar Pradesh, the new state of Uttarakhand produces about 8% of the output of the old Uttar Pradesh state. From 2003, a new industrial policy for the state with generous tax benefits for investors was initiated that has led to a massive upsurge of capital investment. SIDCUL, the State Industrial Development Corporation of Uttaranchal (sic) has established seven industrial estates in the southern periphery of the state, while dozens of hydroelectric dams are being built in the upper reaches. However, hill development remains an uphill challenge as out migration of local people continues from the highland hinterlands.

2.3 Tourism

Leisure, adventure and religious tourism play a prominent role in Uttarakhand’s economy, with the Corbett National Park and Tiger Reserve and the nearby hill-stations of Nainital, Mussoorie, Almora, Kausani, Bhimtal and Ranikhet being amongst the most frequented destinations of India.
2.4 Education

Uttarakhand has educational institutions of major importance to India and the world. It is home to one of the oldest engineering colleges in Asia, the India Institute of Technology at Roorkee (formerly University of Roorkee).

Uttarakhand is a region with great ethnic diversity. Though nobody can be called a native here, there are tribes and villages of people who have no other place to relate to. They are mostly dependent on agriculture and handicrafts. The economy revolves around the fairs that are held all round the year. People of Uttarakhand are commonly known as Pahari, meaning people from hills.

2.5 Ethnicity

Uttarakhand has Rajputs, Brahmins and a number of tribes like Jadh, Marcha, Tolcha, Shauka, Buksha, Tharu, Jaunsari, Bhotia, Raji and Gujjar with ethnic Garhwali and Kumauni people. Anthropologically speaking Uttarakhand has living human samples from ancient races such as Proto-Australoid, Mongoloid, Nordic and Dravidian.

2.6 Population under study

Rajput

The Rajput of Garhwal are believed to be of Aryan origin. They came as waves of settlers either from the south or from the adjoining tracts of Himachal Pradesh, where they had come from the Hindu Kush through Kashmir. Later Rajput settlers to Garhwal also came from Rajasthan to escape from the invasions of the Muslims/Mughals. These people fought and subdued the Kols or Koltas or Doms, who were living in Garhwal at that time. Initially, the Rajputs took to settled agriculture as they had brought new skills with them. Later on, they took to other professions. They also joined the armies of various kings of Garhwal in large numbers. At present, the Rajputs can be found in most professions like agriculture, business and government service. Many Garhwali Rajputs are in the Armed Forces of India, particularly in the army.
Jaunsari

Jaunsar - Bawar forms the northern half of Dehradun district and the people living there are called the Jaunsari. They are probably of very pure Aryan stock. This area had links with the ancient cultural waves, which swept over the northern part of India, particularly during the Vedic, Mahayan, Kushan and Gupta periods of ancient Indian history.

The people follow many of the old customs even today, distinct from their compatriots elsewhere in Garhwal, Kumaon and Himachal Pradesh. Even the art and architecture has its unique features, with profound use of woodwork. The most important festival of the Jaunsari is the Magh Mela. During festivals, they wear the Thalka or Lohiya, which is a long coat. Thangel folds like tight-fitting trousers. Digwa or the cap is the traditional Jaunsari head dress made of woolen cloth. Women wear the Ghagra, Kurti and Dhoti and are fond of ornaments. The Jaunsari still practice polyandry, which is said to be the consequence of their having had a close association with the legendary Pandava brothers of the Mahabharata, who had a common wife, Draupadi.

The sample for the present investigation comprises of a total 1319 Rajput females (664 Garhwali and 655 Jaunsari) measured for 22 anthropometric measurements (19 direct measurements and 3 indirect measurements) (Appendix 2) according to the standard techniques recommended by Weiner and Lourie, 1969. Individuals ranging in age from 8 to 18 years along with other relevant information as outlined in a Proforma (Appendix 1). Data were collected by following the random technique of sampling and also adequate care was taken while measuring the subject to avoid any error in anthropometric measurements. Subjects under study are apparently normal and unrelated individuals of both Jaunsari and Garhwali population groups.
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Table 2.1: Inclusion and exclusion criteria were also modulated for data collection.

<table>
<thead>
<tr>
<th>Inclusion criteria</th>
<th>Exclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhabitants of Dehradun District (Uttarakhand) for the last 3 generations.</td>
<td>Who are not inhabitants of Dehradun District (Uttarakhand) for the last 3 generations.</td>
</tr>
<tr>
<td>Without any apparent physical disability.</td>
<td>With any apparent physical disability.</td>
</tr>
<tr>
<td>With proof of age (such as birth certificate or school record).</td>
<td>Without proof of age (such as birth certificate or school record).</td>
</tr>
</tbody>
</table>

Data for the present study was drawn from villages (door to door) and schools (Appendix 3) with in Dehradun. Schools were selected from different zones in the city to get equal distribution and total twelve schools were finalized for present study after contacting principals and schools authorities. The data were collected during the years 2008 to 2010.

General information recorded in the field from each subject before the commencement of measurements in a proforma pertaining to Subject’s name, date of birth, date of measurement, Parent’s occupation, mating pattern, Dietary pattern and onset of menarche. The aforementioned information is useful in evaluating:

- The exact age of each subject on the date of measurement which helps in categorizing the total sample in respective age groups for evaluating the age changes in different body dimensions.
- The economic and nutritional status of the subjects family.
- The marriage pattern among the groups under study to assess the Mendelian nature of the population.
- Onset of menarche.
2.7 Mating Pattern

A Mendelian population is that population which shares a common gene pool. Thus, a Mendelian population is considered as an independent universe for any kind of biological study (Stern, 1960). Mendelian population are seldom, if ever, genetically uniform. It is a system of individual united by mating and parentage bonds (Dobzhansky, 1951). Members of a species are often distributed over a wide geographical range. A population, however, is a local group belonging to a single species within mating is actually or potentially occurring. Within the population the set of genetic information carried by all interbreeding members, is called gene pool. The general information collected during the present study reveals the mating pattern of two populations. In order to ascertain whether the population in question is Mendelian in nature or not, the mating pattern was obtained from the father’s sub caste (clan or gotra) and maternal sub caste (clan or gotra). Traditionally the Hindu society is divided into the following four varnas Brahmin (Priests), Kshatriya (Warriers and Rulers), Vaishya (Mercantile and Business class) and Shudra (servile class).

The ‘caste’ and ‘sub caste’ are not absolute but comparative in significance. The larger group will be called as a caste while the smaller, the sub caste. In country like India, which shows maximum diversity in caste and population groups, with gene flow guided by caste affiliations, an emphasis to study each of these groups in relation to their own specific gene pool and environmental condition becomes pertinent. Both the populations under study share same environment and more or less same dietary habits but Garhwali is a non tribal population where as Jaunsari is a tribal population. Jaunsari society is a collection of smaller tribes, hence is divided by ‘caste’ with the indigenous Koltas and Khasas. The Jaunsari group is identified to be one of the rare polyandrous societies in the world whereas in some cases they also follow polygamy. Both the populations are purely exogamous and the preference of marriage among them following the caste structure of marrying within their own respective groups.
2.8 Effective sample size

After careful observation of various sub castes during data collection, cases belonging to inter-caste marriages and intra-caste marriages were kept out of the total sample size. A total of 1319 females (664 Garhwali and 655 Jaunsari) were measured for present study after exclusion and subjected to statistical treatment for analysis of data.

2.9 Age Recording

The problem in the present study is progressive age changes in different biological variables with increase of chronological age. Hence, it is the chronological age of an individual that is of central value to us. In studies regarding growth, chronological age of the subject is one of the pivotal factors so as to have an exact picture of the distance and velocity curves and it is conceptually different than the “development” age as is clear from Tanner’s own writing (1962): “For the purpose of assigning a developmental rather than a chronological age to a growing child there are four systems in use. These are:

1. Skeletal age
2. Dental age
3. Morphological age (size, height, etc.) or Shape age
4. Secondary sex character age

Sinclair (1973) suggested the inclusion of neural age, dental age and physiological age, besides the ones recommended by Tanner (1962). In the present study chronological age has been used in view of the fact that the exact date of birth of the subjects was available and verified from the school records and through horoscopes and birth certificate in case of door to door data collection. After obtaining the exact date of birth record for all the subjects measured, the two population groups under study (Garhwali and Jaunsari females) were categorized into different age groups, ranging from 8-18 years. Chronological age happens to be the exact age of an individual calculated by means of subtracting the exact date of birth from the date of
measurement in the decimal notation following “Decimal age calendar” (Tanner et al. 1966).

“Decimal age calendar” method of age recording belongs to “Code No 1” (Birth Date known to within one day) out of the five mentioned in “I.B.P. Handbook No.9” (Weiner and Lourie, 1969). The “Decimal age calendar” provides the decimal values for each day of the month starting from January 1 as equal to 0.000 year to December 31 as equal to 0.997 year.

Table 2.2: Age wise Distribution of the Total Sample

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>Mean Age</th>
<th>Garhwali</th>
<th>Jaunsari</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.500-8.499</td>
<td>8.000</td>
<td>58</td>
<td>62</td>
</tr>
<tr>
<td>8.500-9.499</td>
<td>9.000</td>
<td>57</td>
<td>56</td>
</tr>
<tr>
<td>9.500-10.499</td>
<td>10.000</td>
<td>65</td>
<td>59</td>
</tr>
<tr>
<td>10.500-11.499</td>
<td>11.000</td>
<td>61</td>
<td>63</td>
</tr>
<tr>
<td>11.500-12.499</td>
<td>12.000</td>
<td>59</td>
<td>64</td>
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<tr>
<td>12.500-13.499</td>
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<td>60</td>
<td>56</td>
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<td>13.500-14.499</td>
<td>14.000</td>
<td>64</td>
<td>66</td>
</tr>
<tr>
<td>14.500-15.499</td>
<td>15.000</td>
<td>66</td>
<td>57</td>
</tr>
<tr>
<td>15.500-16.499</td>
<td>16.000</td>
<td>61</td>
<td>60</td>
</tr>
<tr>
<td>16.500-17.499</td>
<td>17.000</td>
<td>56</td>
<td>56</td>
</tr>
<tr>
<td>17.500-18.499</td>
<td>18.000</td>
<td>57</td>
<td>56</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>664</td>
<td>655</td>
</tr>
</tbody>
</table>

2.10 Selected Measurements for present study

“The selection and technique of measurements depend up on the purpose of the study” (Tanner, 1962). In order to study physical growth of individuals, belonging to any community, it is essential to formulate a proper research design. The research design not only includes the selection of the population to be studied but also the
techniques that are required to study them. In accordance with the present study which aims at studying the comparative growth patterns of a non tribal (Garhwali) and a tribal (Jaunsari) female populations of district Dehradun, Uttarakhand, who shares a common environment and have almost similar socio-economic status and nutritional intake.

A set of nineteen (Direct measurements) linear, sagittal, transverse, circumference and skin fold thickness measurements pertaining to trunk and the extremities besides body weight and height have been taken on each subject.

2.11 Assessment of nutritional status

Nutrition status of Garhwali and Jaunsari Rajput females has been assessed by considering BMI, WHR, Height and Body weight percentiles.

2.11.1 Body mass Index

Body mass Index evaluates an individual’s weight status in relation to height. Also known as Quetlet’s index, it is a good anthropometric index for classifying adiposity in adults and it is recommended for use both among the children and adolescents. BMI is a screening tool used to identify individuals who are underweight or overweight. It is a mathematical formula in which a person’s body weight in kilograms is divided by the square of his or her height in meters i.e. Weight (kg) / height (m)²

The following variations are known to apply to BMI calculation:

1. At the same BMI, women tend to have more body fat than men.
2. At the same BMI, older people, on average, tend to have more body fat than younger adults.
3. Highly trained athletes may have a high BMI because of increased muscularity rather than increased body fat.
2.11.2 Waist hip ratio

Waist circumference along with the hip circumference seems to be a better indicator of the abdominal adiposity. Now a days waist hip ratio is used to identify disease risks in an adults and is popularly known as WHR. It is calculated as follows

\[
\text{WHR} = \frac{\text{Waist Hip Circumference}}{\text{Hip Circumference}}
\]

Growth curves

Distance and Velocity curves of all the biological variables have been based on the mean values of different biological variables and the decimal age.

Distance curves

Distance curves refer to the distance travelled by a child along the road to maturity and reflect the individual’s absolute level of growth at each successive age-level. Such curves are cumulative because the body measurement at each age is dependent on how much the child, has grown in all the preceding years. Distance curves have a uniform shape, exhibiting a regularity in growth over the years. They are positively accelerated from birth till maturity and once the adolescence spurt is over, the curve flattens out into a plateau indicating that there is no more than 2% growth thereafter.

Velocity curves

Velocity curves represent an individual’s growth status at a particular age and indicate the relative changes (increments) in growth that occur from one age to another. In other words, they represent the rate of growth per year. Thus, the velocity or rate of growth reflects the individual’s state at any particular time better than does the distance achieved.

2.12 Stipulations of the study

An attempt has been made to assess the growth patterns and nutritional status in pre adolescent and adolescent Rajput Jaunsar-Bawar and Dehradun females, Uttarakhand. Thus, it is presumed, that the difference exists in their physical growth are primarily
due to genetic differences and not because of the environment conditions. Physical growth and development are multidimensional and interdependent, this is empirically well established, the fact is taken as the basis for the study. The general pattern of postnatal growth (physical/somatic/and mental) is quite similar from one individual to another. There is considerable individual variability, however, in size attained and in the tempo of growth and maturation at different ages.

2.13 Rationale of the problem

The process of growth is so complex and interwoven with other factors that not more than a rather general relationship between physical phase of development and nutritional requirement has been demonstrated. The information on synthetic approach to study the growth patterns and dietary requirement is however scanty in India. The inter disciplinary character of this study makes it possible to check the interdependencies of several aspects of physical growth and nutritional demand in individual besides also providing baseline data for future comparisons.

2.14 Objectives of the study

Patterns of growth and nutritional status of individuals in a particular population proves not to be static but changing with time. It is becoming increasingly recognized that most of genetic variation, as determined from antigenic and protein systems, is common to all human beings. Estimates are that only about 10 % to 15% of human variation in single gene systems is specific to populations or races, whereas the remaining variation is shared by all humans regardless of race or population. To better describe the importance of race or human group differences in total human phenotype variance, the between-population variance tends to be generally less than the within population variance for skeletal dimensions of the body.

A wealth of data has accumulated on body dimensions of individual of races and ethnic groups. Even though there are often mean differences for anthropometric measurements among populations, the ranges of values overlap considerably. The growth patterns and nutritional status in Garhwali and Jaunsari Rajput females (age range from 8 to 18 years) is assessed by measuring them cross sectionally for nineteen
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somatometric measurements with the help of proforma regarding general information under present study. Following are objectives of the present study:

1. To study differences in growth patterns between pre adolescent Rajput females of Jaunsar-Bawar and Dehradun, Uttrakhand.

2. To study differences in growth patterns between adolescent Rajput females of Jaunsar-Bawar and Dehradun, Uttrakhand.

3. To observe the age of adolescent spurt in the Rajput females of Jaunsar-Bawar and Dehradun, Uttrakhand.

4. To study differences in the nutritional status between the pre adolescent and adolescent Rajput females of the two hill populations.

2.15 Limitations of the present study

The Present study has its limitations besides having a representative data are listed below.

1. It is well known that the longitudinal type of growth study offers certain advantages, particularly in knowing the exact annual increments and the velocity curves, it has been possible to collect a cross-sectional type of data due to limitation of time.

2. Despite knowing that the body measurements should be taken perfectly in nude or with minimum clothing on, it has not been possible to measure the Garhwali and Jaunsari Rajput females in nude or with minimum clothing as they have personal objections to doing so besides winter season.