

Growth Progression, Blood Pressure and Sickle Cell Trait Among Gadaba Tribal Girls of Visakhapatnam District, Andhra Pradesh

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KEY WORD Growth. Progression. Gadaba. Stature. Body Weight. Blood Pressure. Pulse Rate. Sickle Cell. Andhra Pradesh.

ABSTRACT A cross-sectional study of 253 healthy Gadaba tribal girls aged 0+ and 18+ years was undertaken for growth progression, blood pressure and pulse rate. In this paper data on stature, body weight, upper arm, calf, chest, abdominal and head circumferences and skinfolds at biceps, triceps, subscapular, suprailiac, abdominal, anterior thigh, medial calf, fore arm sites; and blood pressure, pulse rate and sickle cell traits are presented, including patterns of change in these measurements with advancement in age. It has been observed that there is progressively increase in all the dimensions with advancement in age except skinfolds. But homozygous and heterozygous sickle cell anaemic Gadaba tribal girls have decelerating growth trends when compared to normal Gadaba tribal girls. The study reveals that Gadaba tribal girls attained maximum mean annual increase between 10+ and 13+ years. Blood pressure and pulse rate increased with advancement in age with few fluctuations. Gadaba girls are taller and heavier than the ICMR (1984) National standards. The findings of the study can be used as reference material for Gadaba tribal girls.

INTRODUCTION

Physical Growth studies among tribal populations have been conducted in different regions of the country by several scholars (see review of Singh, 1980; Reddy, 1989; Nath et al., 1991; Kapoor and Kapoor, 1991; Sharma, 1991 and Dharma Rao and Busi, 1994, 1995, 1996 and 1997 and others). Research investigation carried out under different conditions by various research groups have shown positive correlation between blood pressure and age (Reddy et al., 1991; Dharma Rao et al., 1997), heredity (Nirmala and Chengal Reddy, 1991), body composition (Sambasiva Rao, 1983 and Dharma Rao et al., 1997), and social status (Srivastava et al., 1977) and sex (Celine and Mathur, 1979). Another important dimension of

the variation in arterial blood pressure is the interaction with other physiometric and anthropometric variables. In India very few researches have been conducted in this field (Padmavati and Gupta, 1959; Kate and Verma, 1989; Das and Mukherjee 1963; Gangopadhyay et al., 1988; Nirmala and Chengal Reddy, 1991; Verma 1991; Dharma Rao and Busi, 1997) among others. Blood pressure is an important indicator of cardio-vascular functioning. Blood pressure varies with age, sex, race, body weight, body fatness and several other factors (Verma, 1991; Gray and Fujoka, 1991 and Putatunda and Dhara, 1994). In Paderu ITDA of Visakhapatnam region there is dearth of published material related to growth progression, blood pressure, pulse rate and sickle cell trait of Gadaba tribal girls, and the Indian Council of Medical Research (ICMR, 1984) in their nation wide growth survey did not include the Gadaba tribal girls of Visakhapatnam district. A cross-sectional growth study of Gadaba tribal girls was therefore undertaken in February 1996 to January 1999 covering 18 measurements.

Many researchers have tried to enumerate the trends of growth under different situations all over the world, but little attention has been paid towards primitive tribal groups *i.e.* Gadaba girls. In the present study an attempt has been made to study the effect of age from 0+ through 18+ years on 18 body measurements, throughout the growth period and also to study the adolescent growth spurt, and is aimed to understand the association between blood pressure, pulse rate and sickle cell trait with height, body weight, circumferences and other skinfold thickness and its implications for health care practises of the population and to compare these girls with other

tribal girls of India in order to find out the population differences of physical and physiological traits. In the present paper the 18 body measurements taken on the Gadaba tribal girls of Paderu, Araku valley, Ananthagiri and Munchingput mandals of Visakhapatnam district of Andhra Pradesh have been discussed.

MATERIAL AND METHODS

Gadabas are predominantly found in tribal areas of Srikakulam Vizianagaram and Visakhapatnam districts. According to 1981 census the population of Gadaba in Visakhapatnam district is 8,975 and in Andhra Pradesh 28,049. Gadabas speak their own dialect and this dialect is included by G.A. Grierson in Munda linguistic family. Gadaba tribes divided into the following sub-divisions viz., (1) Bodo or Gutob (2) Parenga or Golu, (3) Ollero, (4) Koloi or Porja Gadabas, (5) Katheri, (6) Kapu and (7) Kaspera or Boyi Gadabas. Parengi Gadabas are endogamous group found largely in Chinthapalli, Munchingput, Araku and Pedabayalu areas of Visakhapatnam district and Saluru and Mukkuva Mandals of Vizianagaram districts. Porja Gadabas who were notorious robbers are found in the Munchingput, Paderu and V. Madugula Mandals of Visakhapatnam district. All these subdivisions are gradually disappearing and styling themselves in some areas as simply Gadaba or Konda Doras.

Gadabas of Visakhapatnam district reported the following three main divisions: (1) Savara Gita (Palanquine bearers) (2) Luppu Tita (basket makers) (3) Kollai Gita (Cultivators). In some parts of the tribal areas of Srikakulam and Vizianagaram districts Gadabas are also known as Mudli. In former days some sections of Gadabas worked as Palanquine bearers to former Zamindars in tribal areas. In return to their services they were granted Inams. Gadabas are recognised as primitive tribal groups and poverty alleviation programmes are being implemented.

The present occupational pattern consists of podu cultivation, partly settled cultivation and agricultural labour. Collection and sale of minor forest produce, hunting and fishing are the most important subsidiary occupation.

The physical features of Gadabas indicate that they are very much belong to Protoaustraloid stock. Their hair varies from wavy to curly. They have well developed supraorbital ridges with a sunken nasal route and thick verted lips. The colour of the skin is almost dark and they are of medium height.

The crops grown by Gadabas are paddy, ragi, jowar and sama. Ragi is the staple food for Gadabas. They eat cooked ragi when they are hungry and drink Ragi-gruel when they are thirsty. They take rice also on festival and other occasions. Gadabas are also beef eaters. They depend on natural fruits like jack and mango and also depend on edible roots, leaves etc.

The material of the present study was based on a cross-sectional data collected on 253 Gadaba tribal girls drawn from 8 schools of 4 selected mandals, viz Paderu, Araku valley, Ananthagiri and Munchingput of Visakhapatnam district of Andhra Pradesh during the months of February 1996 January 1999. The age of these subjects range from 0+ to 18+ years. The exact date of birth was collected from every subject either from the concerned school registers or from birth records of the Panchayats. The doubtful cases were excluded from the present sample. All the subjects between age 0.00 to 0.99 years were in 0+ age group and 1.00 to 1.99 years were in 1+ age group and so on upto 18+ years is calculated after Eveleth and Tanner (1976). The measurements on each individual were taken during the working hours of the schools with minimum clothing. All bilaterally represented measurements were taken left. The anthropometric measurements were taken after Weiner and Lourie (1969). The weight of each individual was recorded in kilograms using a portable weighing machine. The measurements were taken by the first Author.

Blood pressure were determined on the subject by the method described by Rose et al. (1982) using the sphygmomanometer with standard cuff and the stethoscope. The measurements were thoroughly practised for a week in the presence of cardiologist of the investigator was checked each time with that of the doctor till the readings were consistent. After standardizing the method the investigator started taking the blood pressure of subjects.

Heart rate was conveniently measured as pulse rate by palpation of the radial artery at the wrist, the number of beats occurring in half a minute being counted and doubled to give the rate per minute by using stop watch. Screening test for the presence of sickle cell trait as conducted after Daland and Castle (1948) and confirmation by cellulose acetate membrane electrophoresis.

The values for a growth velocity of a measurement are easily obtained by subtracting for that variable, say at age 'A' from its mean value at age (A+1 years) as below:

$$\text{Velocity (V)} = \bar{X} (A+1) - \bar{X} \cdot A.$$

RESULTS AND DISCUSSION

Mean values and standard deviation for each anthropometric measurements for each individual years of age are depicted in table 1 and 2. It can be inferred from the tables that the mean values for all the body measurements except skinfolds are progressively accelerating trend with age from 0+ to 13+ years showed steady pattern of growth; and from 14+ to 18+ years almost stationery pattern and decelerating trend of growth is investigated. From the table 2 it is clear that all the eight skinfold characters show

non normal distributions at several ages. Standard deviations for these characters have not shown by consistent pattern as found earlier in the linear, transverse and circumferential, and skinfold measurements (Dharma Rao and Busi, 1998).

Among the Gadaba tribal girls a steady pattern in supine length and stature is noticed up to the age of 12+ years. The mean supine length/stature of infant at 0+ years age group is about 61.80 cm and doubled by 8+ years. The highest mean annual increments (+9.02 cm per year) has occurred between 12+ and 13+ years. The mean body weight of infant at 0+ years age group is about 5.54 kg, it is doubled by 3+ years, and thrice by 7+ years and about 5 times by 11+ years and 6 times by 13+ years. The highest mean annual gain (+8.67 kg per year) has occurred between 12+ and 13+ years.

The mean upper arm circumference of infant at 0+ years age group is about 13.14 cm, it is one and half time by 14+ years. An increment of 2 cm is noticed from 15+ to 18+ years. The mean calf circumference of infant at 0+ years age group is about 15.60 cm. It is one and half times by 9+ years. An increment of 10 cm is noticed from 10+ to 18+ years. The maximum mean annual increase of upper arm and calf

Table 1: Mean and standard deviation of seven body measurements among Gadaba tribal girls of Visakhapatnam district of Andhra Pradesh

Age (in years)	N	Body weight (kg)		Supine length Stature (cm)		Upper arm circumference (cm)		Calf circumference (cm)		Chest circumference (cm)		Abdominal circumference (cm)		Head circumference (cm)	
		$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
0+	11	5.54	1.29	61.80	2.61	13.14	1.35	15.60	2.27	40.90	3.32	40.09	4.45	41.27	2.05
1+	9	7.11	1.02	80.28	1.95	13.06	0.87	15.75	1.09	41.55	1.13	36.87	1.36	46.00	1.41
2+	9	8.00	0.56	83.51	6.55	13.62	0.59	17.37	0.49	46.66	1.37	46.41	2.09	47.49	1.84
3+	10	11.25	1.00	91.81	1.76	13.73	0.31	17.37	0.46	48.34	1.88	47.24	0.96	47.62	0.71
4+	10	11.60	1.28	95.74	5.62	14.77	1.29	18.70	0.80	48.32	2.09	47.95	0.76	48.90	1.45
5+	10	13.35	1.03	96.40	1.20	14.26	0.35	19.18	0.45	49.82	1.06	47.86	1.29	48.38	1.35
6+	10	13.95	1.09	107.83	2.89	14.22	0.25	19.34	0.75	50.94	0.75	47.84	0.80	48.40	1.55
7+	12	17.04	1.40	113.52	3.96	14.70	0.93	20.63	1.08	53.30	1.89	49.06	2.20	49.35	1.01
8+	11	20.63	2.18	124.61	7.55	15.01	0.83	22.74	0.76	56.50	2.32	52.10	1.88	49.73	1.12
9+	14	22.32	3.30	125.99	6.76	15.97	0.73	23.43	1.53	58.81	3.08	54.36	2.75	49.95	1.02
10+	20	22.40	2.12	130.01	5.87	15.97	1.04	23.38	1.18	59.25	3.20	54.40	2.60	50.27	1.18
11+	21	27.41	2.83	136.05	5.24	17.12	1.25	25.21	1.82	62.71	4.00	55.33	2.84	51.42	1.55
12+	26	30.79	3.79	141.40	6.56	18.03	1.40	26.01	1.46	67.12	3.69	56.84	3.16	51.88	1.59
13+	14	39.46	3.27	150.43	4.22	20.03	1.58	28.45	1.25	73.44	3.97	63.11	3.95	53.01	1.45
14+	12	39.50	1.02	150.49	5.24	20.08	0.80	28.10	1.36	73.48	2.50	63.01	3.24	52.53	0.93
15+	18	41.67	5.09	150.53	3.58	21.05	1.60	30.06	2.69	76.48	4.70	64.77	3.87	53.40	1.03
16+	12	42.12	4.12	153.00	5.08	21.16	0.92	29.98	1.73	74.20	4.27	62.97	2.92	53.76	1.75
17+	10	47.00	2.16	149.50	1.61	23.42	0.72	34.46	0.78	79.62	0.86	71.42	0.66	55.41	0.93
18+	11	45.45	4.18	153.37	6.17	23.76	1.75	33.84	2.72	75.66	2.83	64.49	2.89	52.96	1.27

Table 2: Mean and standard deviation of eight skinfold measurements among Gadaba tribal girls of Visakhapatnam district of Andhra Pradesh

Age (in years)	N	Triceps (mm)		Biceps (mm)		Subscapular (mm)		Suprailiac (mm)		Abdominal (mm)		Anterior thigh (mm)		Medial calf (mm)		Forearm (mm)	
		$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
0+	11	11.24	3.38	6.64	2.70	8.69	2.23	8.56	3.29	11.15	3.45	16.29	3.48	12.94	2.67	8.43	1.60
1+	9	9.24	0.51	4.67	0.81	4.93	0.70	4.60	1.05	4.84	0.79	9.44	0.76	12.48	1.44	8.82	1.25
2+	9	11.09	0.67	8.49	0.74	7.35	0.63	5.42	1.19	6.55	2.74	12.11	1.96	10.60	0.50	8.20	1.52
3+	10	7.04	1.66	4.88	0.34	5.34	0.51	4.36	0.71	4.58	0.51	7.84	0.48	7.94	0.40	6.50	0.59
4+	10	11.82	2.76	8.12	2.15	7.52	2.44	6.04	1.28	8.74	1.81	10.90	2.69	9.44	1.58	10.54	2.47
5+	10	8.32	2.22	5.78	1.78	6.44	0.80	4.78	0.80	5.86	1.24	9.46	1.96	9.72	1.09	8.74	1.02
6+	10	6.52	1.52	4.04	0.80	4.72	0.58	3.64	0.67	4.32	1.47	7.04	2.00	8.38	1.54	5.40	1.09
7+	12	6.81	2.00	4.38	0.50	6.17	1.48	4.41	0.89	5.41	1.97	9.28	2.07	7.90	1.82	5.51	1.01
8+	11	6.54	1.51	4.85	0.87	7.09	1.37	5.07	0.71	5.72	1.53	11.23	1.72	9.20	1.89	5.27	0.78
9+	14	7.68	1.60	4.56	0.57	7.01	2.07	5.58	1.83	6.60	3.05	11.20	1.44	9.42	1.07	5.67	1.05
10+	20	7.41	1.65	4.49	1.17	7.16	1.92	5.72	1.98	7.43	2.99	11.73	2.13	8.43	2.24	5.98	3.04
11+	24	8.50	2.04	5.37	1.50	9.19	1.93	8.10	2.44	9.86	3.09	13.30	2.44	10.10	1.06	6.04	1.19
12+	26	8.97	1.74	5.16	1.39	9.65	1.95	8.94	2.96	11.06	3.74	13.11	4.40	10.16	1.54	5.87	1.54
13+	14	10.18	2.51	7.76	2.30	11.37	3.08	11.21	3.14	14.11	2.06	18.91	4.47	11.65	2.00	6.57	2.24
14+	12	10.18	2.53	6.83	1.32	10.97	2.49	10.96	2.49	14.76	3.63	18.63	3.94	12.01	2.40	8.00	3.09
15+	18	12.05	2.56	8.02	1.96	13.38	3.22	12.16	3.34	15.83	3.81	20.46	4.25	13.49	2.99	8.34	2.71
16+	12	12.00	2.41	7.21	2.48	11.97	1.73	10.31	2.62	13.78	2.57	18.33	4.83	12.37	2.83	7.75	0.56
17+	10	15.72	0.77	9.26	0.57	14.44	0.90	10.62	0.34	9.04	4.86	25.78	1.36	20.90	11.97	11.84	1.09
18+	11	16.64	2.79	8.01	1.52	15.24	2.48	12.93	2.31	11.74	4.17	23.87	3.66	15.24	2.54	9.10	1.55

circumferences (+2.00 cm and +2.44 cm per year) has occurred between 12+ and 13+ years, while the maximum mean annual loss of upper arm (-0.51 cm) and calf circumference (-0.62 per year) is found respectively between 4+ and 5+ years and 17+ and 18+ years.

The mean chest circumference of infant at 0+ year age group is 40.90 cm. It is one and half times by 11+ years. The maximum mean annual increase (+6.21 cm) has occurred between 12+ and 13+ years. The mean abdominal circumferences of infant at 0+ years age group is 40.09 cm. It is one and half times by 13+ years. The highest mean annual gain (+6.27 cm per year) has occurred between 12+ and 13+ years, while the maximum mean annual loss of abdominal circumferences (-8.45 cm per year) is found between 16+ and 17+ years. The mean head circumference of infant at 0+ years age group is about 41.27 cm. The highest mean annual gain (+1.80 cm) has occurred between 14+ and 15+ years, while the maximum mean annual loss (-2.44 cm per year) is found between 17+ and 18+ years.

Fat fold at Biceps region decreased gradually in the mean form 0+ to 6+ years, and increased to 18+ years; the highest mean annual gain (2.60 mm) has occurred between 12+ and

13+, years while the maximum mean annual loss of thickness (-3.61 mm per year) is found between 2+ and 3+ years. The mean triceps decrease gradually with minor irregularities in the mean from 0+ to 8+ years and increased to 18+ years. The highest mean annual gain (+1.84 mm per year) has occurred between 12+ and 13+ years, while the maximum mean annual loss of thickness (-4.05 mm per year) is found between 2+ and 3+ years.

The mean subscapular skinfold of infant at 0+ years age group is 8.69 mm and then gradually decreased to 6+ years and increased with minute irregularities from 7+ to 18+ years. The highest mean annual gain (+2.41 mm per year) has occurred between 14+ and 15+ years, while the maximum mean annual loss (-3.76 mm per year) is noticed between 0+ and 1+ years. The mean medial calf skinfold of infant at 0+ age group is about 12.94 mm. It decreases 0+ to 3+ years and increase by 18+ years. The highest mean annual gain (+1.67 mm) has attained between 10+ and 11+ years, while the maximum mean annual loss of thickness (-5.66 mm per year) is noticed between 17+ and 18+ years.

The mean forearm skinfold by 3+ years and it increased by 18+ years with minor fluctuations. The highest mean annual gain (+1.43 mm)

has attained between 13+ and 14+ years, while the maximum mean annual loss (-3.34 mm) is observed between 5+ and 6+ years.

The mean suprailiac skinfold of infant at 0+ age group is about 8.56 mm gradually decreases 0+ to 6+ years and increases by 18+ years with few fluctuations (Table 2). The highest mean annual gain (+2.27 mm) has attained between 12+ and 13+ years, the maximum mean annual loss (-3.96 mm per year) is noticed between 0+ and 1+ years. From table 2, it is evident that all skinfold thickness increase gradually with minor irregularities in the means from 0+ to 8+ years reaching a highest peak value 10+ and 14+ years from 16+ to 18+ years again gradual decelerating trend in skinfold thickness is clearly noticed.

The mean abdominal and anterior thigh skinfolds of infant from 0+ to 6+ years almost decelerating trend and 7+ to 16+ years accelerating trend with minor fluctuations, then it declines. The highest mean annual gain of abdominal and anterior thigh skinfold is (+3.05 mm) and (+5.80 mm) respectively occurred between 12+ and 13+ years, while the maximum, mean annual loss of abdominal skinfold (-6.31 mm) per year is found between 0+ and 1+, years and the maximum mean annual loss of anterior thigh skinfold is (-4.27 mm) is found between 2+ and 3+ years.

The highest peak velocity or maximum mean annual increase of stature (9.02 cm), body weight (8.67 kg), upper arm circumference (2.00 cm), calf circumference (6.32 cm), abdominal circumference (6.27 cm), triceps skinfold (1.84 mm), biceps skinfold (2.60 mm), suprailiac skinfold (2.27 mm), abdominal skinfold (3.05 mm), anterior thigh skinfold (5.08 mm), was attained between 12+ and 13+ years, which is earlier by two years than head circumference (6.32 cm), subscapular skinfold (2.41 cm) *i.e.* 14+ and 15+ years and earlier by a 5 year than forearm skinfold *i.e.* 16+ and 17+ years and delayed by two years than medial calf skinfold *i.e.* 10+ and 11+ years.

In the present study stature, body weight and all circumferences as well as systolic, diastolic blood pressure and pulse rate is progressively accelerated with advancement in age with few fluctuations. It supports that the systolic blood

pressure (103.18 mm Hg), in 12+, diastolic (73.57 mm Hg), in 13+ years and pulse rate (80.60 per second) in 17 years, is below the normal range. The highest peak velocity or maximum mean annual increase of systolic blood pressure (115.83 mm Hg) and diastolic blood pressure (80.33 mm Hg) is attained between 5+ and 16+ years and pulse rate (100.50 per second) *i.e.* 15+ and 16+ years. It is well known that the blood pressure is influenced by a large number of external factors. The deviations from the expected trend observed in the present study must have been due to differences in body composition, habitual physical activities, diet, income, smoking, etc. (Table 3). Differential growth trends differential dimensions of homozygous and heterozygous sickle cell anaemic Gadaba tribal girls are presented in table 4. It can be inferred from the table the homozygous sickle cell anaemic Gadaba tribal girls have decelerating growth trend when compared to heterozygous sickle cell anaemic Gadaba tribal girls and also both (HbSS and HbAS) compared to normal Gadaba tribal girls.

Table 3: Values of mean, standard deviation of blood pressure and pulse rate of Gadaba tribal girls by age

Age (in years)	N	Systolic blood pressure		Diastolic blood pressure		Pulse rate	
		$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
12+	22	103.18	9.94	74.54	5.95	22	102.63
13+	14	112.86	9.13	73.57	7.44	14	99.00
14+	12	111.66	7.17	74.16	6.68	12	90.33
15+	18	113.88	16.85	74.44	15.42	18	95.11
16+	12	115.83	20.65	80.00	12.79	12	100.50
17+	10	112.90	6.32	78.00	6.32	10	80.60
18+	11	112.72	4.67	77.27	4.67	11	107.45

It will be apparent from the foregoing discussion that the findings of the Gadaba tribal girls were heavier in body weight and shorter in stature than the results obtained by Singh (1980) and Nath et al. (1991) and also taller than the findings of Hauspie et al. (1980), shorter and lighter than Savara tribal girls and taller and heavier than Chenchu tribal girls and Jatapu tribal girls (Dharma Rao and Busi, 1996, 1997a, b). Gadaba girls are taller and heavier than the

Table 4: Differential growth trends ($\bar{X} \pm SD$) of homozygous and heterozygous sickle cell anaemic Gadaba tribal girls

Age	Body weight		Stature		Upper arm circumference		Calf circumference		Chest circumference		Abdominal circumference		Head circumference		Skinfold thickness	
	HbSS	HbAS	HbSS	HbAS	HbSS	HbAS	HbSS	HbAS	HbSS	HbAS	HbSS	HbAS	HbSS	HbAS	HbSS	HbAS
15+	35.30	37.83	141.50	147.05	19.50	19.67	27.25	28.57	72.00	72.60	60.00	62.23	52.00	52.67	10.40	10.63
SD	0.70	2.48	2.12	2.86	0.70	1.03	0.35	1.30	4.24	3.62	1.41	3.44	52.00	53.00	10.00	11.10
16+	36.00	39.50	147.50	149.60	19.55	21.00	27.50	27.80	68.50	71.00	58.50	62.50	52.00	53.00	10.00	11.10
SD	2.83	0.70	2.12	4.88	0.78	1.41	0.70	0.28	2.12	1.41	4.95	2.12	1.41	1.41	0.56	1.27

Skinfolds

Biceps		Subscapular		Suprailiac		Abdominal		Anterior thigh		Medial calf		Forearm	
HbSS	HbAS	HbSS	HbAS	HbSS	HbAS	HbSS	HbAS	HbSS	HbAS	HbSS	HbAS	HbSS	HbAS
6.10	6.43	10.30	10.77	7.50	10.03	11.00	13.33	15.90	16.76	11.30	11.87	5.90	6.97
2.69	1.86	0.14	2.73	4.67	3.29	7.39	3.67	1.13	1.66	1.27	1.26	0.99	1.15
6.00	6.10	10.00	11.90	8.70	9.90	11.30	14.70	12.00	16.60	11.00	11.20	7.30	7.80
2.26	2.12	1.13	1.56	1.27	3.53	2.96	1.84	1.41	4.80	2.82	2.54	0.14	0.85

15 years HbSS (2), HbAS (6); 16 years HbSS (2), HbAS (2)

15 years HbSS (2), HbAS (6); 16 years HbSS (2), HbAS (2)

ICMR 1984 observations. These results are general, universal in character and are observed in many populations (Johnston et al., 1975), Dharma Rao and Busi (1997). Both juvenile and adolescent growth spurt are similar to the findings of Tanner (1962). These girls were more or less similar to the findings of Tanner et al. (1966), Dharma Rao and Busi (1992, 1993, 1994, 1995, 1996 and 1997). The findings generated in this paper can therefore be utilised and reference material for the Gadaba tribal girls in Visakhapatnam District of Andhra Pradesh. Goldstein and Tanner (1980) and Dharma Rao and Busi (1997) have pointed out that the findings obtained from such studies would be useful as an alternative to the growth standards and also suggest that sickle cell anaemic subjects may require proper medical care and treatment.

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