

Growth Progression in Linear Body Measures among the Boys of Soliga Tribe of Karnataka

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Received on 11.07.2016, Accepted on 22.07.2016

Abstract

The present study comprised of 1155 Soliga tribal boys ranging in age group of 8 to 18 years from Chamaranagar, Coorg and Mysore districts of Karnataka. 12 measurements were included in the present cross sectional data. The segmental growth progression of the body assessed through percentage of growth at each age from 8 to 18 years related to their final size attained at 18 years. The growth spurt was observed for trunk height, leg length, and foot length at 13 years, while for the stature, sitting height, neck length, total upper extremities length, hand length, upper arm length, forearm length, total lower extremity length, thigh length at 15 - 16 years. The growth of constituent components of upper and lower extremity at all ages showed caudo-cephalic sequence of maturation. However the growth of upper arm, thigh gradient showed cephalo-caudal as well as caudo-cephalic sequence of maturation.

Keywords: Growth; Growth Progression; Growth Spurt; Growth Gradients; Soliga Tribal Boys; Karnataka.

Introduction

The processes of growth and development are common to all living organisms intimately linked in time but practically independent. The changes occurring in body proportions during the developmental period are mainly attributed to the lack or uniformity in the process of growth in different parts of the body (Tanner1978). Lesli

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Brainerd Arey (1966) states, growth in living organisms does not proceed at the same rate or in all directions at once, the differential rate of growth, operating during development of organisms in their various regions in a definite direction with relatively constant to the growth rate of body growth pattern.

During postnatal developmental period, the human body when considered as whole exhibits the existence of cephalo-caudal maturity gradient, as the head advanced in maturation over the legs and the arms in their upper two segments advanced over the corresponding segments of the legs. In addition, another maturity gradient operates in the leg, running from an advanced maturity distally to retarded maturity proximally (Tanner 1962, 1964, 1978). This sequence of growth referred as the reversal phenomenon or caudo-cephalic direction of maturation.

The present cross-sectional study was conducted among the Soligas, the major tribe of Karnataka who are hitherto unstudied from this point of view. The study aims to contribute towards further knowledge of growth and development as well as its maturation sequence towards removing the dearth of adequate data on physical growth belonging to South Indian tribal populations.

Material and Methods

The data for the present study comprise a cross sectional sample of 1155 Soliga boys aged between 8 to 18 years. The samples have been collected from various institutions in the tribal belts of Mysore, Chamarajangar and Coorg districts of Karnataka. The ages of all subjects were recorded through the school admission register. The samples were chosen randomly and measurements taken from the each samples with the measurements like stature, sitting height, neck length, trunk height, total upper extremity length, upper arm length, forearm length, hand length, total lower extremity length, thigh length, leg length and foot length. The landmarks of each measurement considered were illustrated in the Table 1. While recording the measurements like *neck*

length, trunk height, lower extremity, thigh length (noted indirectly by using up the height of tibiale was subtracted from the height of illiospinale) and *leg length* followed the techniques suggested by Jones (1971). However, for remaining measures, noted the techniques directed by Singh and Bhasin (2004).

The assessment of growth progression or growth gradient calculated through percentage of growth achieved at each age from 8 years to 18 years relative to their final size attained at 18 years (Surindernath et al, 1993).

$$\text{Growth gradient or Attained size} = \frac{XA}{M} \times 100$$

Where XA is the mean value of measures at age 'A' and 'M' is it's mean value in the highest age group i.e., 18.

Table 1: Anthropometric measurements with landmarks and instrument used

Linear Measurements	Landmarks	Instruments
Stature	Vertex to Floor	Anthropometer rod
Sitting height	Vertex to sitting surface	Anthropometer rod
Trunk height	Cervical to Lumbar	Anthropometer rod (I-Segment)
Neck length	Gnathion to Suprasternale	Anthropometer rod (I-Segment)
Upper extremity length	Acromion to Dactylon	Anthropometer rod
Upper arm length	Acromion to Radiale	Anthropometer rod
Fore arm length	Radiale to stylium	Anthropometer rod
Hand length	Stylium to Dactylon	Anthropometer rod
Lower extremity length	Illiospinale to floor	Anthropometer rod
Thigh length	Ht.illiospinale-Ht.tibiale	Anthropometer rod
Leg length	Tibiale to Spherion	Anthropometer rod
Foot length	Pterion to Acropodion	Anthropometer rod (I-Segment)

Results and Discussion

The Table 2 shows that the mean values of body measures, increasing with the age from 8 to 18 years. The body measurements like trunk height, leg length and foot length recorded maximum growth in 13 years. But, stature, sitting height, neck length, total upper extremity length, hand length, total lower extremity length and thigh length maximum growth achieved in 15 years. Moreover, upper arm length, maximum growth occurs at 15 years as well as 16 years and forearm length exhibits maximum annual increase at 16 years.

The maturational sequence determined by the advanced or retarded maturity of the concerned body segment in terms of percentage of growth gradient / growth achieved at each age level. In the growth gradients for each of the body dimensions at each age group, were also represented in the Table 1. When considering the maturational sequence of stature, the growth of stature results by the increase of sitting height and lower extremity length. i.e. at 8-years to

12-years, sitting height growth advanced over total lower extremity length but 13 to 17-years lower extremity length advanced over sitting height, revealing that the increase of stature ensuing of cephalo caudal growth in the beginning, which was later followed by caudo-cephalic growth.

The increase of sitting height followed by its segment trunk height advanced over neck length by the caudo-cephalic growth up to 17 years, but except at the age of 15 years the neck length shows more percentage of growth by the cephalo-caudal direction of maturation.

The growth of the upper extremity length constitutes growth of its components like hand length advanced growth over forearm length at 8 to 15 years, but later forearm length advanced over hand length, at 16 and 17 years, follow initially caudo-cephalic and later the cephalo-caudal growth. When compared to growth of upper arm length with hand length, caudo-cephalic growth transpired at 9 to 15-years and 17 years by the hand length advanced over upper arm length, except at 8 and 16 years revealed

as the progression of cephalo-caudal growth by the upper arm length advanced maturation over hand length. The comparison between upper arm length and forearm length, showed upper arm length having advanced growth over forearm length at all ages by the cephalo-caudal growth. But the reverse trend was observed i.e. the caudo-cephalic growth at 17 years showing forearm length advanced over upper arm length. The constituent components of lower extremity growth show the caudo-cephalic growth i.e. foot length advanced over leg length and leg length advanced over thigh length at all ages.

The comparisons of homogeneous components like upper and lower extremities. i.e. upper arm – thigh, forearm – leg length, hand–foot, have shown that foot length advanced in maturation over hand at all ages with caudo-cephalic direction of maturation, also leg length advanced over forearm

length at all ages showing caudo-cephalic growth, but in case of the upper arm–thigh showed cephalo-caudal direction of maturation with the upper arm advanced growth over thigh length at all ages, except at 15 and 17 years revealing as caudo-cephalic growth progression. However, both the extremities, yet to achieve the final size at 18 years, that required about 0.74% for upper extremity and 0.68% for lower extremity. In conclusion, at the age of 13 years, the growth spurt was noticed in trunk height, leg length and foot length. Further, at the age of 15 years, stature, sitting height, neck length, total upper extremity length, hand length, total lower extremity length, and thigh length have shown growth spurt. However, growth spurt of upper arm length was observed between 15 and 16 years, but forearm length exhibits at 16 years.

Table 2: Growth progression in linear body measures of soliga boys

Age in years	Statistical Constant	Stature	Sitting Height	Neck Length	Trunk Height	Measurements							
						Total Upper Extremity Length	Upper Arm length	Forearm Length	Hand Length	Total Lower Extremity length	Thigh Length	Leg Length	Foot Length
8 +	Mean	117.08	59.95	3.62	29.21	50.99	22.04	16.49	12.45	64.48	32.30	27.58	17.65
	SD	1.77	1.76	0.63	1.79	1.91	0.94	0.86	0.72	2.05	1.25	1.26	1.20
	GG	71.96	73.23	62.87	72.17	68.88	70.20	66.92	69.27	68.66	67.62	68.16	71.78
9 +	Mean	122.62	61.84	3.74	30.37	53.71	23.09	17.22	13.28	67.89	33.87	29.00	18.86
	SD	2.20	2.61	0.61	1.99	2.49	1.16	0.98	1.30	2.61	1.44	1.39	1.28
	GG	75.37	75.54	65.08	75.03	72.56	73.57	69.85	73.92	72.29	70.90	71.66	76.70
10 +	Mean	127.84	63.65	4.03	30.91	56.77	24.43	18.23	14.11	72.54	36.27	31.20	19.80
	SD	2.40	1.88	0.66	1.13	1.82	0.78	0.58	0.46	1.88	1.15	1.42	1.21
	GG	78.58	77.75	69.99	76.36	76.69	77.82	73.94	78.53	77.24	75.94	77.09	80.54
11+	Mean	130.89	65.34	4.14	31.62	58.18	24.85	18.96	14.37	74.72	37.36	32.23	20.06
	SD	2.47	2.06	0.66	1.24	1.98	1.18	1.01	0.77	2.07	1.27	1.26	0.94
	GG	80.45	79.82	72.00	78.11	78.59	79.15	76.91	79.98	79.56	78.22	79.64	81.59
12+	Mean	133.80	67.28	4.16	32.03	59.67	25.42	19.56	14.68	76.60	38.27	32.93	20.44
	SD	2.93	2.42	0.67	1.45	2.09	1.03	0.91	0.74	2.29	1.44	1.27	0.89
	GG	82.24	82.18	72.36	79.12	80.60	80.97	79.36	81.71	81.57	80.13	81.38	83.12
13+	Mean	140.73	69.80	4.29	34.12	62.46	26.59	20.51	15.36	80.66	39.99	35.17	21.88
	SD	2.61	2.21	0.83	1.08	2.11	0.90	0.69	0.52	2.39	1.40	1.30	0.76
	GG	86.50	85.26	74.62	84.30	84.37	84.69	83.20	85.51	85.89	83.73	86.91	88.98
14+	Mean	145.78	72.05	4.65	35.07	64.46	27.44	21.17	15.84	83.92	41.28	36.55	22.74
	SD	2.16	2.00	0.86	1.32	1.75	0.75	0.61	0.42	1.92	1.07	1.15	0.67
	GG	89.60	88.01	80.80	86.63	87.08	87.41	85.90	88.13	89.36	86.41	90.31	92.49
15+	Mean	154.59	76.11	5.36	37.03	68.80	29.28	22.54	17.01	89.73	44.56	38.71	23.60
	SD	2.76	1.92	0.58	1.79	2.34	1.00	0.77	0.59	1.94	1.28	1.12	1.22
	GG	95.02	92.97	93.24	91.49	92.93	93.25	91.44	94.66	95.54	93.29	95.65	95.99
16+	Mean	159.29	79.44	5.42	38.41	72.16	31.12	24.03	17.03	91.85	46.37	39.47	24.01
	SD	2.63	1.63	0.55	1.43	2.50	1.12	0.85	0.68	2.24	1.53	1.43	0.97
	GG	97.90	97.05	94.26	94.90	97.48	99.12	97.49	94.80	97.80	97.08	97.54	97.64
17+	Mean	161.91	80.91	5.46	40.09	73.48	31.13	24.54	17.84	93.28	47.38	40.30	24.56
	SD	2.53	1.88	0.68	2.30	2.16	0.99	1.33	0.64	2.33	1.66	1.14	0.72
	GG	99.52	98.84	94.93	99.03	99.26	99.16	99.55	99.28	99.32	99.20	99.58	99.88
18+	Mean	162.70	81.86	5.75	40.48	74.03	31.39	24.65	17.97	93.91	47.76	40.47	24.59
	SD	3.90	1.83	0.63	1.54	1.77	1.03	0.83	0.54	2.06	1.13	1.15	1.02
	GG	100	100	100.00	100	100	100	100	100	100	100	100	100

SD = Standard deviation

GG = Growth gradient

The increase of stature resulted by the growth of its constitute components like sitting height and lower extremity. At the outset, i.e. at 8 to 12 years the lower extremity advances over sitting height, subsequently at 13 to 17 years sitting height advanced over the lower extremity due to exhibit of cephalo-caudal sequential growth in first and caudo-cephalic growth in later.

The growth of constituent components of lower extremity at all ages shows caudo-cephalic sequence of maturation. i.e, foot length advanced over leg length and leg length advanced over thigh length. The comparison of the both the upper and lower extremity at all ages denotes foot length advanced over hand length and leg length advanced over a forearm length with caudo-cephalic sequence of maturation. However, in the growth of upper arm- thigh gradient, showed cephalo-caudal as well as caudo-cephalic sequence of maturation. The overall the growth of the body exhibits either caudo-cephalic or cephalo-caudal growth of maturation, and this trend was also noticed from the studies of Nath (1972, 1975, 1982, 1984, 1987 & 1991), Versha and Surinder Nath (1997) and Keshava (2004 & 2016).

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