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A Study of Growth in Physical and Physiological Variables Among Mala Boys of Visakhapatnam District, Andhra Pradesh

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ABSTRACT A cross-sectional study was undertaken among Mala boys 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 to October 1996. The sample consisted of 547 healthy boys 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, medial calf, forearm, suprailiac, abdominal and anterior thigh sites and blood pressure and pulse rate are presented, including patterns of change in these physical and physiological traits with advancing age. It has been observed that there is an increase in all the dimensions with increase in age except skinfolds. Analysis of the data reveal that all the dimensions exhibited the maximum mean annual increments between 14+ and 15+ years for all the measurements except triceps, biceps, anterior thigh and medial calf skinfold which in turn exhibits it two years earlier the spurt *i.e.* 12+ and 13+ years. Blood pressure and pulse rate increased with increase in age with few fluctuations These boys are shorter and lighter than the National Standards (ICMR, 1984). The findings of the study can be used as a reference material for Mala boys of Visakhapatnam.

INTRODUCTION

Physical Growth is a vital process which brings about irreversible changes in the body and its organs, in their size, form, body weight etc. Many studies of physical growth in rural population have revealed that with the increase in age, there is a tendency for increase in all the physical traits except skinfolds (Sidhu, 1969; Sharma, 1970; Singh, 1980; Krishna Rao, 1981; ICMR, 1984; Jhingon and Nath, 1985; Reddy, 1989; Nath et al., 1991; Kapoor and Kapoor, 1991; Dharma Rao and Busi, 1994, 1995, 1996). Investigations carried out under different conditions by various research groups have shown positive correlation 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 dimension of the variation in arterial blood pressure is the interaction with other physiometric and anthropometric variables. In India, very few researchers have been couducted in this field (Padmavati and Gupta, 1959; Das and Mukherjee, 1963; Gangopadhyay et al., 1988; Nirmala and Chengal Reddy, 1991; Dharma Rao and Busi, 1996) among others. However, from the Visakhapatnam region there is a dearth of published material related to growth and development and blood pressure and pulse rate of Mala boys and the Indian Council of Medical Research (ICMR, 1984) in their nation wide growth survey did not include the Mala boys of Visakhapatnam district. A cross-sectional growth study of Mala boys was therefore undertaken in February to October 1996 covering 18 measurements.

Although longitudinal observations on the same set of children are more informative especially for providing individual variations and rate of growth as also develop mental changes, cross-sectional studies are useful nevertheless, in providing information on population differences. In India, since repeated observations on the same children have not yet gained social acceptance, besides being expensive and time consuming we have to rely mostly on cross-sectional data.

Many researchers have tried to enumerate the trends of growth under different situations

all over the world, but little attention has been paid towards Mala (Scheduled caste) boys. 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 thicknesses and its implications for health of the population and to compare these boys with other caste boys of India inorder to find out the population differences of physical and physiological variables.

MATERIAL AND METHODS

The Mala, a scheduled caste population is economically poor and enjoy the lowest status in the society inhabiting in the almost all the districts of Andhra Pradesh. Their population of the state as per 1981 census is 2,896,642 and in Visakhapatnam district is 1,19,806. The scheduled caste population of the Visakhapatnam as per 1991 census is 2,56,936 constituting 7.83% of the total scheduled caste population. Their mother tongue is Telugu only. The Malas of Andhra Pradesh are predominantly labour, though some are having agricultural lands and Government and private services as well. There are several subsects among this community, *viz.* Arava Mala, Adi-Andhra, Adi-Andhra Mala, Konda Mala, Mala Darja, Mala Dasari, Mala Dasu Mala, Mala Mastimi etc. From the information gathered through elders in the field area it is known that the Malas belong to Adi-Andhra Mala type. Marriage among Malas takes place after puberty and cross cousin marriages are encouraged. The following four types of acquiring spouses are in vogue among Malas. 1. Marriage by negotiation. 2. Marriage by love and elopment. 3. Marriage by capture. 4. Marriage by service. Marriage by negotiation is becoming more popular in modern times.

The material of the present study comprises of cross-sectional data collected on 547 Mala boys drawn from 8 schools from 4 selected mandals *viz.* Visakhapatnam (Rural); Pendurthi; Anandapuram and Bheemunipatnam of Visakhapatnam district of Andhra Pradesh during the months of February to October 1996. The age of these subjects range 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 weight of each individual was recorded in kilograms using a portable weighing machine. The measurements were taken by the first author.

The blood pressure was measured on the subject using Diamond B.P. apparatus, Deluxe, Pune, by one of the authors (B.D. Rao). The procedure of the measurement of blood pressure was thoroughly practised as per the manual of the instrument for a week in the presence of a medical doctor of the University Health Centre and the readings were checked each time with that of the doctor till the readings were consistent. Thus after standardisation of the technique, the blood pressure readings were taken thrice on each subject giving 2 minutes gap in between the measurements. The readings of the electronic instrument were checked periodically. *i.e.* once in a week with that of the readings obtained through a mercury sphygmomanometer, to ascertain the former. Blood pressure measurement of the subject were taken in the morning. *i.e.*, before 10 A.M. in seated position at their home environment. The subjects were asked to relax on a stool or flat raised platform for about 10 minutes, rest-

ing his left arm on the flat place at heart level. Pulse rate was taken after Weiner and Lourie (1981).

The whole year mean increments have been calculated by subtracting the mean of the preceding age group from that of the succeeding age group. Growth velocity is increment per unit time of measurement that is constantly growing and the concept is well understood if growth is thought of as a form of motion (Tanner, 1964). The values for 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.

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

RESULTS AND DISCUSSION

Mean values and standard deviations for each anthropometric measurement for each individual year of age are depicted in tables 1 and 2. It can be inferred from the tables that the mean values for all of these measurements increase with advancement of age with a few fluctuating discrepancies of a minor nature because of data are cross-sectional. From the table 2 it is clear that all the eight skinfold characters show non normal distributions at several ages. Standard deviations for all of these characters have not shown any consistent pattern as found earlier in the linear and transverse measurements (Dharma Rao and Busi, 1996).

In Mala boys a steady increase in stature is noticed upto the age of 14 years. The mean stature of infant at 0+ years age group is about 56.43 cm. The height doubled by 7+ years, two and half times by 13+ years. The highest mean annual gain (+8.57 cm. per year) has occurred between 13+ and 14+ years. An increment of 5 cm is noticed from 15+ to 18+ years. The mean body weight of infant at 0+ age group is about 4.86 kg; it is doubled by 2+ years, and thrice by 5+ years, about 5 times by 11+ years and 10 times by 18+ years. The highest annual gain (+5.21 kg per year) has occured between 14+ and 15+ years. An increment of 4 kg is noticed from 15+ to 18+ years. The mean upper arm

Table 1: Mean and standard deviation of seven body measurements among Mala boys of Visakhapatnam district of Andhra Pradesh

Age in years	*N*	*Body weight*		*Stature*		*Upper arm circumference*		*Calf circumference*		*Chest circumference*		*Abdominal circumference*		*Head circumference*	
		$\overline{X}$	*S.D.*	$\overline{X}$	*S.D.*	$\overline{X}$	*S.D.*	$\overline{X}$	*S.D.*	$\overline{X}$	*S.D.*	$\overline{X}$	*S.D.*	$\overline{X}$	*S.D.*
0+	7	4.86	1.34	56.43	8.30	13.86	1.65	13.50	3.48	38.50	4.66	35.96	4.64	39.71	2.16
1+	9	7.05	0.46	71.52	3.66	13.50	0.87	15.97	1.29	45.05	5.21	45.25	3.74	45.07	3.07
2+	11	8.36	1.96	76.69	5.96	13.30	0.49	16.44	1.40	45.27	2.57	43.56	2.04	45.18	2.13
3+	13	9.96	1.31	85.66	3.99	13.89	1.70	17.01	2.13	47.46	2.18	44.80	2.67	46.72	2.50
4+	25	11.74	1.67	93.38	7.69	13.90	1.32	18.57	1.05	48.82	2.50	46.57	2.80	47.08	1.03
5+	27	14.54	2.17	104.35	7.39	14.20	0.73	19.47	1.26	51.28	2.59	48.15	2.60	48.60	1.29
6+	32	15.73	1.89	108.96	5.88	14.24	0.87	20.32	1.13	52.16	2.50	49.38	3.16	48.85	1.38
7+	36	17.64	2.36	115.19	7.20	14.59	1.03	20.90	1.10	54.08	2.82	49.97	2.70	49.39	2.48
8+	39	18.73	2.30	119.74	5.85	14.73	1.00	21.34	1.13	55.37	2.40	50.71	3.10	49.09	1.43
9+	45	20.59	2.44	123.16	5.02	15.35	0.99	22.22	1.21	56.51	2.73	51.95	2.75	50.13	2.58
10+	59	22.41	2.33	128.42	4.58	15.66	1.10	22.71	1.28	57.39	3.09	52.58	3.53	49.94	1.38
11+	59	24.30	2.38	132.09	5.15	16.27	1.09	23.72	1.27	59.29	2.62	54.16	3.50	50.54	2.03
12+	49	26.64	3.23	137.37	6.08	16.70	1.07	24.51	1.80	60.58	4.38	56.24	4.52	50.87	2.18
13+	38	30.76	4.28	142.03	5.90	17.64	1.85	26.02	2.32	62.73	3.33	56.95	4.90	51.29	2.38
14+	38	35.34	3.91	150.59	6.02	18.29	1.18	27.15	1.54	66.12	4.09	58.48	4.55	51.72	2.12
15+	21	40.55	4.80	155.17	5.86	20.13	1.43	28.87	1.68	70.90	4.66	60.67	4.49	52.34	1.74
16+	13	42.96	6.48	159.10	6.72	20.43	1.98	29.08	1.44	71.92	4.20	61.94	4.19	52.13	1.38
17+	8	43.87	6.01	159.13	7.04	20.75	1.73	29.51	2.06	73.63	4.44	61.69	4.21	52.46	1.06
18+	18	44.77	6.38	160.28	8.25	21.55	1.84	29.09	2.01	75.05	5.35	63.50	4.60	53.01	1.38

Table 2: Mean and standard deviation of eight skinfold measurements among Mala boys of Visakhapatnam district of Andhra Pradesh

Age in years	N	Triceps		Biceps		Subscapular		Suprailiac		Abdominal		Anterior thigh		Medial calf		Fore arm	
		$\bar{X}$	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+	7	8.34	2.93	6.80	2.44	7.08	2.44	6.68	2.12	8.31	5.10	12.57	4.41	10.43	3.15	8.68	3.08
1+	9	8.89	1.40	6.22	1.66	7.49	1.27	7.33	1.82	8.71	3.68	13.38	2.49	10.51	1.55	8.24	2.09
2+	11	8.69	1.34	7.40	2.24	7.05	1.83	6.20	2.56	6.29	2.58	12.40	2.90	11.54	2.66	8.94	2.11
3+	13	9.74	1.43	7.58	1.68	6.90	2.18	6.26	1.92	8.04	2.68	10.84	1.95	9.69	2.80	7.97	2.05
4+	25	9.16	1.43	6.76	1.63	7.10	1.62	5.58	1.75	6.85	2.39	10.77	1.99	10.39	1.97	7.58	1.59
5+	27	8.61	2.28	5.74	2.30	6.10	1.41	4.85	1.58	5.94	1.59	9.95	2.73	9.46	1.86	6.44	1.79
6+	32	7.76	1.72	5.33	1.67	5.89	1,54	4.59	1.30	5.78	1.78	9.25	1.88	9.04	1.41	5.80	1.35
7+	36	6.91	1.65	4.79	1.28	5.89	1.37	4.68	1.76	5.81	1.60	8.84	1.71	8.80	1.78	5.11	1.34
8+	39	7.24	1.88	4.76	1.68	5.90	1.49	4.51	1.17	6.03	2.40	8.96	1.99	8.75	1.70	5.04	1.15
9+	45	7.40	1.56	4.88	1.38	5.89	1.26	4.99	1.80	6.18	2.12	9.27	2.07	9.04	1.71	5.07	1.06
10+	59	7.25	1.99	4.58	1.38	6.43	1.86	5.16	2.08	6.41	2.61	9.67	2.77	9.35	2.49	5.10	1.50
11+	59	7.06	1.77	4.77	1.47	6.41	1.67	5.22	1.73	6.79	2.48	9.94	2.57	9.94	1.87	4.89	1.31
12+	49	7.28	2.04	4.59	1.45	6.94	1.99	5.78	1.67	7.44	2.85	10.70	2.89	10.31	2.67	4.81	1.24
13+	38	7.84	2.30	4.91	2.23	7.17	2.25	6.48	2.37	8.11	2.53	11.46	3.09	11.24	2.07	5.12	1.40
14+	38	6.91	1.76	4.47	1.27	7.37	2.17	6.08	1.74	7.57	2.26	10.90	2.81	10.47	2.31	4.52	1.14
15+	21	7.19	2.12	4.65	1.08	8.46	3.74	7.50	3.25	9.21	4.07	11.08	3.33	11.34	2.89	5.25	1.59
16+	13	7.40	2.42	4.92	2.08	9.40	5.23	8.04	4.97	9.94	5.65	11.10	4.37	11.37	4.42	4.58	1.35
17+	8	7.65	4.47	4.65	2.58	9.32	5.67	7.30	4.08	8.57	4.12	11.52	5.35	11.02	4.24	5.05	2.44
18+	18	8.13	4.22	5.44	2.59	9.46	5.02	7.30	3.57	8.50	3.90	12.15	4.86	11.20	3.96	5.29	2.37

circumference of infant at 0+ age group is about 13.86 cm, it is one and half times by 15+ years. An increament of 1½ cm is noticed from 15+ to 18+ years. The mean calf circumference of infant at 0+ age group is about 13.50 cm. It is one and half times by 6+ years. An increment of 8 cms is noticed from 7+ to 18+ years. The maximum mean annual increase of upper arm and calf circumference (+1.84 cm and +1.71 cm per year) has occured respectively between 14+ and 15+ years. While the maximum mean annual loss of upper arm circumference (-0.36 cm) is found between 0+ and 1+ year and in calf circumference it is attained (-0.42cm) between 17+ and 18+ years.

The mean chest circumference of infant at 0+ age group is 38.50cm. It is one and half times by 10+ years. The maximum mean annual increase (+4.78cm) has occurred between 14+ and 15+ years. The mean abdominal circumference of infant at 0+ age group is 35.96 cm. It is one and half times by 11+ years. The highest mean annual gain (+2.19 cm per year) has occurred between 14+ and 15+ years. The mean head circumference of infant at 0+ age group is 39.71cm. The highest mean annual gain (+0.62cm) has occurred between 14+ and 15+ years while the maximum mean annual loss (-0.29cm) per year is found between 7+ and 8+ years.

Fat fold at triceps region increase gradually with minor irregularities in the mean from 0+ to 18+ years; the highest annual gain (+0.56mm) has occurred between 12+ and 13+ years while the maximum mean annual loss of thickness (-0.93mm per year) is found between 13+ and 14+ years, and increase to 18+ years. The mean biceps decreases continuously throughout 0+ to 8+ years with minor fluctuations, and from 9+ to 18+ years almost consistent. The highest mean annual gain (+0.32 mm per year) has occurred between 12+ and 13+ years while the maximum mean annual loss of thickness (-1.01 mm per year) is found between 4+ and 5+ years.

The mean subscapular skinfold of infant at 0+ age group is 7.08mm and then gradually decreases with minute irregularities from 0+ to 9+ years. The highest mean annual gain (+1.09 mm per year) has occurred between 14+ and

15+ years while the maximum mean annual loss (-1.00 mm per year) is noticed between 4+ and 5+ years. The mean medial calf skinfold of infant at 0+ age group is about 10.43mm. It increases 0+ to 2+ years and 9+ to 18+ years and decreases from 3+ to 8+ years. The highest annual gain (+0.93mm) has attained between 12+ and 13+ years while the maximum mean annual loss of thickness (-0.76mm per year) is noticed between 13+ and 14+ years.

The mean forearm skinfold increases 0+ to 2+ years. The highest annual gain (+0.73mm) has attained between 14+ and 15+ years, the maximum mean annual loss (-1.13mm) is observed between 4+ and 5+ years, and it increases by 18+ years. The mean suprailiac skinfold of infant at 0+ age group years is about 6.68mm, gradually increases from 6+ to 18+ years with minor fluctuations (Table 2). The highest mean annual gain (+1.42mm) has attained between 14+ and 15+ years, the maximum mean annual loss (-1.13mm per annum) is noticed between 1+ and 2+ years. From table 2 it is evident that skinfold thickness increases gradually with minor irregularities in the means from 0+ to 11+ years reaching a peak value between 12+ to 15+ years. From 16+ to 18+ years again gradual downward trend in thickness is clearly noticed.

The mean abdominal and anterior thigh skinfolds of infant for 0+ to 18+ years almost accelerating in trend with minor fluctuations. The highest annual gain of abdominal and anterior thigh skinfold is +1.65 mm and +0.76 mm, respectively occurred between 14+ and 15+ years and 12+ and 13+ years while the maximum mean annual loss of abdominal skinfold (-1.36 mm per year) is found between 16+ and 17+ years and the maximum mean annual loss of anterior thigh skinfold (-0.98 mm) is found between 1+ and 2+ years.

The maximum mean annual increments or highest peak velocity of triceps (+0.56 mm), biceps (+0.32 mm), anterior thigh (+0.76 mm), medial calf (+0.93 mm) were attained between 12+ and 13+ years which is earlier by a year than stature (8.57cm) (*i.e.* 13+ and 14+ years) and two years than body weight (5.21 kg), head circumferences (0.62cm), chest circumference (4.78 cm), abdominal circumference (2.19 cm), upper arm circumference (1.89cm), calf circumference (1.71cm), subscapular skinfold (1.09 mm), suprailiac skinfold (1.42 mm), abdominal skinfold (1.65 mm), forearm skinfold (0.73 mm) *i.e.* 14+ and 15+ years.

In the present study stature, body weight and all circumferences as well as the systolic, diastolic and pulse rate is accelerated with advancement in age with minor fluctuations. It supports that the systolic blood pressure is below the normal range (*i.e.* 102.73 mmHg) in between 15+ and 16+ years while the diastolic blood pressure is below the normal range (*i.e.* 66.36 mmHg) in between 15+ and 16+ years. The systolic (117.00 mmHg) and diastolic (73.00 mmHg) blood pressure reach the peak in between 14+ and 15+ 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 differ-

Table 3 : Values of mean, standard deviation of blood pressure and pulse rate of Mala boys 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+	13	103.84	13.25	69.23	9.54	86.46	10.46
13+	19	104.73	9.64	70.79	6.29	86.31	8.74
14+	20	106.00	9.95	71.50	9.88	83.60	8.27
15+	10	117.00	8.23	73.00	8.23	87.00	13.96
16+	11	102.73	12.72	66.36	17.48	89.81	13.60
17+	8	112.50	11.64	70.00	9.26	89.25	12.23
18+	16	110.00	12.11	70.62	11.36	87.12	13.34

ences in body composition, habitual physical activity, diet, income, smoking, etc. (Table 3).

It will be apparent from the foregoing results that the findings among Mala boys reveals that they were shorter and lighter and larger calf muscles with higher triceps and subscapular and suprailiac skinfolds than the findings of Singh (1980), and also shorter and lighter than findings of Jhingon and Nath (1985). These boys are shorter and ligher than the standards of ICMR (1984) and these boys were more or less similar to the findings of Wolanski (1961), Tanner et al. (1966), Sidhu (1969), Malcom (1970), Sharma (1971), Low (1971), Johnston et al. (1975), Malhotra (1975), Injeti (1980), Krishna Rao (1981), Reddy (1989), Nath et al. (1991), Dharma Rao and Busi (1989, 1994, and 1995). These findings are general, universal in character and observed in many populations (Johnston et al., 1975). The results generated in this paper can therefore be utilised as reference material for the Mala boys in Visakhapatnam District of Andhra Pradesh. Goldstein and Tanner (1980) have recently pointed out that the findings obtained from such studies would be useful as an alternative to the growth standards.

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