

## Growth Progression in Physical and Physiological Traits Among Madiga Girls of Visakhapatnam District, Andhra Pradesh

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**ABSTRACT** A cross-sectional study was undertaken among Madiga girls in rural schools situated in the 4 mandals viz. Visakhapatnam (Rural), Pendurthi, Anandapuram and Bheemunipatnam of Visakhapatnam district of Andhra Pradesh (South India) during February 1996 to October 1997. The sample consisted of 328 healthy girls aged 0+ to 18+ years. In this paper data on stature, body weight, upper arm, calf, chest, abdominal and head circumferences and skinfolds at triceps, biceps, subscapular, suprailliac, abdominal, anterior thigh, medial calf, fore arm sites and blood pressure and pulse rate are presented including patterns of change in these physical and physiological traits with advancement of age. It has been observed that there is progressively increase in all the dimensions with advancement in age except skinfolds. Analysis of the data reveal that all the dimensions exhibited maximum mean annual increments between 10+ and 14+ years for all measurements. Blood pressure and pulse rate increased with increase in age with minor fluctuations. These girls are shorter and lighter than the ICMR, 1984 observations. The findings of the study can be used as a reference material for Madiga girls of Visakhapatnam district.

### INTRODUCTION

Several studies of physical growth in rural population have observed that with the increase in age, there is a tendency for acceleration in all the physical traits except skinfolds (Singh, 1980; ICMR, 1984; Nath, 1987; Bharati et al., 1991; Sharma, 1991; Nath et al., 1991; Dharma Rao and Busi, 1994, 1995, 1996, 1997). Investigations carried out under different conditions by various research groups have shown positive correlations between blood pressure and age (Reddy et al., 1991), heredity (Nirmala and Chengal Reddy, 1992), body composition (Sambasiva Rao, 1983), and social status (Srivastava et al., 1977) and sex (Celine and Mathur, 1979). Another important dimensions of the variation in arterial blood pressure is the interaction with other physiometric and anthropometric variables. In India very few researches have been con-

ducted in this field (Padmavati and Gupta, 1959; Das and Mukherjee, 1963; Gangopadhyay et al., 1988; Nirmala and Chengal Reddy, 1991; Verma, 1991; Dharma Rao and Busi, 1997) among others. However, in the Visakhapatnam region there is a dearth of published material related to growth and development and blood pressure and pulse rate of Madiga girls, and the Indian Council of Medical Research (ICMR 1984) in their nation wide growth survey did not include the Madiga girls of Visakhapatnam district. A cross-sectional growth study of Madiga girls was therefore undertaken in February 1996 to October, 1997, covering 18 measurements.

Many studies have tried to enumerate the trends of growth under different situations all over the world, but little attention has been paid towards Madiga (as scheduled caste) girls. In the present study an attempt has been made to study the effect of age from 0+ through 18+ years on eighteen body measurements, throughout the growth period and also to study the adolescent growth spurt, and aimed to understand the association between blood pressure and pulse rate with height, body weight, circumferences and other skinfold thickness, and its implications for health of the population and to compare these girls data with other girls of India in order to find out the population differences of physical and physiological traits. The present paper reports the 18 body measurements derived on the Madiga girls of Visakhapatnam district of Andhra Pradesh.

### MATERIAL AND METHODS

The Madigas are concentrated in Andhra Pradesh but distributed in all the southern states, namely Karnataka, Tamil Nadu, Kerala and Maharashtra. The Madigas are also known as left hand caste or Edagaiyavam among themselves.

The Madigas of Andhra Pradesh are also referred to as Arundhatiya, Jambavalu, Jambhavanthulu, Adi-Andhra etc. There are many legendary accounts of the origin of the Madiga. The Madiga and Mala have common legends that speak of their origins. Many legends say that the divine cow, Kamadhenu, was killed by two watchmen of Esvara and as a consequence they were cursed by him. The descendents of these two watchmen were the Madiga and Mala. Most Madigas live in their own hamlets (Madiga palle) segregated from the main village. According to the 1981 census the population of the Madiga in Visakhapatnam district is 82,279 and in Andhra Pradesh is 3, 572,072. They are predominantly found in rural areas. However, a considerable number of them, *i.e.* 477,596 persons (13.37 per cent of the total population) are returned from urban areas. The Dravidian language, Telugu and the Telugu script are used for both intra and inter-group communication. The morphometric features of the Madiga in Andhra Pradesh fall between the tribal communities and the agricultural and economically dominant castes and, in general, are similar to the average physical features of the state's population. The Madiga are predominantly round-headed, of below medium to short height and have a broader facial profile. The Madiga are non-vegetarians and are in the habit of taking alcoholic drinks frequently. It is stated that their untouchable status was due to their habit of eating beef. Rice is the staple cereal consumed. For details see Dharma Rao and Busi (1997).

The material for the present study was based on a cross-sectional data collected on 328 Madiga girls drawn from 8 schools from 4 selected mandals *viz.* Visakhapatnam (Rural), Pendurthi, Anandapuram and Beemunipatnam of Visakhapatnam Districts of Andhra Pradesh during the months of February 1996 to October 1997. The age of these subjects ranged from 0+ to 18+ years. The exact date of birth was collected for 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). All bilaterally

represented measurements were taken on the left. The Anthropometric measurements were taken after Weiner and Lourie (1969). 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 these phygmanometer with standard cuff and the stethoscope. 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.

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 year) as below.

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

## RESULTS AND DISCUSSION

The mean values and standard deviations for all the anthropometric measurements have been shown 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 with age 0+ to 14+ years showed study pattern of growth and from 15+ 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 any consistent pattern as found earlier in linear, transverse and circumferential and skinfold measures (Dharma Rao and Busi, 1997).

The Madiga girls a steady pattern in stature is noticed upto the age of 11+ years. The mean stature of infant at 0+ years age group is about 61.94 cm and doubled by 10+ years. The highest mean annual increments (+9.17 cm) per year has occurred between 10+ and 11+ years while the maximum mean annual loss (-6.05 cm per year) is noticed between 15+ and 16+ years. The mean body weight of infant at 0+ years age group is about 5.17 kg it is doubled by 3+ years, and thrice by 7+ years and about 5 times by 11+ years and 6 times by 12+ years. The highest mean annual gain (6.95 kg per year) has occurred between 11+ and 12+ years, while the maximum



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

Age in years	N	Stature (cm)		Body weight (kg)		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+	9	61.94	7.66	5.17	1.84	12.50	1.49	15.52	0.89	38.09	3.92	39.37	3.41	41.02	3.90
1+	10	69.68	2.10	6.95	0.80	13.11	1.22	15.56	1.02	43.79	2.54	41.13	1.59	43.27	1.53
2+	10	75.90	3.91	7.65	0.81	13.00	1.24	16.03	1.41	44.85	1.88	43.58	2.36	44.85	1.89
3+	10	87.35	6.35	10.60	1.54	14.11	1.05	17.50	1.33	48.65	4.40	47.15	5.83	46.47	1.19
4+	10	92.05	12.88	11.85	1.23	13.66	0.66	17.93	1.19	47.95	1.50	46.55	1.30	46.70	1.48
5+	15	100.49	5.35	13.33	1.33	13.95	0.60	19.00	1.02	49.73	1.98	48.73	2.99	48.09	1.31
6+	22	108.13	6.39	15.34	2.39	14.44	0.83	20.29	1.30	50.59	2.75	49.48	2.32	47.81	1.41
7+	24	108.08	7.02	15.50	2.01	14.91	0.81	21.51	2.11	50.97	1.68	49.07	2.83	47.93	1.08
8+	18	116.04	4.90	17.89	2.48	14.95	1.10	21.51	1.60	53.36	2.94	50.44	2.01	48.79	1.60
9+	28	120.49	6.72	20.16	3.17	15.49	1.05	21.96	1.22	55.04	3.17	51.04	4.67	48.91	1.71
10+	29	126.79	4.69	22.08	2.37	15.67	0.93	22.60	1.46	56.01	2.16	52.26	2.94	50.13	1.59
11+	31	135.96	6.38	26.08	3.20	16.80	1.12	23.77	1.42	59.87	4.01	55.27	6.90	49.65	1.26
12+	20	142.04	5.05	33.03	5.19	18.83	1.83	26.97	2.69	64.70	5.39	57.06	6.03	52.03	5.30
13+	27	145.52	5.40	33.98	3.25	19.00	1.38	26.61	1.59	66.74	3.39	59.80	2.78	50.86	1.55
14+	21	146.69	4.17	38.74	5.79	20.28	1.88	28.76	2.74	70.58	5.07	61.95	6.64	51.09	1.17
15+	12	152.34	5.20	43.46	4.45	21.74	2.41	30.00	2.75	75.41	5.48	63.68	7.93	55.40	5.14
16+	10	146.29	3.04	40.35	3.01	22.08	2.26	29.19	1.80	71.56	1.20	56.00	2.21	52.41	1.08
17+	10	149.87	6.51	39.65	3.10	21.17	1.56	27.28	0.80	71.61	5.20	62.21	4.11	51.55	1.57
18+	12	147.73	4.71	38.29	3.30	20.29	1.07	27.30	1.76	71.04	2.50	61.41	4.19	51.78	1.08

**Table 2: Mean and standard deviation of eight skinfold measurements among Madiga 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)		Fore-arm (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+	9	8.67	1.88	7.44	1.79	7.36	2.05	7.67	3.53	9.37	4.15	13.71	4.15	10.75	3.00	8.73	2.33
1+	10	9.40	1.46	7.44	3.25	8.10	2.19	7.36	2.32	8.72	4.00	15.56	2.58	12.82	1.67	9.16	1.48
2+	10	9.26	1.20	7.20	1.97	7.96	2.01	6.00	1.35	6.44	2.09	11.20	1.57	10.18	2.81	9.20	1.42
3+	10	9.80	1.21	7.74	1.60	7.86	2.34	6.64	2.07	6.44	1.76	12.14	2.46	10.98	1.70	8.78	1.72
4+	10	10.34	2.15	8.22	2.72	7.34	1.79	6.18	2.41	7.16	3.35	12.22	2.38	11.02	2.16	7.24	1.80
5+	15	9.13	2.03	6.29	1.90	7.41	2.35	6.45	2.58	6.85	2.82	10.30	1.14	9.65	1.48	7.40	1.60
6+	22	8.53	1.47	5.99	1.89	6.83	1.64	5.91	1.81	6.55	1.86	11.25	2.38	10.50	1.62	6.19	1.50
7+	24	8.38	1.80	5.51	1.35	6.70	1.79	5.55	1.95	7.15	2.03	10.04	2.60	9.70	1.76	6.84	2.80
8+	18	8.78	1.65	6.26	1.81	7.97	2.16	5.81	1.75	8.10	2.81	12.14	2.69	10.14	1.99	6.19	1.75
9+	28	8.36	1.35	5.68	1.60	6.89	1.59	5.89	1.63	7.49	2.29	11.68	2.22	10.20	1.74	5.98	1.12
10+	29	8.17	1.45	5.63	1.59	7.66	1.79	6.13	1.84	8.37	2.52	11.80	3.53	10.51	1.78	6.01	1.34
11+	31	8.88	2.34	6.08	1.99	9.20	2.87	8.08	3.04	11.41	4.30	14.63	3.19	10.94	2.37	6.20	2.15
12+	20	11.32	2.51	7.68	2.35	11.64	2.29	11.50	3.27	15.53	3.58	18.93	5.09	15.09	3.46	7.05	2.11
13+	27	9.78	1.98	6.65	1.90	11.04	2.38	9.98	3.35	13.13	5.15	18.10	4.96	13.86	3.99	6.69	1.51
14+	21	12.71	3.08	8.18	1.76	14.03	4.13	13.86	4.75	17.49	6.20	20.40	4.54	15.93	4.75	7.75	2.46
15+	12	12.75	3.53	9.30	2.22	16.78	7.05	14.28	5.52	16.00	4.94	22.13	4.25	16.65	3.12	8.51	1.94
16+	10	12.26	1.03	8.00	1.96	14.06	4.32	11.84	2.80	17.34	4.42	17.82	4.87	14.16	3.05	8.26	1.35
17+	10	12.80	1.79	8.90	1.69	14.56	2.63	14.52	2.89	16.02	3.68	19.40	4.12	14.46	1.55	8.40	1.58
18+	12	11.63	2.07	7.45	1.99	13.01	2.53	10.30	2.55	14.70	4.96	18.28	5.47	14.77	3.44	7.40	2.06

mean annual loss (-3.11 kg per year) is found between 15+ and 16+ years.

The mean upper arm circumference of infant at 0+ years age group is about 12.50 cm, it is one and half times by 12+ years. An increment of 4 cm is noticed from 12+ to 18+ years.

The mean calf circumference of infant at 0+ year age group is about 15.52 cm. It is one and half times by 10+ years. An increment of 8 cms is noticed from 11+ to 15+ years and declined. The maximum mean annual increase of upper arm and calf circumferences (+2.03 cm and +3.19

cm per year) has occurred between 11+ and 12+ years. While the maximum mean annual loss of upper arm (-0.91cm) and calf circumference (-1.91 cm per year) is found between 16+ and 17+ years.

The mean chest circumference of infant 0+ year age group is 38.09 cm. It is one and half times by 11 + years. The maximum mean annual increase (+4.83cm) has occurred between 11+ and 12+ years. The mean abdominal circumference of infant at 0+ years age group is 39.37 cm. It is one and half times by 13+ years. The highest mean annual gain (+6.21 cm per year) has occurred between 16+ and 12+ years. The mean head circumference of infant at 0+ years age group is about 41.02 cm. The highest mean annual gain (+4.31 cm) has occurred between 14+ and 15+ years, while the maximum mean annual loss (-2.99 cm per year) is found between 15+ and 16+ years.

Fat fold at biceps region increase gradually with minor irregularities in the mean from 0+ to 18+ years; the highest mean annual gain (+1.60 mm) has occurred between 11+ and 12+ years, while the maximum mean annual loss of thickness (-1.93 mm per year) is found between 4+ and 5+ years. The mean triceps increase gradually with minor irregularities in the mean from 0+ to 18+ years. The highest mean annual gain (+2.93 cm per year) has occurred between 13+ and 14+ years, while the maximum mean annual loss of thickness (-1.54 mm per year) is found between 12+ and 13+ years.

The mean subscapular skinfold of infant of 0+ years age group is 7.36 mm and then gradually increased with minute irregularities from 0+ to 18+ years. The highest mean annual gain (+2.99 mm per year) has occurred between 13+ and 14+ years, while the maximum mean annual loss (-1.55 mm per year) is noticed between 17+ and 18+ years. The mean medial calf skinfold of infant at 0+ age group is about 10.75 mm. It increase 0+ to 18+ years. The highest mean annual gain (+4.15 mm) has attained between 11 + and 12+ years, while the maximum mean annual loss of thickness (-2.49 mm per year) is noticed between 15+ and 16+ years and it declines by 18+ years.

The mean Forearm skinfold declines by 13+ years and it increases by 18+ years with minor fluctuations. The highest mean annual gain (+

1.06 mm) has attained between 13+ and 14+ years while the maximum mean annual loss (-1.54 mm) is observed between 3+ and 4+ years.

The mean suprailiac skinfold of infant at 0+ group is about 7.67 mm gradually decreases from 0+ to 9+ years and increases by 17+ years with few fluctuations (Table 2). The highest mean annual gain (+3.88 mm) has attained between 13+ and 14+ years, the maximum mean annual loss (-4.22 mm per year) is noticed between 17+ and 18+ years. From table 2 it is evident that all skinfold thicknesses increases gradually with minor irregularities in the means from 0+ to 9+ years reaching a highest peak value between 10+ to 15+ years. From 16+ to 18+ years again gradual deceleration trend in thickness is clearly noticed.

The mean abdominal and anterior thigh skinfolds of infant from 0+ to 18+ years almost accelerating trend with minor fluctuations. The highest mean annual gain of abdominal and anterior thigh skinfold is +4.36 mm and +4.30 mm, respectively occurred between 13+ and 14+ and 11+ and 12+ years, while the maximum mean annual loss of abdominal skinfold (-2.40 mm per year) is found between 12+ and 13+ years and the maximum mean annual loss of anterior thigh skinfold is (-4.34 mm) is found between 1+ and 2+ years.

The maximum mean annual increments or highest peak velocity of stature (9.17 cm) and abdominal circumference (3.01 cm) were attained between 10+ and 11+ years which is earlier by a year than body weight (6.95 kg), chest circumference (4.83 cm), upper arm circumference (2.03 cm), calf circumference (3.19 cm), biceps (1.60 mm), anterior thigh (4.30 mm) and medial calf skinfold (4.15 mm) *i.e.* 11+ and 12+ years which is earlier by two years than triceps skinfolds (2.93 mm), subscapular skinfold (2.99 mm), suprailiac skinfold (3.88 mm), abdominal skinfold (4.36 mm) and fore arm skinfold (1.06 mm) *i.e.* 13+ and 14+ years and earlier by 4 years than head circumference (4.31 cm) *i.e.* 14+ and 15+ years and earlier by 6 years than abdominal circumference (6.21 cm) *i.e.* 16+ and 17+ years.

In the present study stature, body weight and all circumferences as well as systolic, diastolic blood pressure and pulse rate are progressively accelerated with advancement in age with few fluctuations. It supports that the systolic blood pressure (105.00 mm Hg), in 14+ years, diastolic



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

Age (in years)	N	Systolic blood pressure		Diastolic blood pressure		N	Pulse rate	
		$\bar{X}$	S.D	$\bar{X}$	S.D		$\bar{X}$	S.D
12+	14	100.00	7.84	67.14	8.59	12	85.83	16.30
13+	12	109.17	6.68	71.67	10.30	12	72.33	4.41
14+	16	105.00	8.16	65.63	15.48	14	79.00	5.80
15+	10	109.00	7.38	70.00	7.07	10	70.00	9.57
16+	9	108.89	7.81	74.44	5.27	9	87.11	3.62
17+	10	108.00	6.32	72.00	7.89	10	93.20	10.96
18+	14	110.00	3.92	73.57	4.97	14	91.57	13.73

(65.63 mm Hg) in 14+ years and pulse rate 72.33 per second) in 13+ years is below the normal range. The highest peak velocity of systolic blood pressure (109.17 mm Hg) and diastolic blood pressure (74.44 mm Hg) is attained, respectively in between 12+ and 13+ years and 15+ and 16+ years, and pulse rate 93.20 i.e. 16+ and 17+ 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 the differences in body composition, habitual physical activities, diet, income, smoking etc. (Table 3).

It will be apparent from the foregoing discussions that the findings on Madiga girls were lighter in body weight and shorter in stature than the results obtained by Singh (1989) and Sharma (1991), Bharati et al. (1989), Nath et al., (1991). These girls are shorter and lighter than the I.C.M.R. (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 spurts are similar to the findings of Tanner (1962). The blood pressure and pulse rate are more or less similar to the findings of Tanner et al. (1966). Dharma Rao and Busi (1992, 1993, 1994, 1996, 1997). The findings generated in this paper can therefore be utilised as reference material for the Madiga (scheduled caste) 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. This research is conducted among Madiga girls to suggest programmes and strategies for improvement of the nutritional status and proper management of health.

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