GROWTH STATUS AND FAT PATTERNING AMONG RAJPUT TRIBAL ADOLESCENT BOYS OF SANGLA VALLEY, DISTRICT KINNAUR, HIMACHAL PRADESH

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ABSTRACT

The present cross-sectional study was conducted on the tribal adolescents of Sangla valley situated at an altitude of 2800 m in district Kinnuar of Himachal Pradesh. Height, Weight and selected body circumferences were measured on 206 boys aged between 10 and 18 years. Their Body Mass Index was calculated and compared with their age peers living in varied altitudes of hilly areas of Kinnaur, Rampur Bushahr, Lahaul Spiti, Ladakh, J&K, Chamba, and Bharmour. Besides the anthropometric measurements, additional information regarding the age, sex, caste, family size, income, educational and occupational background of the parents and dietary habits, through personal interview based schedule was also collected. The attained means of height and weight of Rajput boys from Sangla Valley increased from 137.3 cm to 171.9 cm. Compared to their counterparts, mean height and weight of Rajput boys from Sangla was significantly higher (P<0.05) at all age groups. With respect to body circumferences these boys showed almost parity with their peers. Among the Limb Circumferences, the mid upper arm and calf circumference of the boys from Sangla showed higher attained means (P< 0.05) than their counterparts from other areas.

Key Words: Growth, Fat Patterning, Adolescent, Tribal.

INTRODUCTION

Growth may be defined 'as a quantitative increase in size or mass whereas the development is defined as dynamic progression, either quantitative or qualitative, that lead from an undifferentiated or immature state to a specialized and mature state' (Bogin, 1988). However, growth and development are regularly used interchangeably and go side by side in a normal child (Sinclair, 1985). Tanner (1989) typifies human growth pattern as a prolonged period of infant dependency, an extended childhood and a rapid and large acceleration in growth velocity at adolescence leading to physical and sexual maturation. Normal human growth

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and development is the net outcome of the interaction between genetic and environmental factors, as an individual will grow to its full potential only under suitable environmental conditions (Frisancho *et al.,* 1980). The several environmental features that affect growth are nutrition, altitude, climate, migration, socio-economic status, and urbanization. Nutrition plays an important role to regulate proper growth (Jelliffe and Jellifee, 1960; Rao and Rao, 1975; Singh and Harrison, 1996). Hence, growth status is generally accepted as a good index of nutritional status of a population (Eveleth and Tanner, 1990). Growth and nutrition are closely correlated. Many scientists have focussed their attention on the impact of environmental factors on growth (Shapiro, 1938; Frisancho and Baker, 1970; Frisancho *et al.,* 1975; Singh *et al.,* 1986). There is an association between change in dietary practices and growth (Takahashi, 1984) especially the milk consumption.

Maximum changes in body dimensions are observed during adolescence which is visible in sexual, skeletal, physiological and psychological changes. Puberty is a highly dynamic biological process associated with size, proportions, and body composition, followed by a rapid increase in body weight which is reflected in an increase in BMI (de Leonibus *et al.* 2013). Body composition is assessed to find out the health risk associated with excessively low or high levels of total body fat, effectiveness of nutrition and exercise interventions (Heyward and Wagner, 2004). Fat patterning is an important concept which has greater health implications. Abdominal fat is considered to be a risk factor for metabolic complications. Numerous studies have already been conducted in India which has described physical growth status, fat patterning and body composition among Indian adolescents. (Malik and Singh, 1978; Singh, 1980; Malhotra, 1989; Pathmanathan and Prakash, 1994; Khadilkar *et al.,* 2009; Marwaha *et al.,* 2011; Gaur and Brar, 2014; Talwar and Singh, 2014; Sahani and Das, 2015). The present study was conducted among the tribal Rajput adolescent boys of Sangla valley of district Kinnaur to study their growth status and fat patterning.

MATERIAL AND METHODS

The present study is based on a cross-sectional sample of 206 school going Rajput boys aged between 10-18 years of Sangla valley in Kinnaur district of Himachal Pradesh. The data collection was carried out during the month of September, 2011. The study was done in a subscribed period of time at the designated area and best of time utilization was done to achieve the desired sample size. The data were collected from different schools located in the area. The information and data obtained from each subject was recorded on a Performa. Each subject was measured for seven anthropometric measurements. The date of birth of each subject was checked from school records. The chronological age of all the subject was converted into decimal age using the 'decimal age calendar' (Tanner *et al.* 1966).

The seven measurements taken on each subject for the present study were Height, Weight and five circumferences (Waist, Hip, Upper arm, Calf and Chest) which were taken following the techniques recommended by Weiner and Lourie (1981).

The BMI of each subject was calculated. Waist / hip ratio was calculated to study fat patterning. Besides anthropometric measurements additional information was obtained regarding the age, sex, caste, family size, income, educational and occupational background and dietary habits through personal interview based schedule. Decimal ages of these subjects were calculated and the whole subjects were grouped in to one year age group with the year as midpoint. That is (9.500 – 10.499; 10.500 – 11.499 up to 17.500 – 18.499). Convenient sampling technique was used to collect data, only apparently healthy children without any history of chronic illness were included in this study. The subjects were asked to recall their daily routine dietary pattern and the items consumed daily at different intervals were recorded.

RESULTS

The attained mean and standard deviation of various anthropometric measurements of the Rajput boys of Sangla Valley, Kinnaur are given in Table 1. The mean height of 10 to 18 years boys of Sangla valley ranged between 137.3 cm at 10 years and 171.9 cm at 18 years, thereby showed a net increase of 34.6 cm over a period of nine years. This cross sectional sample showed a maximum gain in height between 14 and 15 years (10.2 cm). The attained mean values of weight of 10 to 18 years boys of Sangla valley increased from 28 Kg at 10 years to 55.6 Kg at 18 years. They added 27.6 Kg from 10 to 18 years. However, they attained maximum gain of 7.5 kg between 14 and 15 years. The minimum value of the attained mean weight of Rajput boys was 30 kg.

The attained mean values of chest circumference of Rajput boys from Sangla valley ranged between 61.5 cm at 10 years to 79.2 cm at 18 years. It showed a net increase of 17.7 cm over a period of nine years. The maximum gain in chest circumference was between 14 and 15 years (5.0 cm). The minimum mean value of 54.2 cm for waist circumference was observed at age 10 years and increased continuously till the age of 18 years to reach its highest value of 67.2 cm. The boys of the present study added 13.0 cm in their waist circumference during nine years. The maximum gain (2.8 cm) in this parameter was witnessed between 17 to 18 years. The mean value of hip circumference of Rajput boys from Sangla valley, Kinnaur showed a continuous increase with the advancing age, ranged between 64.2 cm at 10 years to 83.0 cm at 18 years, with maximum gain (6.0 cm) between 14 and 15 years.

The attained mean value of mid upper arm circumference at the age of 10 years was 17.1 cm and it reached its highest value of 23.1cm at 18 years with the maximum gain (1.6 cm) in this circumference between 14 and 15years. The attained mean value of calf circumference was noticed at the age of 10 years was 24.3 cm and the attained mean of 31.4 cm at the age of 18 years. Maximum mean value of 2.0 cm in calf circumference was witnessed between 14 and 15 years. Waist/Hip ratio showed a general decreasing trend with increasing age from a mean value of 0.84 at 10 years to 0.80 at 18 years. The attained mean of Body Mass Index of adolescent boys showed a continuous increase from 14.7 kg/m² at 10 years to 18.6 kg/m² at 18

years with a maximum increase of 1.1 kg/m² between 14 and 15 years. Significant differences between age groups for various measurements were shown by ANOVA.

DISCUSSION

Anthropometry is a systematic technique for measuring and making observations on man and his skeleton, by the most reliable and scientific methods. Anthropometry provides simple means to observe or measure the growth of different parts of the body, total fatness and fat distribution pattern of adolescent boys. The growth and body composition can be expressed as a number, percentile, standard deviation or comparison from a norm. The comparison may be with the growing individuals, at different ages or with standardized norm values. So, we can access and compare the differential growth of the various parts of the body using anthropometric measurements.

In the present study Rajput boys of Sangla valley have been compared for height, weight and various circumferences with the adolescent boys from Kullu, Kinnaura, Bushahri, Bharmour and Chamba Rajputs. They were significantly taller (P < 0.05) at all ages compared to their other hilly area peers. As shown in Figure 2, the attained means of the weight of 10-18-year-old Sangla Rajput boys were significantly higher (P < 0.05) compared to their counterparts, i.e., Kullu Rajputs, Bushahri Rajputs, Kinnaura Rajputs and Bharmour Rajputs at all ages except the Chamba Rajputs at age 11 and 14 years. However, even though at the younger ages, Rajput boys were more or less similar in weight from 10 -14 years, as those of Sangla, Kullu, Bushahri and Chamba,yet. The difference between the attained mean of Sangla boys and the rest were significant (P < 0.05) while the mean weight of Kinnaura Rajputs and Bharmour Rajputs were lower throughout (P < 0.05).

Surprisingly, as compared to the Rajput boys of Sangla valley (present study), the Kinnaura Rajputs (Malhotra, 1975) and Gaddi Rajputs of Bharmour (Singh, 1980) showed significantly low mean height and weight at all age groups, and this difference was consistent throughout. Kinnaura Rajputs (Malhotra, 1975) belonged to Kalpa valley of District Kinnaur, even though; they lived at almost the same altitude (less by about 180 m.). Whereas, Bushahri Rajputs measured by the same author (Malhotra, 1989; Alt. 2708m), Kullu Rajputs (Talwar *et al.*, 2011; Alt 1000 m) and Chamba Rajputs (Talwar& Kaur, 2015; Alt. 1200-2000 m) were more or less at par with each other in these dimensions .The plausible reason of the higher means in Sangla Rajputs (Present study) might be that the attained heights of these children might have increased during the last more than 3 decades or so especially in Kinnuar due to secular trends because of improved nutrition, health care awareness, living standards etc.

As shown in the Figure 3, the attained means of Chest circumference of 10-18 year old Sangla Rajput boys were significantly lower (P< 0.05) compared to their counterparts, from J & K (P< 0.05) (Bhasin *et al.*, 2008) and Ladakh (P< 0.05) (Bhasin *et al.*, 2008) at all ages except at 16 years. But at the same time, Sangla Rajput boys

had significantly higher (P< 0.05) values for this circumference compared to their counterparts from Spitian boys (Malhotra *et al.,* 2006) and Bharmour Rajputs at all age points except at 12 years and 18 years. As shown in Figure 4, the attained means of waist circumference of Sangla Rajput boys were more or less similar till 14 years compared to their counterparts, from Kullu but lower than the Chamba Rajputs. Thereafter, at 13 and 14 years onwards the cross-sectional means of waist circumference of Kullu boys and Chamba boys showed no noticeable increment, meaning thereby that the Kullu Rajput and Chamba boys might have reached their adult mean waist circumference. Whereas means of Sangla Boys did not show any such tendency. (Figure 5). Means of hip circumference of Sangla Rajput boys and their age peers from Kullu depicted significant (P< 0 .05) differences. Sangla Rajput boys had significantly lower (P< 0.05) values of hip circumference as compared to their counterparts, from Chamba Rajputs at all ages.

As shown in the Figure 6, the cross-sectional means of mid upper arm circumference of Sangla Rajput boys were significantly higher (P<0.05) compared to their counterparts, i.e., Kullu Rajputs, J & K, Ladakh, Bharmour and Spitian Boys at all age points and showed a steady increase throughout. Though, the means of Kullu, J & K, Ladakh, Bharmour and Spitian boys' means showed a steady increase they started to show less and less increments between the successive means during the later years, meaning thereby that their adult attained mean values were being reached. As shown in the Figure 7, the cross-sectional means of calf circumference of Sangla Rajput boys were significantly higher (P<0.05) compared to their counterparts, i.e., Kullu Rajputs, J & K, Ladakh and Bharmour boys at all age points and showed a steady increase throughout. Though the means of Kullu and J & K, Ladakh and Bharmour boys' means showed a steady increase in their means started to show lesser increments during the later years i.e., the adult means are being reached. Figure 8, shows that the cross-sectional means of BMI of 10-18-year-old Sangla Rajput boys were more or less similar with those of their counterparts from Kullu and Chamba- showed a steady increase throughout the younger ages, whereas the means of Kullu and Chamba started showing lesser increment during the later years.

CONCLUSION

It can be concluded from above findings that Kinnaura tribal Rajput adolescent boys of Sangla valley witnessed their growth spurt in height, weight and BMI from 14-15 years showing accelerated growth in these components during this period. All body and limb circumferences also exhibited maximum gain between 14 and 15 years except for waist circumference, which showed maximum gain between 17 and 18 years. Sangla Rajput boys showed a decrease in waist hip ratio during adolescence thereby showing greater thickening of hip region as compared to waist region. They were found to be taller and heavier at all ages when compared with Kinnaura Rajput, Bushahri Rajput, Kullu Rajput, Bharmour Rajput, Chamba Rajput, J & K, Ladakh and Spitian boys.

Table 1: Mean, Standard deviations (SD) and ANOVA of anthropometric measurements and indices in Tribal adolescent boys of Sangla Valley Kinnaur

Age (years) Variables	10 N=22	11 N=24	12 N=23	13 N=22	14 N=22	15 N=27	16 N=23	17 N=23	18 N=20	ANOVA F-Ratio
Height										
Mean	137.3	139.0	146.1	149.3	153.8	164.0	167.1	169.8	171.9	88.18*
SD	6.0	6.2	7.1	8.1	8.0	5.8	5.1	5.6	8.1	
Weight										
Mean	28.0	29.9	32.3	35.1	38.7	46.2	50.9	52.8	55.6	99.79*
SD	3.8	4.6	3.6	4.4	6.6	4.7	5.7	4.0	6.7	
Chest Circ										
Mean	61.5	62.4	64.2	66.6	69.3	74.3	77.7	78.1	79.1	70.66*
SD	3.1	3.9	2.6	3.9	4.7	3.7	6.2	3.2	3.4	
Waist Circ										
Mean	54.2	55.1	55.4	57.9	59.4	61.5	63.6	64.3	67.1	38.99*
SD	3.4	4.6	3.1	3.0	3.8	3.3	4.0	2.7	4.0	
Hip Circ										
Mean	64.2	65.4	67.4	70.3	73.0	79.0	80.0	81.9	82.9	68.86*
SD	4.0	5.2	4.0	4.0	5.8	3.1	4.6	2.7	3.5	
Mid Upper Arm Circ										
Mean	17.1	17.7	17.8	18.8	19.5	21.1	22.2	22.5	23.1	36.08*
SD	1.2	1.9	1.7	1.0	2.0	1.4	3.7	1.2	1.5	
Calf Circ										
Mean	24.3	25.2	26.0	26.7	28.4	30.4	30.7	31.0	31.4	36.94*
SD	1.8	2.6	1.7	3.1	2.1	1.9	1.9	2.1	1.5	
WHR										
Mean	0.84	0.85	0.82	0.82	0.81	0.77	0.82	0.78	0.80	8.84*
SD	0.03	0.04	0.04	0.02	0.04	0.04	0.04	0.03	0.03	
BMI										
Mean	14.7	15.0	15.1	15.6	16.2	17.3	17.6	17.9	18.6	26.04*
SD	2.0	1.4	1.1	1.0	1.4	1.3	2.6	1.0	1.0	

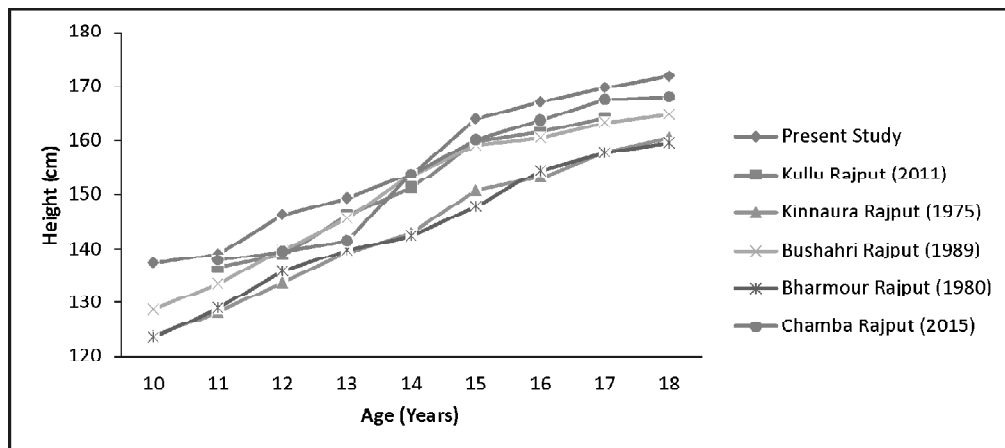WHR: Waist-Hip Ratio, BMI: Body Mass Index

Figure 1: Attained Mean height of 10-18 years old Rajput boys of Sangla valley (Kinnaur) are compared with Kullu, Kinnuara and Bushahri, Bharmour and Chamba Rajput boys
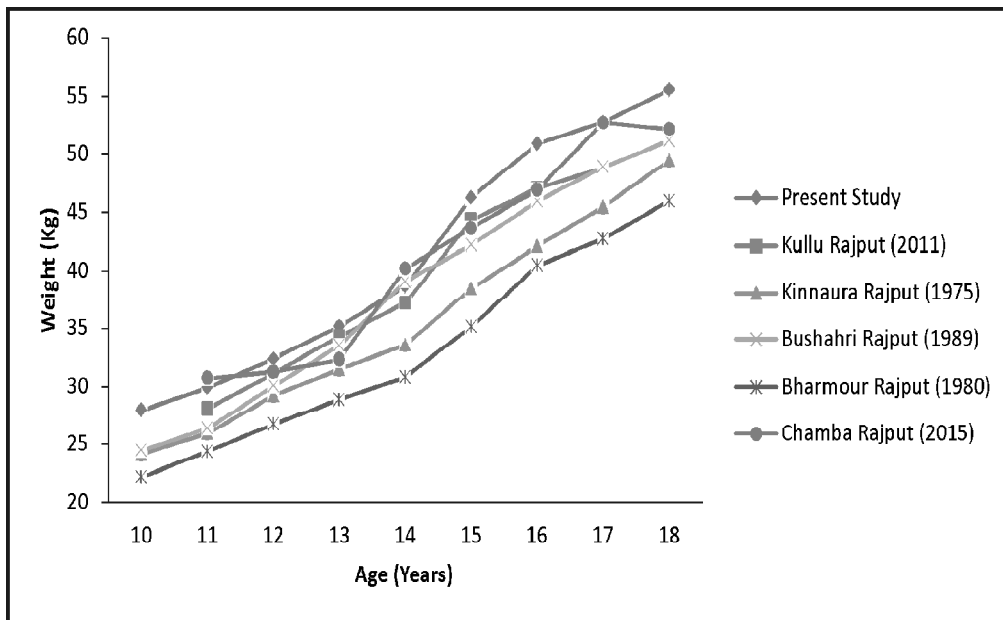
Figure 2: Attained Means of Weight, of 10-18 years old Rajput boys of Sangla valley (Kinnaur) are compared with Kullu, Kinnuara and Bushahri, Bharmour and Chamba Rajput boys
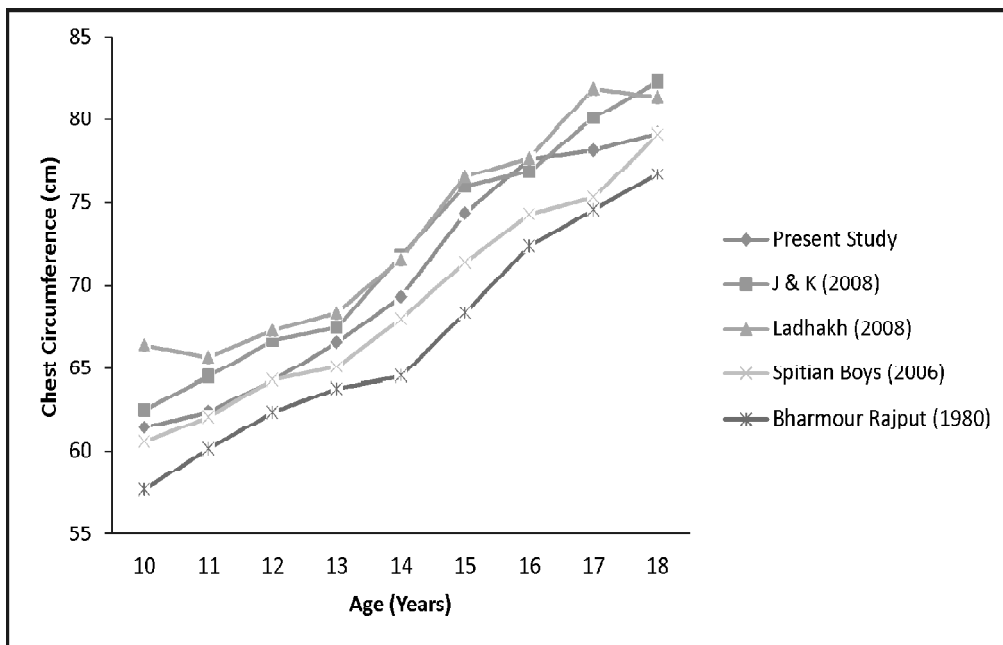

Figure 3: Attained Means of Chest Circumference, 10-18 years old Rajput boys of Sangla valley (Kinnaur) are compared with their high altitude counterparts belonging to J&K, Ladakh, Spiti and Bharmour
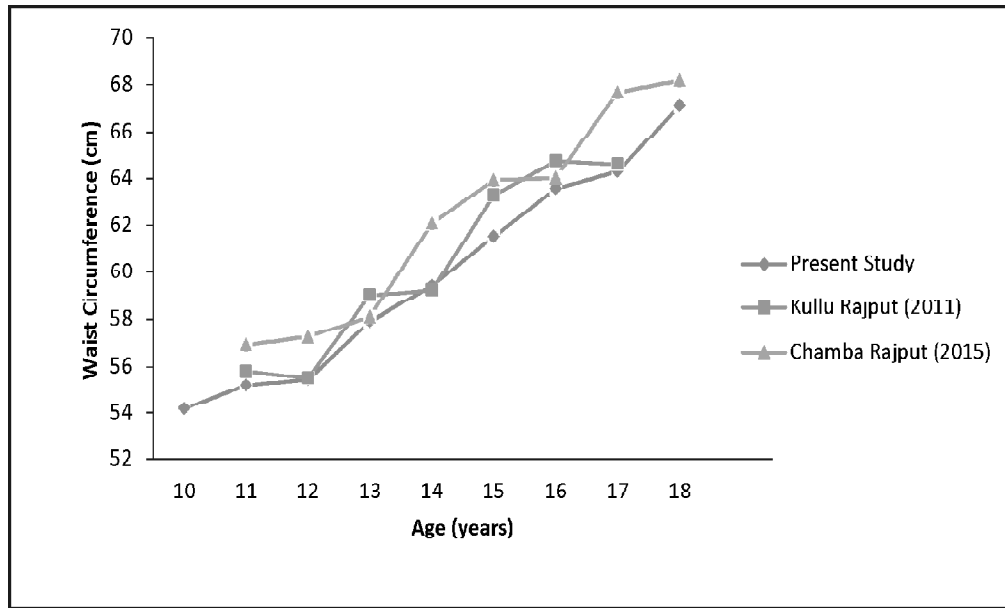
Figure 4: Attained Means of Waist Circumference, 10-18 years old Rajput boys of Sangla valley (Kinnaur) are compared with their hilly area counterparts belonging to Kullu and Chamba
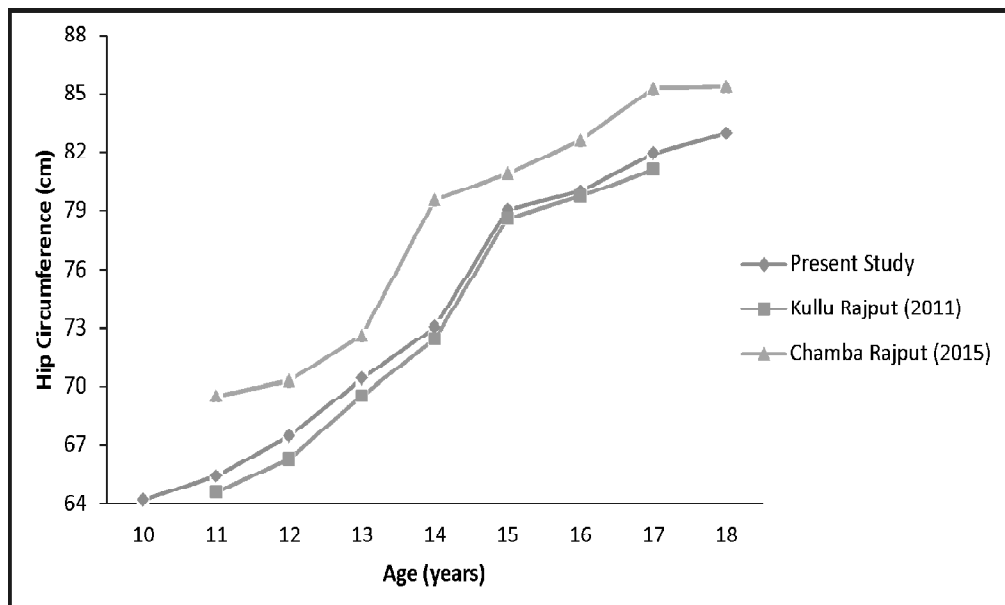

Figure 5: Attained Means of Hip Circumference, 10-18 years old Rajput boys of Sangla valley (Kinnaur) are compared with their hilly area counterparts belonging to Kullu and Chamba
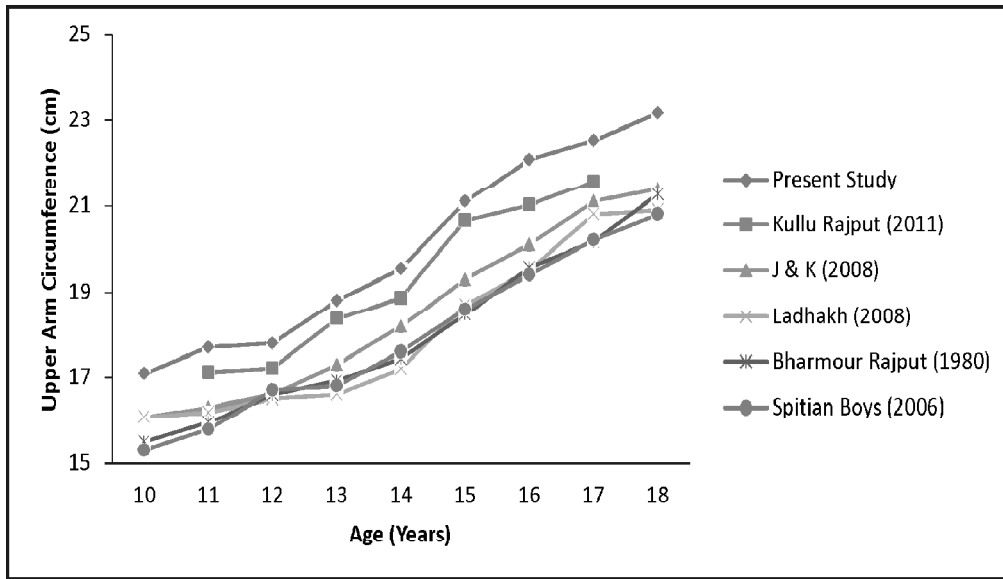
Figure 6: Attained mean Mid Upper arm Circumference of 10-18 years old Rajput boys of Sangla valley (Kinnaur) are compared with their hilly area counterparts from Kullu, J & K, Ladakh, Bharmour and Spiti
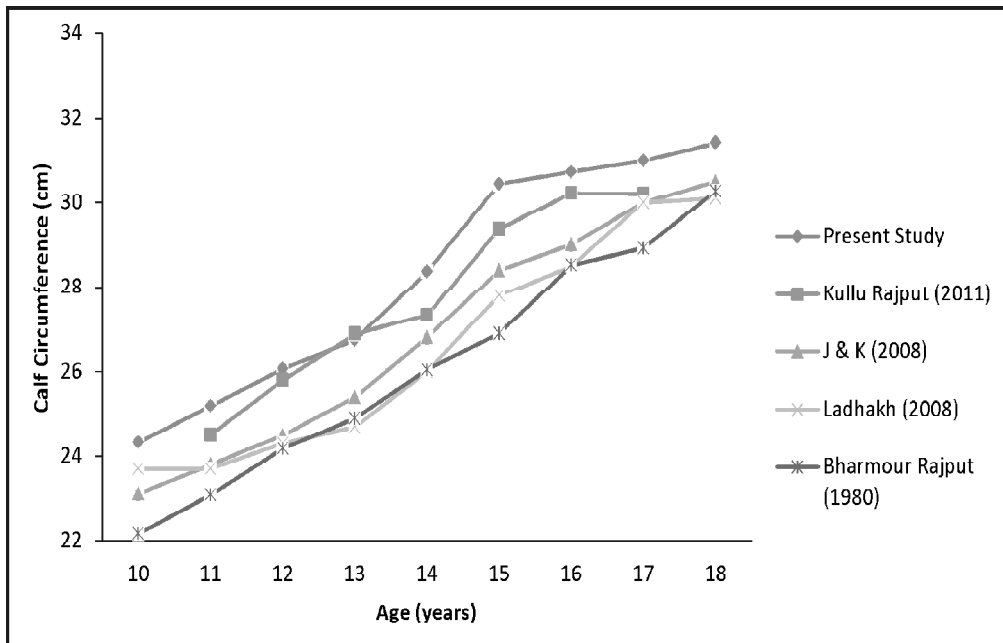

Figure 7: Attained Mean Calf Circumference of 10-18 years old Rajput boys of Sangla valley (Kinnaur) are compared with their hilly counterparts from Kullu, Ladakh, J & K and Bharmour
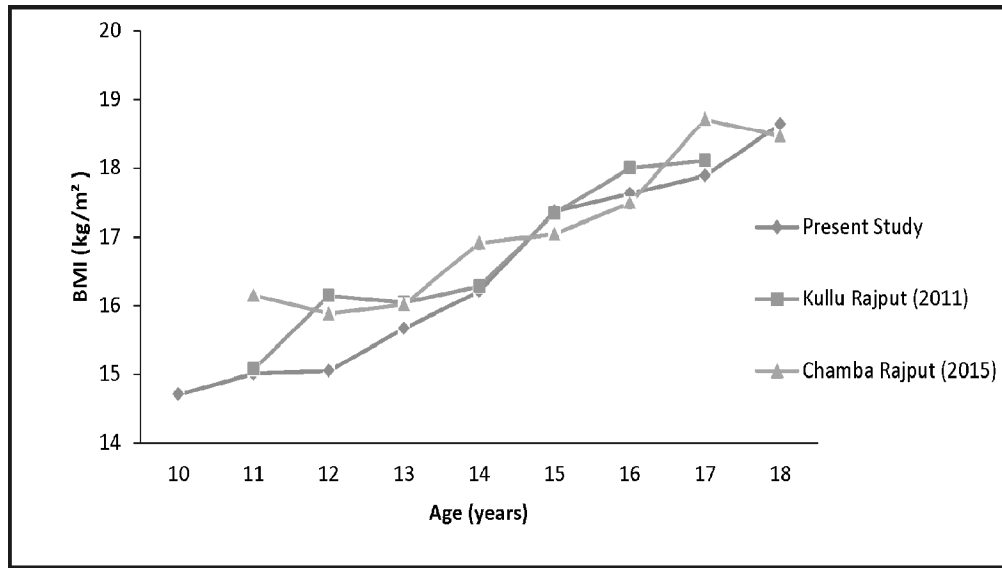
Figure 8: Attained Mean Body Mass Index (BMI) of 10-18 years old Rajput boys of Sangla valley (Kinnaur) are compared with Kullu and Chamba Rajput boys

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