

## **Sex Differences in Lower Limb Measurements among Jats of Haryana**

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### **Abstract**

An attempt has been made in the present study to observe the developmental sequence of growth sex differences in stature and measures of the lower limb among Jats of Haryana. A total of 1035 Jats (502 males and 533 females) ranging in age from 9 to 17 years were measured for stature, total lower extremity length, thigh length, lower leg length and foot length in accordance with the standard measurement techniques. Analysis of the data reveals that the female Jats are not only taller than their male counterparts in stature but also have longer total lower extremity length, thigh length and lower leg length from 9 to 13 years. However males have longer feet than the females at all ages. Notwithstanding the variations in all the measurements of lower limb and stature between the sexes the differential trends reveal significant variations between 14 and 17 years for stature, lower extremity length and lower leg length while in case of thigh length and foot length the differences are significant from 12 to 17 years.

**Key Words: Hawkin's Test, Isometric Abduction, Isometric External Rotation, Injury**

### **Introduction**

Human growth is an incessant process while the pace at which it proceeds is inconsistent for every growing individual. The individual development generally occurs in spurts, with different body components growing at a variable rate, time and intensity.

It is a known fact that trunk and leg segments have equal proportion within the body by about 14 years where after the legs outgrows the trunk and remains longer for the remaining period of growth. Similarly the arms are longer than the legs only during prenatal period, with regards to the growth of different body segments.

Krogman (1973) emphasized that during postnatal period the hand and neck segment increases twice in size, trunk three times, arms four times and the legs five times in their respective proportions.

These main body segments are further divided into certain sub segments or components, for example, the arm segment

comprises of upper arm, fore arm and hand, while the leg segment comprises of thigh, calf and the foot. Most of the studies conducted by Indian researchers pertain to the general patterns of growth among different communities. However, pattern of change in the components of the upper or the lower extremities has not attracted attention of researchers, due to which only a few studies covered this aspect. The present study has been attempted to observe the sex and age changes in components of the leg segment among the Jats of Haryana.

### **Materials and Methods**

Data for the present study comprises of 1035 Jats (502 males and 533 females), ranging in age from 9 to 17 years. All the subjects were measured cross sectionally for the following dimensions: stature, total leg length, thigh length, lower leg length, and foot length as per standard measurement techniques recommended by Martin and Saller (1959), Weiner and Lourie (1969).

Age of each subject was obtained from the school records and converted into decimal notation following decimal age calendar (Tanner, 1966) by subtracting the date of birth of an individual from the date of measurement. The age grouping was done in accordance with the following system, e.g., age group 9 includes all such subjects whose age ranges between 8.500 and 9.499 years, thereby providing mean age as 9.000 years. Age group 10 includes all subjects who fall in the age range of 9.500 to 10.499 years thereby giving mean age as 10.000 years and so on up to 17 years of age.

**Results & Discussion**

Data for the present study have been analyzed to obtain the results pertaining to the assessment of patterns of growth among male and female Jats of Haryana in the age range of 9 through 17 years, besides evaluating the sex differences, if any in different measures of the lower extremity and stature among jats.

**Table 1. Sex differences in Stature among Jats of Haryana**

Age (yrs)	Males		Females		Value of t
	Mean (cm)	S.E.M.	Mean (cm)	S.E.M.	
9.0	128.2	0.89	130.5	1.02	0.30
10.0	133.5	0.78	134.6	1.8	0.83
11.0	141.0	1.10	141.5	1.21	0.07
12.0	145.7	1.32	146.0	0.96	0.18
13.0	148.7	1.33	150.5	0.74	1.18
14.0	158.0	1.07	153.0	0.61	4.07*
15.0	165.4	0.87	153.9	0.61	10.84*
16.0	168.4	0.93	157.1	0.84	9.52*
17.0	172.6	0.63	159.9	0.51	9.08*

\*Significant at 5 % level

Table 1 presents the basic statistical constants for stature among male and female Jats in the range of 9 to 17 years along with the values of t-test. It is evident from the table that male and female Jats exhibit an increase in stature with enhancement in age from 9 to 17 years

The male Jats exhibits an overall increase of 44.4 cm in stature from 9 to 17

years in contrast to 29.4 cm among females. The increase in stature among males is about 1.5 times greater than that of females. The maximum yearly increase in stature occurs earlier among females (10 and 11 years) than the males (13 and 14 years).

It is further observed that the females are taller than the males from 9 to 13 years, while the males outgrow them between 14 and 17 years. In spite of being taller between 9 and 13 years than the males, the sex differences are non significant during this period.

On the other hand, the differential trends as observed through t-test reveal that males are significantly taller than the females from 14 to 17 years.

**Table 2. Sex differences in Total lower extremity length among Jats of Haryana**

Age (yrs)	Males		Females		Value of - t
	Mean (cm)	S.E.M.	Mean (cm)	S.E.M.	
9.0	72.9	0.59	73.7	0.61	0.94
10.0	74.3	0.54	75.3	0.65	1.18
11.0	78.1	0.63	78.8	0.71	0.32
12.0	82.3	0.80	82.8	0.66	0.48
13.0	84.1	0.78	85.1	0.54	1.04
14.0	89.9	0.68	85.9	0.45	4.81*
15.0	92.9	0.53	86.8	0.53	9.03*
16.0	93.1	0.58	88.0	0.75	4.79*
17.0	93.3	0.56	88.5	0.49	6.58*

\*Significant at 5 % level

Table 2 presents the basic statistical constants for total lower extremity length among male and female Jats in the age range of 9 to 17 years along with the values of t-test. It is observed that both male and female Jats exhibit an increase in total lower extremity length from 9 years through 17 years. It is further witnessed that the male Jats exhibit an overall increase of 20.4 cm in total lower extremity length from 9 to 17 years in contrast to 14.8 cm increase attained by females. The female Jats possess longer lower extremities than the males from 9 to 13 years where after from 14 to 17 years the males outgrow the females. The differential trends as assessed through t-test reveal that the males possess

significantly lower extremity length than the females from 14 to 17 years while the female Jats, despite possessing longer lower extremity length from 9 to 13 years, exhibit non significant sex differences.

The maximum yearly increase in lower extremity length occurs between 13 and 14 years among males while females exhibit it two year earlier, i.e. between 11 and 12 years This pattern is identical to the one observed in case of stature for male Jats while in case of females the maximum annual increase in stature occurs a year before, i. e. between 10 and 11 years.

**Table 3. Sex differences in Thigh length among Jats of Haryana**

Age (yrs)	Males		Females		Value of t
	Mean (cm)	S.E.M.	Mean (cm)	S.E.M.	
9.0	36.9	0.34	37.0	0.50	0.17
10.0	37.6	0.34	38.4	0.61	1.15
11.0	40.1	0.48	40.8	0.48	1.05
12.0	41.5	0.46	43.0	0.49	2.23*
13.0	42.3	0.47	44.1	0.47	2.71*
14.0	45.9	0.47	44.3	0.39	2.15*
15.0	47.4	0.56	45.2	0.35	7.23*
16.0	47.6	0.42	45.7	0.57	3.67*
17.0	47.8	0.46	46.0	0.46	2.77*

\*Significant at 5 % level

Table 3 exhibits the basic statistical constants for thigh length among male and female Jats in the age range of 9 to 17 years along with the values of t- test. It is apparent from the table that male and female Jats of Haryana exhibit an increase in thigh length from 9 years to 17 years. Table 3 further reveals that the males Jats attain an overall increase of 10.9 cm in thigh length from 9 to 17 years in contrast to 9.0 cm increase attained by the females in this age range. In spite of exhibiting lesser overall increase the females possess longer thighs than the males from 9 to 13 years, thereafter till 17 years the males outgrow them.

The maximum yearly increase, in thigh length, occurs earlier among females (11 and 12 years) than males (13 and 14

years). Although the females possess longer thighs than the males' upto 13 years of age, the differential trends as assessed through t-test reveal significant sex differences from 12 to 17 years only.

**Table 4. Sex differences in Lower leg length among Jats of Haryana**

Age (yrs)	Males		Females		Value of t
	Mean (cm)	S.E.M.	Mean (cm)	S.E.M.	
9.0	30.7	0.33	31.5	0.32	1.74
10.0	31.4	0.30	31.9	0.40	0.76
11.0	33.2	0.34	32.6	0.45	1.77
12.0	35.2	0.46	34.8	0.43	1.43
13.0	36.0	0.48	35.5	0.45	1.52
14.0	38.7	0.42	36.1	0.30	5.04*
15.0	38.9	0.43	36.3	0.31	4.15*
16.0	39.2	0.37	36.5	0.46	5.59*
17.0	39.5	0.34	36.7	0.29	5.06*

\*Significant at 5 % level

Table 4 expounds the basic statistical constants of lower leg length among male and female Jats in the age range of 9 to 17 years along with the values of t-test. It is evident from the table that the lower leg length increases with advancement in age from 9 through 17 years for male and female Jats of Haryana It is also observed that the overall increase in the lower leg length is greater (8.8 cm) among males than the females (5.2 cm) in this age range. The increase in lower leg length among males is little over 1.5 times than that of the one observed among females. Male Jats possess longer lower leg length at all ages except for 9 and 10 years where females out grow them.

The maximum yearly increase, in lower leg length, occurs among males between 13 and 14 years while in case of females it occurs between 11 and 12 years. This pattern is similar to the one observed in case of total lower extremity length and thigh length. However in case of stature the females exhibit this phenomenon earlier between 10 and 11 years while male Jats exhibit it at 13-14 years only. The differential trends as observed on applying

t-test reveal that the males possess significantly longer lower legs than their female counterparts from 14 to 17 years only, while at remaining ages the apparent variations observed in the lower leg length the differences are non significant.

**Table 5. Sex differences in Foot length among Jats of Haryana**

Age (yrs)	Males		Females		Value of t
	Mean (cm)	S.E.M.	Mean (cm)	S.E.M.	
9.0	20.8	0.16	20.5	0.18	0.67
10.0	21.3	0.14	21.1	0.13	.043
11.0	22.0	0.25	21.6	0.20	1.88
12.0	22.9	0.24	22.6	0.14	3.61*
13.0	23.4	0.32	22.9	0.12	2.25*
14.0	25.0	0.17	23.3	0.16	5.68*
15.0	25.4	0.18	23.5	0.13	5.24*
16.0	25.7	0.16	23.7	0.16	6.78*
17.0	25.9	0.19	23.8	0.18	7.67*

\*Significant at 5 % level

Table 5 exhibits the basic statistical constants of foot length among male and female Jats in the age range of 9 to 17 years along with the values of t-test. It is observed that both male and female Jats exhibit an increase in foot length with advancement in age from 9 to 17 years. Male Jats attain an overall increase of 3.7 cm in foot length from 9 to 17 years of age in contrast to 2.3 cm increase attained by the female Jats. The increase in foot length among males is approximately 1.6 times greater than that of females during this age range. It is further observed that unlike other measurements of the lower extremity and stature, males Jats possess longer feet than their female counterparts at each age from 9 to 17 years.

The maximum yearly increase, in foot length, occurs earlier among females (11 and 12 years) than the males (13 and 14 years). Despite the apparent variations observed in the foot length at each age between male and female Jats, the differential trends reveal that the males possess significantly longer feet from 14 to 17 while at remaining ages the sex differences are non-significant.

The results of the present study revealed that all the dimensions of lower extremity exhibits a progressive increase with increase in age from 9 – 17 years for both males and females Jats of Haryana. It is further observed that the female Jats possesses greater dimensions than males from 9 to 13 years for stature, lower extremity length and thigh length where after the males out grow them till 17 years. In case of lower leg length this patten varies as the females exhibit greater dimensions than males only at 9 and 10 years where after the males possess longer lower legs. This pattern is completely reversed in case of foot length as males exhibit longer feet than the females at each age from 9 to 17 years.

The yearly gain in different measurements of the lower extremity and stature reveal more or less an identical pattern as males attain maximum annual increase for all the measurements between 13 and 14 years, however the intensity of increase is variable for different measurements. Stature attains the maximum gain during this period followed by total lower extremity length, thigh length, lower leg length and foot length. On the other hand, the intensity of increase is relatively low in all the measurements of lower extremity and stature among females but they follow an identical pattern as observed in case of males.

The apparent variations in the mean values of all the measurements of lower extremity and stature among Jats of Haryana reveal significant variations at the higher ages in contrast to the younger age groups. Stature, Total lower extremity length and lower leg length exhibit significant sex differences from 14 to 17 years, while thigh length and foot length reveal significant variations between 12 and 17 years.

## References

- Dwivedi, A. 2000. Assessment of growth patterns and sex differences in different body dimensions among Jats of Gurgaon. Unpublished Doctoral thesis. University of Delhi, Delhi.
- Krogman, W.M. 1972. Child Growth. University of Michigan Press. Ann Arbor.
- Martin, R and K. Saller, 1959. Lehrbuch der Anthropologie. Gustav Fischer Verlag. Stuttgart.
- Sachdeva, V. and S. Nath 1995. Developmental pattern of different body segments among Bengali females. *Man in India*. **75**:261-267.
- Sathyavathi, K.S. K.N. Agarwal and D.K. Agarwal, 1981. The growth pattern of upper and lower extremity during adolescence. *Ind. Pediatr.* **18**: 563-575.
- Scammon, R.E. 1953. Developmental Anatomy. In 11<sup>th</sup> edition of Morris Human Anatomy (ed.) J.P. Schaeffer. Mc Graw Hill Book Co. Inc.
- Sinclair, D 1973. Human Growth after birth. 2<sup>nd</sup> edition. Oxford Medical Publications, New York
- Tanner, J.M. 1973. Growing Up. *Scientific American*, **229**: 35-45.
- Tanner, J.M. 1978. Foetus in to Man: Physical growth from Conception to maturity. Open Book Publication Limited. London.
- Weiner, J.S. and J.A. Lourie. 1969. Human Biology: A Guide to Field Methods. I.B.P. Handbook No. 9. Oxford and Blackwell scientific Publications. Edinburgh.