Human Biology Review (ISSN 2277 4424) 1(2) 2012
Original scientific paper (Kharyal et al. pp 169-181)
Revised and accepted on April 30, 2012

# Maturational Sequence of Growth in Upper Extremity Dimensions among Garhwali and Jaunsari Rajput Females of Dehradun, Uttarakhand

Archana Kharyal*, Rupinder Bansal* and Surinder Nath**

***Department of Human Biology, Punjabi University, Patiala**
****Department of Anthropology, Delhi University, Delhi.**

**Corresponding author: Archana Kharyal, Department of Human Biology, Punjabi University, Patiala. Email: *kharyalarchana@gmail.com***

## Abstract

*The present study attempts to evaluate the progression of maturation in the three sub-segments (upper arm, forearm and hand length) of the upper extremity among pre-adolescent and adolescent females of a tribal group and a non tribal group sharing common environment. A total of 1319 females (664 Garhwali and 655 Jaunsari Rajput ) in the age range of 8 to 18 years have been measured for upper arm length, forearm length, hand length and stature, following standard techniques recommended by Weiner and Lourie (1969). Analysis of data clearly reveals the existence of both cephalo- caudal and caudo- cephalic directions of maturation. The existence of multiple gradients is also observed at different age groups within the sub-segments of upper extremity in both the populations. At 16 years, the upper arm length and at 17 years the forearm length among the Garhwali females have attained complete maturation, while in Jaunsari females the forearm length and hand length achieve complete maturation at 17 years.*

***Keywords****: Gradient, Cephalo- caudal, Caudo- cephalic and Maturational sequence.*

## INTRODUCTION

The concept of growth and development is a complex one. According to the British Medical Dictionary, growth can be defined as, "The progressive development of a living being or part of an organism from its earliest stage to maturity including the attained increase in size."Growth is an extremely sensitive index of the general status of health of children. The process of growth

which begins with fertilization and continues till maturity is attained at a comparatively faster rate after which it slows down in linear measures and continues to be operative in transverse and circumferential measurements and finally declines towards the old age. The process of growth is organized into maturity gradients. It is , thus observed that the foot is nearer its mature size at all ages than the calf , and the calf in turn is nearer than the thigh. A maturity gradient is said to operate in leg running from an advanced maturity distally to a retarded maturity proximally, as demonstrated by Davenport,1932; Meredith, 1939; Tanner, 1962; Marshall, 1977;1979; 1982; 1984; 1987; Nath and Chacko, 1988; and Singh and Sidhu, 1981, as following a caudo-cephalic direction. A similar gradient operates in the arm segment as well this differentiation may probably be due to some differentiation in the concentration of some chemical substance in the limb buds during embryonic stage which gives rise to such differences in the developing physical structure( Tanner,1978). In present study an attempt has been made to study the patterns of maturational sequence of growth of tribal and non tribal females from 8 to 18 years.

## MATERIAL AND METHOD

Under present study a total of 1319 females (664 Garhwali and 655 Jaunsari) within the age range of 8 to 18 years were measured cross sectionally for the following seven measurements: stature, body weight, sitting height, total arm length, upper arm length, fore arm length and hand length. Standard measurement techniques recommended by Martin and Saller (1959) with incorporating relevant modifications advocated by I.B.P Handbook No.9 (Weiner and Lourie, 1969) were followed.

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 two 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).

## RESULTS

The variation in rates of growth of different parts of body, not only varies from one child to another but also within one individual child as well, which is due to the differential rate of somatic growth. Thus, it is often observed that the increase in stature is more due to the increase in trunk size than in leg or head and neck during the adolescence (Tanner, 1962; Nath, 1975 and Marshal, 1977). It is also observed that the adolescent growth spurt may occur at the same time in different parts of the body or different parts of body may show the growth spurt at different time, because some dimensions increase more than other during the adolescent spurt.

Table 1 and 2 depicts the mean values and standard deviation for seven body measurements among Garhwali and Jaunsari Rajput females respectively in the age range of 8 to 18 years. Table 3 represents percentage of growth achieved by general body measurements from 8 to 17 years among Garhwali and Jaunsari Rajput females and Table 4 presents percentage of growth achieved by different segments of upper extremity at each age group from 8 to 17 years among Garhwali and Jaunsari Rajput females. Percentage of growth achieved was calculated to observe the percentage of growth yet to be achieved at 17 years of its final value taken at 18 years (mean values for 18 years are taken for this purpose being the values of the highest age group of the present study).

Measurement wise description among Garhwali and Jaunsari Rajput females is as follows:

Body weight

The mean body weight of Garhwali females varies between 31.16 kg at 8 years and 50.65 kg at 18 years (table 1) while among Jaunsari females (table 2) it varies between 29.38 kg at 8 years and 52.82 kg at 18 years. Garhwali females exhibit an overall increase of 18.49 kg from 8 to 18 years whereas Jaunsari females exhibit total increase of 23.44 kg during the same period, which is nearly 5 .0 kg greater than the Garhwali females.

It is observed from table 3 that Garhwali females attain 61.52 percent growth at 8 years of their final value taken at 18 years as against 55.62 percent growth attained by Jaunsari female at the same age. The Jaunsari females surpassed the Garhwali females at 11 years with slight decline at 12 years while at remaining ages growth attained is greater among Garhwali females. At 17 years

Garhwali females require 0.44 percent growth to attain complete maturation while Jaunsari female are much behind and require 2.22 percent growth to reach their final size.

The maximum annual increase (Table 5), corresponding to adolescent spurt in body weight, occurs between 10 to 11 years among Garhwali and Jaunsari females, however the intensity of increase is greater among Jaunsari females (7.51 kg) than the Garhwali females (5.10 kg).

Stature

Table 1 represents the mean stature of Garhwali females which varies between 128.25cm at 8 years and 154.20 cm at 18 while for Jaunsari females (table 2) it varies between 126.87 cm to 155.62 cm. Garhwali females exhibit an overall increase of 25.95 cm from 8 to 18 years of age whereas in the case of Jaunsari females, the total increase was found to be 28.75 cm during same period, which is nearly 3 cm more than the Garhwali females. Table 3 reveals that Garhwali females attain 83.19 percent growth at 8 years of their final value taken at 18 years as against 81.52 percent growth attained by Jaunsari female at the same age. The Jaunsari females surpassed the Garhwali females at 11 years while at remaining ages growth attained is greater among Garhwali females. At 17 years Garhwali females achieved complete growth while Jaunsari females are behind and require 0.65 percent growth to reach their final size.

The maximum annual increase (Table 5), corresponding to adolescent spurt in stature, occurs between 11 to 12 years among Garhwali and between 10 to 11 years among Jaunsari females, however the intensity of increase is greater among Garhwali females (7.81 cm) than the Jaunsari females (6.51cm).

Sitting height

In case of Garhwali females mean sitting height varies between 65.96 cm at 8 years and 80.68 cm at 18 years (table 1) while for Jaunsari females (table 2) it varies between 64.14 cm to 80.43 cm . Garhwali Rajput females exhibit an overall increase of 14.62 cm from 8 to 18 years of age whereas Jaunsari females exhibit a total increase of 16.29 cm during the same period, which is nearly 2 cm more than the Garhwali females.

Garhwali females attain 81.86 percent growth at 8 years of their final value taken at 18 years as against 79.75 percent growth attained by Jaunsari female at the same age (Table 3). The Jaunsari

females surpassed the Garhwali females at 11 and 13 years while at remaining ages growth attained is greater among Garhwali females. At 17 years Garhwali females achieved complete growth while Jaunsari females require 0.36 percent growth to reach their final size. The maximum annual increase (Table 5), corresponding to adolescent spurt in sitting height, occurs between 11 to 12 years among Garhwali and between 12 to 13 years among Jaunsari females, however the intensity of increase is greater among Jaunsari females (4.89 cm) than the Garhwali females (3.32 cm).

Total arm length

The mean total arm length varies between 55.01 cm at 8 years and 65.49 cm at 18 years for Garhwali females (table 1) while for Jaunsari Rajput females (table 2) it varies between 51.10 cm to 65.82 cm. Garhwali females exhibit an overall increase of 10.48 cm from 8 to 18 years of age whereas Jaunsari females exhibit total increase of 14.72 cm during same period, which is nearly 4 cm more than the Garhwali females. Table 3 reveals that Garhwali females attain 84.00 percent growth at 8 years of their final value taken at 18 years as against 77.90 percent growth attained by Jaunsari female at the same age. The Jaunsari females surpassed the Garhwali females at 11, 13, 15 and 16 years while at remaining ages growth attained is greater among Garhwali females. At 17 years Jaunsari females achieved complete growth while Garhwali females are behind and require 0.61 percent growth to reach their final size.

Corresponding to adolescent spurt in total arm length, the maximum annual increase (Table 5) occurs between 11 to 12 years for Garhwali and between 10 to 11 years for Jaunsari females, however the intensity of increase is greater among Jaunsari females (3.68 cm) than the Jaunsari females (2.96cm).

Upper arm length

The mean upper arm length varies between 22.11 cm at 8 years and 26.59 cm at 18 years for Garhwali females (table 1) while for Jaunsari females (table 2) it varies between 20.13 cm at 8 years and 26.65 cm at 18 years. Garhwali Rajput females exhibit an overall increase of 4.48 cm from 8 to 18 years of age whereas Jaunsari females exhibit total increase of 6.52 cm during same period, which is nearly 2 cm more than the Garhwali females.

Table 4 reveals that Garhwali females attain 83.50 percent growth at 8 years of their final value taken at 18 years as against 75.53 percent growth attained by Jaunsari female at the same age. The Garhwali females attained greater growth than Jaunsari females at all age groups. Garhwali females achieved complete growth at 16 years while Jaunsari females are behind and require 0.98 percent growth to reach their final size. Corresponding to adolescent spurt in upper arm length, the maximum annual increase (Table 5) occurs between 11 to 12 years for Garhwali and between 10 to 11 years for Jaunsari females. The intensity of increase is greater among Jaunsari females (1.79 cm) than the Garhwali females (1.29cm).

Fore arm length

In Garhwali females the mean fore arm length varies between 20.31 cm at 8 years and 24.34 cm at 18 years (table 1) while for Jaunsari females (table 2) it varies between 18.64 cm to 24.43 cm. Garhwali Rajput females exhibit an overall increase of 4.03 cm from 8 to 18 years of age whereas Jaunsari females exhibit total increase of 5.79 cm during same period, which is nearly 2 cm more than the Garhwali females.

Garhwali females (table 4) attain 84.62 percent growth at 8 years of their final value taken at 18 years as against 76.42 percent growth attained by Jaunsari female at the same age. The Garhwali females attained greater growth than Jaunsari females at all age groups .Garhwali and Jaunsari females achieved complete growth at 17 years .Table 5 shows the maximum annual increase , corresponding to adolescent spurt in fore arm length, occurs between 11 to 12 years for Garhwali and between 8 to 9 years for Jaunsari females. The intensity of increase is greater among Garhwali females (1.24 cm) than the Jaunsari females (1.02 cm).

Hand length

The mean hand length varies between 14.01 at 8 years and 16.69 cm at 18 years for Garhwali Rajput females (table 1) while for Jaunsari Rajput females (table 2) it varies between 12.15 cm at 8 years and 16.44 cm at 18 years. Garhwali Rajput females exhibit an overall increase of 2.68 cm from 8 to 18 years of age whereas Jaunsari females exhibit total increase of 4.29 cm during same period, which is nearly 2 cm more than the Garhwali females. Garhwali females attain 83.94 percent growth at 8 years of their final value taken at 18 years as against 73.99 percent growth attained by Jaunsari female at the same age. The Garhwali females surpassed the Jaunsari

females from 8 to 11 years while at remaining ages growth attained is greater among Jaunsari females. Jaunsari females achieved complete growth at 15 years while Garhwali females are behind and require 2.58 percent growth to reach their final size. Table 5 shows the maximum annual increase ,corresponding to adolescent spurt in hand length, occurs between 9 to 10 years for Garhwali and between 11 to 12 years for Jaunsari females, however the intensity of increase is greater among Jaunsari females (1.09 cm) than the Garhwali females (0.63 cm).

The maturational direction of different segments of upper extremity from 8 to 17 years among Garhwali shows mixed direction of growth in all ages, except at 9 and 16 years which represents caudo- cephalic direction. While in the case of Jaunsari females, mixed maturational sequence occurs at all age groups except at 10 years which shows cephalo-caudal gradient of growth.

## DISCUSSION

Several studies on growth pattern have been done on Indian girls. No growth study on similar lines has been reported on the pre-adolescent and adolescent females of Uttarakhand, particularly on Jaunsari tribe as yet. In the present study, adolescent growth spurt of body weight (10+ years) of Garhwali females are observed similar to that of Jaunsari females and in Stature (11+ years) Garhwali females (Present study) show affinity to that of Porja (Rao et.al. 1999 a) and Garhwali (Vashist et.al. 2005) females. In comparison with other populations Garhwali and Jaunsari females (Present study) attain adolescent growth spurt in Body weight earlier than Khond (Rao et.al. 2005) and Gadaba (Rao et.al, 1999 b) (12+ years), Relli's (Busi et. al. 2003), Hindu bania, Punjabi (Singh and Nath, 1996) and Garhwali (11+ years) and Porja and Pinjore (Talwar. et. al 2012) females (13+ years). With regard to stature the present study shows that Garhwali females attain adolescent growth spurt later than Kond and Relli's females (9+ years) and earlier than Pinjore, Hindu bania, Punjabi and Gadaba females. On the other hand, Jaunsari females attain spurt earlier than Porja, Gadaba, Garhwali, Hindu bania, Punjabi and Pinjore females and later as compared to Kond and Relli. They were also found to be taller and heavier as compared to Kond, Relli's, Pinjour, Gadaba, Garhwali and Porja girls. In case of sitting height Garhwali (present study), Hindu bania and Punjabi females attain adolescent growth spurt at 12 years whereas Jaunsari females at 13 years. Hindu bania, Punjabi and Jaunsari females attain adolescent growth spurt in total arm length at 11 years but Garhwali females at 12.

It is evident from the comparison drawn with other studies that Garhwali, Jaunsari, Hindu bania and punjabi females requires 2.32, 0.44, 1.29 and 0.21 percent to achieve complete growth respectively in case of body weight whereas Khond females achieve complete growth at 16 years. Garhwali, Pinjour ,Khond and Hindu bania females achieve complete growth at 17,17 ,15 and 16 years respectively in case of Stature whereas Jaunsari and Punjabi females requires 0.65 and 0.32 percent respectively to achieve complete growth . In case of sitting height Garhwali and Pinjour females achieve complete growth at 17 and 16 years respectively but Jaunsari, Hindu bania and Punjabi females requires 0.36, 0.25 and 0.97 percent to achieve complete growth respectively. Whereas in case of total arm length Jaunsari females achieved complete growth at 16 years but Garhwali, Hindu bania and Punjabi females requires 0.61, 0.29 and 0.56 percent to achieve complete growth.

## REFERENCES

Busi BR, Rao BD. 2003. Growth Progression in Physical and Physiological Variables among Relli's of Visakhapatnam District of Andhra Pradesh. *J Hum Ecol* **14(2):** 101-111.

Davenport CB. 1932. Growth of human foot. *Amer J Phys Anthrop* **17**: 167-211.

Dharma RB, Rao VLN, Busi BR. 1999. Growth progression in physical, physiological and sickle cell traits among Porja tribal girls of Visakhapatnam district, Andhra Pradesh. *Anthropologist* **1(3):** 155- 161.

Dharma RB, Rao VLN, Busi BR. 1999. Growth progression, blood pressure and sickle cell trait among Gadaba tribal girls of Visakhapatnam district, Andhra Pradesh. *Anthropologist* **1(3):** 163-169.

Meredith HV. 1939. Length of head and neck, trunk and lower extremities of Iowa city children aged 7 to 17 years. *Child Development* **10**: 129-144.

Martin R, Saller K. 1959. Lehrbuch der Anthropologie in Systematischer Darstellung. Fisher, Stuttgart.

Marshal WA. 1977. Human Growth and its Disorders. Academic Press, London.

Nath S. 1975. Cephalocaudal and Caudocephalic Directions of Growth: A Study on the Jat Population, India. *Acta Med Auxol* **7:** 225-226.

Nath S. 1979. Direction de la croissance differentielle et la maturation des Jats du Nord de L' Inde, the sexe masculine, *L' Anthropologie* **83**: 460-467.

Nath S. 1982. Maturational trends of growth progression among Jats of North India. *Anthrops* **22**: 311-320.

Nath, S. 1984. Maturational sequence of growth in transverse dimensions of head, face, and trunk among male Jats of North India. *Anthrop Anz* **43:** 37-40.

Nath S. 1987. Maturational sequence among females in relation to socio-economic status. *Indian Anthropologists* **17**: 41-64.

Nath S, Chacko M. 1988. Maturational sequence in the arm and the leg segments among the Dangi females of Udaipur, Rajasthan. *Anthropologie* **26**: 7-11.

Rao VLN, Dharma RB, Rao S, Busi BR. 2005. Patterns of Growth and Physiological Variables among Khond Tribal Population of Visakhapatnam District, Andhra Pradesh. *Anthropologist* **7(4):** 237-245.

Singh SP, Sidhu LS. 1981. Physical growth of Gaddi Rajput boys of Dhaula Dhar Range of the Himalayas. II. Extremities. *Z. Morph. Anthrop* **72**: 113-126.

Singh R, Nath S. 1996. Comparative assessment of growth patterns in linear, transverse and circumferential dimensions among females of Delhi. *South Asian Anthro* **17 (2):** 89-94.

Tanner JM. 1962. Growth at Adolescence. Blackwell Scientific Publications, Oxford.

Tanner JM, Whitehouse RH, Takaish M. 1966. Standards from birth to maturity for height, weight, height velocity and weight velocity, British children 1656. *Arch Dis Child* **41**: 454-471.

Tanner JM. 1978. Foetus into Man: Physical Growth from Conception to Maturity. Open Books Publ. Ltd., London.

Talwar I, Kansal A, Jindal P. 2012. Growth Pattern and Menarcheal Status in Relation to Body Size and Physique among Adolescent Rural Girls of Pinjore-Nalagarh dun Valley. *Hum Biol Rev* **1 (1)**: 68-83.

Vashist RN, Krishan K, Devlal S. 2005. Physical growth and nutritional status in Garhwali girls. *Indian J Pediatr* **72**: 573-578.

Weiner JS, Laurie JA. 1969. Human Biology: A Guide to Field Method. I.B.P. Handbook No. 9. Blackwell Publications, Oxford.

Table 1: Mean and standard deviation of Body Weight among Garhwali Rajput females of Dehradun District, Uttarakhand

| Age groups | N | Stature | | Body weight | | Sitting height | | Total arm length | | Upper arm length | | Fore arm length | | Hand length | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | S.D | Mean | S.D | Mean | S.D | Mean | S.D | Mean | S.D | Mean | S.D | Mean | S.D |
| 8.0 | 58 | 128.25 | 3.57 | 31.16 | 3.57 | 65.96 | 1.92 | 55.01 | 2.54 | 22.11 | 1.02 | 20.31 | 1.18 | 14.01 | 0.79 |
| 9.0 | 57 | 129.36 | 4.59 | 31.81 | 3.65 | 66.93 | 2.26 | 55.15 | 2.35 | 22.41 | 1.32 | 20.28 | 1.33 | 14.09 | 0.78 |
| 10.0 | 65 | 133.14 | 3.21 | 33.26 | 2.89 | 69.58 | 2.22 | 57.20 | 3.14 | 23.34 | 1.33 | 20.95 | 1.55 | 14.72 | 0.78 |
| 11.0 | 61 | 136.82 | 4.56 | 37.36 | 4.07 | 71.20 | 2.45 | 58.82 | 3.08 | 23.87 | 1.40 | 21.65 | 1.49 | 14.97 | 0.88 |
| 12.0 | 59 | 144.63 | 4.75 | 40.78 | 4.41 | 74.52 | 2.99 | 61.78 | 2.20 | 25.16 | 1.01 | 22.89 | 1.16 | 15.49 | 0.93 |
| 13.0 | 60 | 147.84 | 4.58 | 43.13 | 4.66 | 76.30 | 2.23 | 62.44 | 1.85 | 25.32 | 1.25 | 22.97 | 0.95 | 15.90 | 0.82 |
| 14.0 | 64 | 151.39 | 4.61 | 46.41 | 4.14 | 78.35 | 2.52 | 63.45 | 1.95 | 25.73 | 1.05 | 23.14 | 1.07 | 16.18 | 0.85 |
| 15.0 | 66 | 151.58 | 3.85 | 48.62 | 5.01 | 79.42 | 2.63 | 63.60 | 2.15 | 25.70 | 1.09 | 23.50 | 1.21 | 16.26 | 0.68 |
| 16.0 | 61 | 153.03 | 3.66 | 48.45 | 3.72 | 79.31 | 2.34 | 64.66 | 1.87 | 26.54 | 1.05 | 23.61 | 1.03 | 16.41 | 0.63 |
| 17.0 | 56 | 154.20 | 4.11 | 50.43 | 4.35 | 80.68 | 2.41 | 65.45 | 1.86 | 26.59 | .831 | 24.34 | 0.82 | 16.42 | 0.85 |
| 18.0 | 57 | 154.17 | 3.68 | 50.65 | 4.48 | 80.58 | 2.04 | 65.49 | 2.03 | 26.48 | .882 | 24.00 | .936 | 16.69 | 0.87 |

Table 2: Mean and standard deviation of Body Weight among Jaunsari Rajput females of Dehradun District, Uttarakhand

| Age groups | N | Stature | | Body weight | | Sitting height | | Total arm length | | Upper arm length | | Fore arm length | | Hand length | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | S.D | Mean | S.D | Mean | S.D | Mean | S.D | Mean | S.D | Mean | S.D | Mean | S.D |
| 8.0 | 62 | 126.87 | 2.89 | 29.38 | 3.10 | 64.14 | 2.30 | 51.10 | 1.80 | 20.13 | .844 | 18.64 | 0.65 | 12.15 | 0.47 |
| 9.0 | 56 | 127.86 | 3.38 | 30.18 | 2.53 | 66.08 | 1.97 | 53.83 | 1.91 | 20.94 | .850 | 19.66 | 1.08 | 13.22 | 0.43 |
| 10.0 | 59 | 131.65 | 2.96 | 31.72 | 2.58 | 67.85 | 2.52 | 55.37 | 1.64 | 21.68 | .710 | 20.06 | 0.80 | 13.65 | 0.59 |
| 11.0 | 63 | 138.16 | 3.29 | 39.23 | 3.07 | 71.13 | 2.62 | 59.05 | 2.04 | 23.47 | 1.09 | 21.07 | 0.93 | 14.62 | 0.60 |
| 12.0 | 64 | 143.15 | 3.67 | 41.82 | 3.59 | 72.66 | 2.48 | 61.83 | 2.82 | 24.47 | 1.38 | 21.65 | 1.20 | 15.71 | 0.96 |
| 13.0 | 56 | 146.91 | 3.82 | 46.78 | 3.24 | 77.55 | 2.12 | 62.98 | 2.47 | 25.36 | 1.53 | 22.53 | 1.27 | 16.27 | 0.78 |
| 14.0 | 66 | 150.64 | 4.29 | 47.76 | 3.62 | 78.17 | 2.49 | 63.44 | 2.22 | 25.69 | 1.35 | 22.63 | 1.11 | 16.20 | 0.93 |
| 15.0 | 57 | 152.13 | 3.69 | 46.66 | 3.48 | 79.23 | 2.48 | 63.99 | 2.20 | 25.81 | 1.16 | 23.58 | 1.20 | 16.50 | 0.73 |
| 16.0 | 60 | 152.38 | 3.28 | 49.80 | 2.14 | 78.90 | 1.95 | 64.79 | 1.79 | 26.39 | 1.01 | 23.80 | 0.78 | 16.29 | 0.66 |
| 17.0 | 56 | 154.61 | 3.05 | 51.65 | 3.46 | 80.14 | 2.45 | 65.82 | 1.72 | 26.51 | .808 | 24.43 | 0.75 | 16.44 | 0.52 |
| 18.0 | 56 | 155.62 | 3.29 | 52.82 | 3.54 | 80.43 | 2.52 | 65.60 | 1.89 | 26.65 | .843 | 24.39 | 0.88 | 16.42 | 0.83 |

Table 3: Percentage of growth achieved by general body measurements from 8 to 17 years among Garhwali and Jaunsari Rajput females

| Age (years) | Garhwali | | | | Jaunsari | | | |
|---|---|---|---|---|---|---|---|---|
| | Body Weight | Stature | Sitting Height | Total Arm Length | Body Weight | Stature | Sitting Height | Total Arm Length |
| 8.0 | 61.52 | 83.19 | 81.86 | 84.00 | 55.62 | 81.52 | 79.75 | 77.90 |
| 9.0 | 62.80 | 83.91 | 83.06 | 84.21 | 57.14 | 82.16 | 82.16 | 82.06 |
| 10.0 | 65.67 | 86.36 | 86.35 | 87.34 | 60.05 | 84.60 | 84.35 | 84.40 |
| 11.0 | 73.76 | 88.75 | 88.36 | 89.81 | 74.27 | 88.78 | 88.44 | 90.01 |
| 12.0 | 80.51 | 93.81 | 92.48 | 94.33 | 79.17 | 91.99 | 90.34 | 94.25 |
| 13.0 | 85.15 | 95.91 | 94.69 | 95.34 | 88.56 | 94.40 | 96.42 | 96.01 |
| 14.0 | 91.63 | 98.20 | 97.23 | 96.88 | 90.42 | 96.80 | 97.19 | 96.71 |
| 15.0 | 95.99 | 98.29 | 98.56 | 97.11 | 88.32 | 97.76 | 98.51 | 97.54 |
| 16.0 | 95.66 | 99.26 | 98.42 | 98.73 | 94.28 | 97.92 | 98.10 | 98.76 |
| 17.0 | 99.56 | 100.02 | 100.12 | 99.39 | 97.78 | 99.35 | 99.64 | 100.33 |
| 18.0 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

Table 4:Percentage of growth achieved by different segments of upper extremity at each age growth from 8 to 17 years among Garhwali and Jaunsari Rajput females

| Age (years) | Garhwali | | | Jaunsari | | |
|---|---|---|---|---|---|---|
| | Upper Arm Length | Fore Arm Length | Hand Length | Upper Arm Length | Fore Arm Length | Hand Length |
| 8.0 | 83.50 | 84.62 | 83.94 | 75.53 | 76.42 | 73.99 |
| 9.0 | 84.63 | 84.50 | 84.42 | 78.57 | 80.61 | 80.51 |
| 10.0 | 88.14 | 87.29 | 88.20 | 81.35 | 82.25 | 83.13 |
| 11.0 | 90.14 | 90.21 | 89.69 | 88.07 | 86.39 | 89.04 |
| 12.0 | 95.01 | 95.37 | 92.81 | 91.82 | 88.76 | 95.68 |
| 13.0 | 95.62 | 95.71 | 95.27 | 95.16 | 92.37 | 99.09 |
| 14.0 | 97.17 | 96.42 | 96.94 | 96.40 | 92.78 | 98.66 |
| 15.0 | 97.05 | 97.92 | 97.42 | 96.84 | 96.68 | 100.49 |
| 16.0 | 100.23 | 98.37 | 98.32 | 99.02 | 97.58 | 99.21 |
| 17.0 | 100.41 | 101.42 | 98.38 | 99.47 | 100.16 | 100.12 |
| 18.0 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

Table 5 Annual increments for body measurements in Garhwali and Jaunsari Rajput females

| Age groups | Garhwali | | | | | | | Jaunsari | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stature | Body weight | Sitting height | Total arm length | Upper arm length | Fore arm length | Hand length | Stature | Body weight | Sitting height | Total arm length | Upper arm length | Fore arm length | Hand length |
| 8.0 | _ | _ | _ | _ | _ | _ | _ | _ | _ | | _ | _ | _ | _ |
| 9.0 | 1.11 | 0.65 | 0.97 | 0.14 | 0.30 | -0.03 | 0.08 | 0.99 | 0.80 | 1.94 | 2.73 | 0.81 | 1.02 | 1.07 |
| 10.0 | 3.78 | 0.45 | 2.65 | 2.05 | 0.93 | 0.67 | 0.63 | 3.79 | 1.54 | 1.77 | 1.54 | 0.74 | 0.40 | 0.43 |
| 11.0 | 3.68 | 5.10 | 1.62 | 1.62 | 0.53 | 0.70 | 0.25 | 6.51 | 7.51 | 3.28 | 3.68 | 1.79 | 1.01 | 0.97 |
| 12.0 | 7.81 | 3.42 | 3.32 | 2.96 | 1.29 | 1.24 | 0.52 | 4.99 | 2.59 | 1.53 | 2.78 | 1.00 | 0.58 | 1.09 |
| 13.0 | 3.21 | 2.35 | 1.78 | 0.66 | 0.16 | 0.08 | 0.41 | 3.76 | 4.96 | 4.89 | 1.15 | 0.89 | 0.88 | 0.56 |
| 14.0 | 3.55 | 3.28 | 2.05 | 1.01 | 0.41 | 0.17 | 0.28 | 3.73 | 0.98 | 0.62 | 0.46 | 0.33 | 0.10 | -0.07 |
| 15.0 | 0.19 | 2.21 | 1.07 | 0.15 | -0.03 | 0.36 | 0.08 | 1.49 | -1.10 | 1.06 | 0.55 | 0.12 | 0.95 | 0.30 |
| 16.0 | 1.45 | -0.17 | -0.11 | 1.06 | 0.84 | 0.11 | 0.15 | 0.25 | 3.14 | -0.33 | 0.80 | 0.58 | 0.22 | -0.21 |
| 17.0 | 1.17 | 1.98 | 1.37 | 0.80 | 0.05 | 0.73 | 0.01 | 2.23 | 1.85 | 1.24 | 1.03 | 0.12 | 0.63 | 0.15 |
| 18.0 | -0.03 | 0.22 | -0.10 | 0.04 | -0.11 | -0.34 | 0.27 | 1.01 | 1.17 | 2.29 | -0.22 | 0.14 | -0.04 | -0.02 |