

Patterns of Growth and Physiological Variables Among Khond Tribal Population of Visakhapatnam District, Andhra Pradesh

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ABSTRACT A cross sectional study was undertaken on 1525 Khond boys and 1132 Khond girls aged between 0+ to 18+ years in schools situated in the tribal areas of Visakhapatnam district of Andhra Pradesh (South India) during April-October 2004. In this paper, data on body weight, stature, head, chest, abdominal, upper arm and calf circumferences, skin folds, blood pressure and pulse rate, along with the patterns of change in these physical and physiological traits with advancement of age are presented. It has been observed that there is a progressively increasing trend in all the dimensions with advancement in age. The study reveals that the adolescent growth spurt or highest peak velocity of girls (9+ and 10+) is attained earlier by two years than boys (12+ and 14+ years). Blood pressure and pulse rate increased with advancement in age with few fluctuations. Analysis of the data reveals that all the measurements showed significant differences by sex according to age. Khond boys and girls are shorter lighter with broader chest and head circumference than ICMR (1984) National standards. The growth curves shows as measure of population well being, secular trend, and the much neglected subject of the relation between mental and physical development. The findings of the study can be used as reference material for Khond boys and girls of Visakhapatnam district.

INTRODUCTION

Human Physical Growth is a dynamically changeable and inherently vital phenomenon. Growth patterns change over time and geography. Growth as an index of good health has been accepted for some time in the field of preventive medicine. The various parts of the body growing at different rate and time express a fairly regular sequence of development. Many studies have shown that the patterns of physical growth and development though genetically determined to some extent, are strongly influenced by socio-economic and or nutritional status (Tanner et al., 1966; Eveleth and Tanner, 1976; Garn, 1980). Jelliffe (1966) shows that environmental influences, especially nutrition, are of greater importance in determining growth pattern than genetic background. Studies carried out on different rural and tribal populations of Andhra Pradesh have indicated a positive tendency for increase in all the physical and physiological traits (except skin folds) with the advancement of age (Singh, 1980; ICMR, 1984; Bharati et al., 1991; Sharma, 1991; Nath et al., 1991; Dharma Rao and Busi, 1994, 1995 a, b, 1996 a, b, 1998, 1999 a; Dharma Rao et al., 1997 a, b, c, 1999 b, c, 2000; Busi and Dharma Rao, 2003).

Several 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, 1991), body composition (Sambasiva Rao, 1983), social status (Srivastava et al., 1977) and sex (Celine and Mathur, 1979). In India, very few studies however, have been conducted in this field (Padmavathi and Gupta, 1959; Das and Mukherjee, 1963; Nirmala and Chengal Reddy, 1991; Busi and Dharma Rao, 2003). Feeling the dearth of published data related to patterns of physical growth and blood pressure of tribal populations of Andhra Pradesh, especially from north coastal Andhra Pradesh, on Primitive tribal groups, a cross-sectional survey on Khond tribal boys and girls was undertaken during April 2004 - October 2004.

In the present study, an attempt has been made to study the effect of age from 0+ to 18+ years on eighteen body measurements throughout the growth period and also to study the adolescent growth spurt. Secondly, it is also aimed to understand the association between blood pressure with certain morphometric measurements like stature, body weight, circumferences and skin folds and its implications on the health of the population. Finally, it is envisaged to compare this data with other available data in order to find out the population differences in physical and physiological traits.

MATERIAL AND METHODS

Khond is an important Primitive tribal group found predominantly in the agency tracts of Visakhapatnam district, Andhra Pradesh. They are called Kodulu or Samanthulu in the agency tracts of Visakhapatnam. They mainly depend on Podu cultivation. The population of Khond in the ITDA (Paderu) sub-plan area is reported to be 51,293 (1998). They are divided into four sub-tribes viz., Jatapu Khond, Desai Khond, Dungria Khond and Kutia Khond. The present investigation is conducted on Kutia Khond. They are further divided into a number of totemic clans.

The material for the present study is based on a cross-sectional study conducted on 1525 boys and 1132 girls drawn randomly from 15 schools of Chintapalli, G. Madugula and Pedabayalu mandals of Visakhapatnam district, Andhra Pradesh during April 2004 to October 2004. The ages of the subjects are ranged from 0+ to 18+ years. The ages of the subjects were recorded based on school admission registers. The information on age was cross-checked with elders of the village and schoolteachers. All the subjects between age 0.00 to 0.99 years were included in 0+ age group, 1.00 to 1.99 years in 1+ age group, 2.00 to 2.99 in 2+ age group and so on up to 18+ years after Eveleth and Tanner (1976). All bilaterally represented measurements were taken on the left side of the body. The anthropometric measurements were taken after Weiner and Lourie (1981). Blood pressure was determined on the subject as per Rose et al. (1982) using the Sphygmomanometer with standard cuff and the Stethoscope after standardizing the method (Dharma Rao and Busi, 1997a). The measurement of hypertension was followed after WHO (1962). Heart rate was conveniently measured as pulse rate by palpating the radial artery at the wrist (with the help of three fingers) the number of beats occurring in half a minute being counted and doubled to give the rate per minute using stop watch (Weiner and Lourie, 1981). The whole year mean annual increments have been calculated by subtracting the mean of the preceding age group from that of the succeeding age group (Tanner, 1964). The statistical analysis was carried out using SPSS 8.0 Program Package of IBM computers. The t-test of significance was estimated after Fisher and Yates (1963).

RESULTS AND DISCUSSION

The mean values and standard deviations for seven anthropometric measurements among boys and girls are presented in Tables 1 and 2. The mean values for all the body measurements are observed to be progressively increasing with advancement of age from 0+ to 14+ years in boys and 0+ to 13+ years in girls and showed a steady pattern of growth, and afterwards almost stationery pattern is noticed with decelerating trend of growth progression in both sexes. Standard deviations for these characters have not shown any consistent pattern as found earlier in linear, transverse and circumferential measurements. The highest value of standard deviation in stature was observed at 4+ years in boys and at 5+ years in girls.

The mean body weight of Khond infants at 0+ age group is observed to be 5.60 kg in boys and 6.10 kg in girls. Between 0+ and 18+ years, the boys and girls showed a marked difference of 6.75 kg, and 5.57 kg respectively between the lowest and highest annual increments. The highest peak velocity has occurred between 13+ and 14+ years in boys and earlier by one year (12+ and 13+ years) in girls and indicates the growth of total body mass manifested.

The mean supine length of infants at 0+ year's age group is observed to be 63.85 cm. in boys and 64.85 cm. in girls. The difference in lowest and highest annual gain of stature in boys is lower than that in girls. The highest mean annual increments have occurred between 13+ and 14+ years in boys and earlier by two years, i.e., 9+ and 10+ years in girls. The difference in minimum and maximum annual increments of head circumference in boys is higher than that in girls. The highest mean annual gain has occurred between 12+ and 13+ years in boys and 9+ and 10+ years in girls (Tables 1, 2). Extreme growth curve was observed in head circumference (quick development) than in body weight (slow development). Some of the measurements followed the pattern of growth in stature, chest, abdominal, upper arm and calf circumferences.

The maximum and minimum annual incremental difference in chest circumference is higher in boys than that in girls. The maximum mean annual increase has attained between 13+ and 14+ years in boys and earlier by one year, i.e. 12+ and 13+ years in girls. The mean abdominal

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

Age (in years)	No.	Body weight (Kg)		Stature (cm)		Head circumference (cm)		Chest circumference (cm)		Abdominal circumference (cm)		Upper arm circumference (cm)		Calf 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
Boys															
0+	36	5.60	1.60	63.85	6.07	42.15	4.23	42.18	2.78	42.14	1.78	14.34	0.49	15.83	1.62
1+	44	8.00	1.05	72.19	5.45	46.65	2.13	45.18	2.85	42.35	6.31	14.19	1.24	16.43	1.40
2+	75	9.96	1.43	79.82	7.37	47.95	3.19	48.71	3.03	47.13	5.05	15.84	3.73	18.27	1.78
3+	67	11.70	1.25	92.16	6.69	47.71	2.54	51.16	2.94	51.03	3.51	14.87	1.25	18.29	1.71
4+	84	12.75	2.26	95.42	9.60	49.02	1.94	50.67	3.13	49.97	4.04	14.86	0.92	19.04	1.75
5+	59	16.03	2.34	107.19	9.06	49.20	1.63	53.91	2.89	53.13	4.30	15.22	1.10	19.95	1.88
6+	30	18.20	2.56	111.47	8.09	49.35	0.81	54.04	2.07	51.70	2.00	15.12	1.18	21.48	1.03
7+	47	19.22	2.37	117.31	4.49	50.04	1.10	56.64	2.56	53.55	3.24	15.87	0.89	22.36	1.44
8+	37	20.84	3.36	121.70	8.27	50.39	1.80	57.71	3.07	54.08	3.55	16.12	1.06	22.95	1.27
9+	74	24.10	3.79	128.65	7.08	51.08	1.33	59.67	4.01	55.66	3.55	16.8	1.20	24.05	1.85
10+	79	24.96	4.22	130.54	7.19	51.06	1.26	60.12	3.70	56.38	3.93	16.82	1.17	24.28	1.93
11+	127	27.40	4.71	134.34	7.95	51.38	1.38	61.61	3.66	57.60	3.67	17.07	1.10	25.07	1.84
12+	168	30.50	5.23	139.38	7.87	51.99	1.35	64.73	4.44	59.62	4.03	18.09	1.44	26.09	2.12
13+	139	37.64	6.74	148.60	7.54	53.16	2.01	69.22	6.15	62.52	5.91	19.64	2.14	28.22	2.79
14+	87	43.52	6.00	154.77	5.95	53.48	1.62	74.61	6.14	65.18	4.37	21.00	1.84	29.96	2.47
15+	50	45.46	5.80	156.92	6.74	53.48	1.29	75.20	4.31	66.72	4.52	21.85	2.05	30.61	2.22
16+	51	48.41	4.92	157.66	6.31	54.33	1.88	77.27	4.13	67.90	7.90	22.92	6.01	31.48	2.20
17+	40	48.02	5.75	158.08	5.81	53.99	2.15	74.69	5.86	66.46	4.30	22.83	1.24	32.41	1.64
18+	46	47.22	6.23	153.37	7.09	55.59	4.53	76.56	4.59	64.95	5.76	22.39	1.25	30.37	1.89
Girls															
0+	32	6.10	0.79	64.85	5.00	43.53	3.04	42.64	3.99	42.30	5.49	14.25	0.76	16.55	0.99
1+	40	6.87	1.03	69.94	5.01	44.69	2.73	43.98	2.76	42.01	6.84	14.21	1.72	16.43	1.93
2+	59	9.18	1.70	76.22	11.73	45.98	3.66	47.47	2.36	47.00	3.47	15.12	4.25	16.88	1.49
3+	52	11.98	2.48	93.95	11.73	48.20	2.99	50.23	2.55	48.66	6.65	15.04	1.60	18.43	3.40
4+	75	13.05	1.79	96.35	9.30	48.31	1.72	49.97	3.25	50.53	4.74	15.12	1.11	19.10	1.51
5+	61	15.94	3.71	105.93	13.87	49.58	2.08	53.70	1.88	52.67	3.45	15.80	1.22	20.06	2.15
6+	30	15.98	3.41	109.85	7.25	49.68	1.17	54.50	2.75	52.66	2.83	15.56	0.99	21.24	1.88
7+	33	19.35	3.88	118.39	8.95	49.60	0.90	54.90	3.12	51.70	2.93	15.38	1.42	22.35	2.34
8+	31	21.19	3.03	121.75	6.70	50.17	1.18	57.51	2.12	55.13	2.58	16.12	0.78	23.62	1.43
9+	32	23.40	4.04	125.37	6.25	51.01	2.09	57.88	3.04	53.50	3.02	16.57	0.89	23.45	1.27
10+	53	28.13	4.53	135.04	7.62	52.02	1.77	61.43	4.29	57.67	4.45	18.37	1.55	25.54	1.45
11+	63	29.38	5.58	136.54	6.47	51.63	1.53	61.85	3.36	57.42	4.03	19.05	6.66	26.05	2.13
12+	77	32.88	4.68	141.47	5.79	52.18	1.55	66.77	5.57	59.74	4.23	19.40	1.61	27.28	2.08
13+	79	38.49	5.23	145.33	4.85	53.01	1.49	71.95	7.52	63.91	5.34	20.76	1.53	28.74	1.90
14+	68	42.80	4.78	148.47	4.57	53.50	1.47	75.69	5.02	65.64	5.10	21.78	1.98	30.09	1.98
15+	50	42.71	5.59	150.87	5.05	53.60	1.88	77.46	7.93	68.87	4.33	22.52	6.49	30.00	4.11
16+	44	44.81	3.65	149.88	4.07	54.49	1.38	79.11	7.91	72.91	5.03	23.52	7.24	30.56	1.88
17+	36	47.33	4.74	152.87	10.49	54.33	1.07	76.98	3.83	68.05	6.85	22.94	1.01	33.14	1.81
18+	34	43.11	3.45	149.86	4.78	54.53	1.80	76.07	7.62	65.60	5.11	21.82	0.97	28.38	1.00

circumference of infants at 0+ years age group is observed to be 42.14 cms and 42.30 cms in boys and girls respectively. The maximum and minimum mean annual incremental difference in abdominal circumference is observed to be higher in boys than that in girls. The highest mean annual gain has occurred between 12+ and 13+ years in boys and earlier by three years, i.e. 9+ and 10+ years in girls.

The maximum and minimum mean annual incremental difference in upper arm circumference among boys is observed to be higher than that in girls and it is contrary to the condition observed in the case of calf circumference. The maximum mean annual increase in upper arm has occurred between 12+ and 13+ years in boys and earlier by three years, i.e. 9+ and 10+ years in girls. Further, it is found that the calf circumference is attained between 12+ and 13+ years among boys and earlier by three years, i.e., 9+ and 10+ years in girls (Table 1).

Fat fold at triceps region has shown gradual decrease from 0+ to 4+ years. Almost stationery condition is observed in boys but slight acceleration is noticed among girls. The highest mean annual gain has occurred between 16+ and 17+ years in boys and 12+ and 13+ years in girls. The mean biceps is observed to decrease gradually with minor irregularities in the mean value from 0+ to 4+ years and almost stationary condition is noticed in both sexes. The highest mean annual gain has occurred between 15+ and 16+ years in boys and 12+ and 13+ years in girls. The sub-scapular skin fold at 0+ years age group is observed to be 13.22 mm in boys and 11.32 mm in girls and then showed gradual decrease in both sexes with minor irregularities from 0+ to 18+ years. The highest mean annual gain has occurred between 12+ and 13+ years in both boys and girls.

The mean supra-iliac skin fold in both sexes has shown gradual decrease up to 4+ years and has shown an increase from 5+ to 18+ years with minor fluctuations. The highest mean annual gain has attained between 12+ and 13+ years in boys and it is earlier by three years, i.e., 9+ and 10+ years in girls. With regard to abdominal and anterior thigh skin folds, accelerating trend is noticed in both sexes from 0+ to 18+ years but with minor fluctuations. The highest mean annual gain in abdominal skin fold among boys and girls is attained between 12+ and 13+ years and 9+ and 10+ years respectively as similar to that of anterior

thigh skin fold in girls i.e. 9+ and 10+ years and but delayed by three years in boys i.e. 14+ and 15+ years (Table 2).

The medial calf skin fold of infants at 0+ age group is observed to be 13.51 mm. in boys and 14.45 mm. per year in girls. It has shown decrease from 0+ to 3+ years and acceleration from 13+ years in boys and 10+ years in girls with minor fluctuations. The highest mean annual gain has attained between 12+ and 13+ years in boys and it is earlier by one-year i.e., 13+ and 14+ years in girls. The mean fore arm skin fold is observed to decline by 3+ years and it is almost stationery by 18+ years in both sexes. The highest mean annual gain has attained between 11+ and 12+ years in boys and it is earlier by two years i.e., 9+ and 10+ years in girls. It is inferred that the maximum and minimum annual incremental differences in all fat folds among girls is observed to be significant than that of boys (Table 2).

The Juvenile spurt in triceps and biceps skin folds, fore arm and head circumference among Khond boys is observed to be attained between 3+ and 4+ years which is early by one year than body weight, stature, chest circumference, abdominal circumference, upper arm circumference, skin folds such as sub-scapular, supra-iliac, abdominal, anterior thigh and medial calf i.e. 4+ and 5+ years, and which is delayed by two years to that of calf circumference i.e. 5+ and 6+ years. The juvenile spurt in upper arm circumference and skin folds such as biceps, sub-scapular, supra iliac, abdominal and anterior thigh among Khond girls is observed to be attained between 7+ and 8+ years which is delayed by a year than body weight, i.e. 6+ and 7+ years and also delayed by two years than calf circumference, triceps and medial calf i.e. 5+ and 6+ years and also delayed by three years than stature, head circumference, chest circumference and abdominal circumference i.e. +4 and +5 years and also delayed by four years than fore arm skin folds i.e. +3 and +4 years.

The highest peak velocity or adolescent growth spurt is a constant phenomenon and occurred in all children in this period (12+ and 14+ years). There is a marked acceleration in stature, head, calf circumference and skin folds such as sub-scapular, supra-iliac, abdominal and medial calf among Khond boys which is attained between 12+ and 13+ years and earlier by one year than body weight, chest and abdominal circumference i.e. 13+ and 14+ years and two years

Table 3: Mean and standard deviation of eight skin fold measurements among Khond of Visakhapatnam district, Andhra Pradesh

Age (in No. years)	Triceps (mm)		Biceps (mm)		Sub scapular (mm)		Supra iliac (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
Boys																
0+	11.11	1.9	11.65	2.93	13.22	4.19	12.40	4.04	11.62	2.94	13.83	5.84	13.51	2.93	10.35	1.92
1+	9.66	2.83	7.58	2.19	8.74	3.01	8.33	2.45	8.72	2.84	12.08	3.16	11.53	2.41	7.08	1.43
2+	9.48	3.19	6.57	2.21	7.86	3.15	7.05	2.43	7.49	3.17	10.49	3.08	10.73	2.89	6.50	1.73
3+	7.52	1.41	4.82	4.82	5.83	1.94	5.54	2.68	6.38	1.83	8.88	2.22	8.96	2.66	5.42	1.55
4+	8.71	2.99	5.43	1.50	5.91	1.78	5.94	2.09	6.23	1.93	8.78	1.49	10.15	2.57	6.22	1.30
5+	7.12	2.11	5.50	1.63	8.14	3.13	9.11	4.89	8.89	4.75	11.93	4.66	11.92	5.24	6.21	1.85
6+	6.99	2.32	5.80	2.41	6.17	1.42	5.85	1.76	5.76	1.91	9.28	2.06	9.47	1.95	5.38	1.52
7+	7.76	2.60	5.44	1.60	6.23	1.89	5.85	2.04	5.81	2.23	9.15	2.39	8.72	2.79	5.28	1.28
8+	6.68	1.24	4.64	1.25	6.11	1.45	5.83	2.01	5.73	1.55	8.14	2.07	9.18	1.50	5.17	0.99
9+	6.96	1.55	5.02	1.51	6.21	1.46	6.32	1.65	6.19	1.96	8.60	1.91	8.78	1.86	5.51	1.02
10+	7.81	1.89	5.43	1.68	6.76	1.73	6.55	2.15	6.49	2.26	8.88	2.44	9.33	2.34	5.60	1.24
11+	7.13	1.52	5.54	1.62	6.73	1.57	7.09	2.45	7.18	2.28	9.03	1.93	8.93	2.15	5.41	0.94
12+	7.46	2.02	5.56	1.70	6.86	1.79	6.97	1.92	7.63	2.49	9.69	2.86	9.54	2.57	5.67	1.39
13+	7.57	2.03	5.70	1.58	8.51	5.73	7.90	1.96	8.66	2.38	10.28	2.64	10.71	2.93	5.79	1.87
14+	7.27	1.71	5.65	1.33	8.51	1.85	8.08	1.89	9.09	2.00	10.04	2.65	10.20	2.68	5.75	1.20
15+	7.34	1.60	5.95	1.46	9.51	1.82	8.44	1.76	9.52	2.26	12.26	2.38	10.88	2.46	5.75	1.37
16+	7.89	2.43	6.90	3.91	10.12	2.08	8.91	3.11	9.54	2.47	10.79	2.70	11.35	3.49	5.31	0.99
17+	9.40	2.96	5.89	1.14	9.27	1.68	9.18	2.11	9.81	1.66	11.53	1.77	13.29	3.14	5.38	0.96
18+	9.53	3.97	7.15	2.52	9.86	2.09	9.10	2.66	9.90	2.34	11.64	2.69	9.90	3.43	5.57	0.97
Girls																
0+	12.37	3.03	11.05	3.66	11.32	5.64	10.96	5.16	11.18	3.60	15.80	4.47	14.45	2.69	10.82	3.39
1+	9.45	2.90	6.00	1.38	7.38	1.70	6.33	2.09	7.29	2.00	11.49	2.80	12.49	3.24	6.76	1.66
2+	8.53	2.77	5.94	1.78	6.95	2.23	7.08	1.96	6.34	2.56	10.05	2.47	11.10	2.66	6.30	1.49
3+	9.97	1.78	5.87	2.39	6.85	2.83	6.72	3.30	7.23	2.96	9.27	2.69	10.40	2.50	5.97	1.90
4+	9.01	1.92	6.59	2.08	6.64	1.81	6.24	2.47	6.79	1.73	9.52	2.13	10.05	1.74	6.62	1.19
5+	7.32	1.63	5.18	1.50	6.64	1.66	6.42	2.49	6.65	2.18	9.24	2.43	8.89	3.72	5.30	1.37
6+	8.33	2.48	5.51	1.62	6.35	1.65	6.82	2.31	6.54	1.88	9.62	2.38	9.84	2.62	5.66	2.01
7+	6.86	1.58	4.41	1.20	5.58	1.35	5.15	2.23	5.94	1.48	9.01	2.22	8.90	2.59	5.24	1.44
8+	7.76	1.51	6.02	1.44	5.77	1.58	8.05	2.13	7.58	2.16	12.14	2.92	8.72	2.19	5.88	0.85
9+	7.71	1.12	5.92	1.34	7.18	1.48	7.20	2.12	7.14	1.93	10.97	1.69	9.96	1.82	5.15	1.29
10+	8.58	1.83	6.11	1.79	8.19	2.10	8.32	2.08	9.76	5.02	12.29	3.12	11.61	2.53	6.28	1.65
11+	9.05	2.66	7.11	1.70	8.52	1.81	8.82	2.02	9.52	2.65	13.34	3.09	11.89	2.66	6.28	1.63
12+	10.20	2.60	7.47	2.10	9.74	2.34	9.90	2.48	11.09	3.09	15.17	4.15	13.19	3.47	6.41	1.59
13+	11.76	2.82	8.54	2.24	12.05	3.38	11.67	2.98	13.13	3.78	17.75	4.28	14.68	4.15	7.24	1.98
14+	12.78	2.97	9.06	2.14	13.51	3.06	12.52	2.93	14.36	4.15	19.50	4.56	17.06	3.46	7.85	2.86
15+	12.90	3.58	10.09	3.62	14.21	3.97	11.60	2.61	13.18	4.16	18.54	6.09	15.30	4.80	7.25	1.57
16+	13.90	3.73	11.00	2.96	14.25	3.53	13.11	2.65	15.33	2.69	19.85	4.23	17.21	2.84	10.86	4.29
17+	11.23	2.32	7.38	1.61	12.56	1.96	10.91	1.14	13.71	3.52	17.20	4.48	13.19	4.06	6.21	1.14
18+	10.65	3.86	7.49	2.87	11.12	1.11	7.67	0.40	10.78	1.44	11.88	2.47	12.22	4.34	4.00	3.43

than anterior thigh skin fold, i.e. 14+ and 15+ years and three years than biceps i.e. 15+ and 16+ years and four years than triceps i.e. 16+ and 17+ years.

The adolescent growth spurt among Khond girls in stature and in circumferences such as head, chest, abdominal, upper arm, calf and in skin folds such as supra iliac, abdominal and fore arm is observed to be attained between 9+ and 10+ years which is earlier by two years than bodyweight and skin folds such as triceps, biceps and sub- scapular i.e. 12+ and 13+ years. The t-test comparison between fifteen measurements among Khond boys and girls according to age shows significant differences (Table 3).

Both systolic and diastolic blood pressure and also pulse rate (12+ to 69+ years) are observed to be progressively accelerating with advancement in age with few fluctuations. Data on the body weight and arm girths of the present study sample is divided into different classes and the mean pressure was calculated for each group sex-wise. Even the mean blood pressure levels are observed to be not rising consistently in all these graded characters, with the increase observed only in the respective variable. Sex differences were also not observed in these variables. Only age was observed to show an impact on the rise of blood pressure levels.

The adolescent growth spurt in bodyweight of Khond boys is observed to be similar to that of Savara and Koya Dora boys of Andhra Pradesh and in stature, Khond boys (13+ and 14+ years) are observed to approach Koya Dora, Savara, Jatapu and Konda Reddi boys of Andhra Pradesh (Dharma Rao and Busi, 1994, 1995; Dharma Rao et al., 1997). In head circumference (12+ and 13+ years) and medial calf skin fold (12+ and 13+ years), Khond boys are similar to that of Konda Reddis and Gadaba boys of Andhra Pradesh (Dharma Rao et al., 1997). The spurt in chest circumference (13+ and 14+ years) among Khond boys is also observed to be similar to that of Koya Doras of Andhra Pradesh (Dharma Rao et al., 1997). In upper arm and calf circumference (12+ and 13+ years), Khond boys have shown similarity with that of Porja boys of Andhra Pradesh (Dharma Rao and Busi, 1999 a) and in the spurt of biceps (15+ and 16+ years), they are observed to show affinity with Porja tribal boys of Andhra Pradesh (Dharma Rao and Busi 1999 a). In anterior thigh (14+ and 15+ years) skin fold, they are observed to be similar to that of Porja boys of Andhra Pradesh (Dharma Rao and Busi, 1999 a). In

adolescent growth spurt of sub-scapular and supra- iliac skin folds, Khond boys (12+ and 13+ years) are observed to be inclined to that of Jatapu boys of Andhra Pradesh. (Dharma Rao and Busi 1994) and in forearm skin fold (11+ and 12+ years), Khond boys are observed to show similarity to that of Bondo boys of Orissa (Dharma Rao et al., 2000).

In the adolescent growth spurt of body weight, chest circumference and triceps skin fold (12+ and 13+ years), Khond girls are observed to be similar to that of Gadaba, Chenchu and Jatapu girls of Andhra Pradesh. With regard to biceps skin fold, they are observed to be similar to that of Gadaba and Savara girls of Andhra Pradesh and in sub- scapular (12+ and 13+ years) skin fold, they show affinity to that of Chenchu and Jatapu girls of Andhra Pradesh. In the medial calf skin fold (13+ and 14+ years), Khond girls are observed to be similar to that of Porja and Savara girls of Andhra Pradesh and in the remaining dimensions Khond girls were observed to differ with the condition noticed among Gadaba, Porja, Savara and Chenchu girls of Andhra Pradesh (Dharma Rao and Busi, 1996 a,b; Dharma Rao et al., 1999 b,c).

It will be apparent from the foregoing discussion that the findings on Khond boys and girls indicate that they are lighter in weight and shorter in height than the findings of Singh (1980), Sharma (1991), Bharati et al. (1991) and Dharma Rao et al. (1997 a, b, c, 1999 b, 2000), Dharma Rao and Busi (1998, 1999 a) and also lighter and shorter than the findings of Hauspie et al. (1980). Khond boys and girls are also observed to be shorter and lighter with broader head and chest circumferences than I.C.M.R. (1984) Standards. Khond boys and girls are also observed to be taller and heavier than Chenchu and Jatapu and shorter and heavier with narrow chest, abdomen and broader head than Porjas and also similar chest circumference, upper arm and calf circumference to that of Savaras and Konda Reddis of Andhra Pradesh (Dharma Rao and Busi, 1994, 1995 a, b, 1996 a, b, 1998, 1999 a; Dharma Rao et al., 1997a, 1999 b).

Khond tribal population inhabiting in Visakhapatnam agency area is observed to subsist on hard labour. Though blood pressure is a physiological variable, it is neurogenic in origin. Wolanski (1961), Dharma Rao and Busi (1994, 1995 a, b, 1996 a, b, 1998, 1999 a), Dharma Rao et al. (1997 a, b, c, 1999 b, c, 2000) have opined that

Table3: t-test comparison between fifteen measurements of khond boys versus girls according to age

Age (in yrs)	Body weight	Stature	Head circum.	Chest circum.	Abdominal circum.	Upper arm circum.	Calf circum.	Triceps ⁺	Biceps ⁺	Sub scapular ⁺	Supra iliac ⁺	Abdo- minal ⁺	Anterior thigh ⁺	Medial calf ⁺	Fore arm ⁺
0+	1.69 ¹	0.73	1.55	0.77	0.15	0.55	2.24 ¹	2.01 ¹	0.73	1.57	1.26	0.54	1.56	1.36	0.69
1+	4.94 ³	1.96 ¹	3.62 ³	1.82 ¹	0.23	0.06	0.08	0.33	4.00 ³	2.55 ²	4.02 ³	2.69 ²	0.90	1.52	0.94
2+	2.60 ²	2.06 ²	3.26 ³	2.54 ²	0.18	1.03	4.91 ³	1.85 ¹	1.81 ¹	1.94 ¹	0.07	2.31 ²	0.91	0.75	0.70
3+	0.75	0.98	0.92	0.98	2.32 ²	0.60	0.28	1.49	2.89 ²	2.20 ²	2.10 ¹	1.80 ¹	0.84	3.02 ³	1.68 ¹
4+	0.93	0.62	2.44 ²	1.60	0.77	1.59	0.24	0.78	3.95 ³	2.56 ²	0.82	1.91 ¹	2.48 ¹	0.29	2.03 ¹
5+	0.15	0.58	1.17	0.35	0.64	2.75 ²	0.28	0.56	1.11	3.25 ³	3.78 ³	3.30 ³	3.92 ³	3.63 ³	3.04 ³
6+	2.84 ³	2.82 ³	1.23	0.73	1.51	1.56	0.63	2.16 ¹	0.55	0.44	1.81 ¹	1.59	0.60	0.61	0.59
7+	0.16	0.64	1.94 ¹	2.83 ²	2.63 ²	1.74 ¹	0.02	1.91 ¹	3.25 ³	1.83 ¹	1.43	0.31	0.27	0.29	0.14
8+	0.45	0.02	0.58	0.29	1.40	0.02	2.01 ¹	3.16 ³	4.16 ³	0.91	4.38 ³	3.97 ³	6.40 ³	0.99	3.15 ³
9+	0.83	2.38 ²	0.16	2.62 ²	3.18 ³	1.08	1.92 ¹	2.78 ²	3.02 ³	3.11 ³	2.08 ²	2.30 ²	6.35 ³	2.99 ³	0.51
10+	4.05 ³	3.40 ³	3.39 ³	1.60	1.72 ¹	6.14 ³	4.25 ³	4.14 ³	2.17 ²	4.10 ³	4.72 ³	4.43 ³	6.67 ³	5.22 ³	2.54 ²
11+	2.42 ²	2.03 ²	1.10	0.34	0.30	2.34 ²	3.11 ³	5.29 ³	6.07 ³	6.65 ³	5.17 ³	5.97 ³	10.12 ³	7.65 ³	3.92 ³
12+	3.53 ³	2.33 ²	0.91	3.00 ³	0.20	6.09 ³	4.12 ³	8.17 ³	6.98 ³	9.59 ³	9.15 ³	8.66 ³	10.51 ³	8.24 ³	3.56 ³
13+	1.03	3.88 ³	0.61	3.00 ³	1.77 ¹	4.26 ³	1.64	11.57 ³	9.95 ³	5.74 ³	10.05 ³	9.46 ³	14.05 ³	7.50 ³	5.27 ³
14+	0.83	7.45 ³	0.07	1.17	0.59	2.50 ²	0.37	13.63 ³	11.48 ²	11.86 ³	10.82 ³	9.62 ³	15.20 ³	13.48 ³	5.68 ³
15+	2.41 ²	5.07 ³	0.38	2.42 ²	2.42 ²	0.70	0.92	10.01 ³	7.48 ³	7.59 ³	7.07 ³	5.46 ³	7.87 ³	5.78 ³	5.07 ³
16+	4.08 ³	7.29 ³	0.49	1.88 ¹	3.73 ³	0.44	2.20 ¹	9.12 ³	5.79 ³	6.80 ³	7.09 ³	10.76 ³	12.09 ³	8.97 ³	8.28 ³
17+	0.60	2.63 ³	0.91	1.73 ¹	1.20	0.44	1.82 ¹	2.95 ²	4.58 ³	7.78 ³	4.49 ³	6.65 ³	7.10 ³	0.12	3.40 ³
18+	3.76 ³	2.64 ³	1.44	0.53	0.52	2.46 ²	6.05 ³	1.27	0.53	3.47 ³	3.57 ³	2.07 ²	0.41	2.60 ³	10.90 ³

¹significant at 5% level²significant at 1% level³significant at 0.1% level⁺Skin fold thickness

Table 4: Mean, standard deviation of Blood pressure and pulse rate of Khond

Age in yrs	N	Systolic blood pressure		Diastolic blood pressure		N	Pulse rate	
		$\bar{X}$	SD	$\bar{X}$	SD		$\bar{X}$	SD
Male								
12 - 20	142	105.18	11.50	66.53	12.01	134	84.00	12.32
20 - 29	52	111.50	11.33	76.33	11.17	45	88.66	13.53
30 - 39	60	114.33	14.66	76.16	10.90	48	89.83	13.28
40 - 49	32	113.75	9.07	75.94	8.75	24	98.04	17.60
50 - 59	12	124.66	9.50	77.08	9.65	10	82.40	8.57
60 - 69	14	120.00	6.79	72.14	6.99	14	94.75	14.77
Female								
>20	110	111.59	14.00	72.54	9.99	95	90.44	13.24
20 - 29	69	111.16	12.19	75.71	10.84	66	89.64	12.81
30 - 39	41	109.51	10.23	76.09	9.19	38	97.79	13.58
40 - 49	17	115.88	13.52	73.52	9.31	14	91.86	9.62
50 - 59	17	115.11	6.99	79.59	4.04	17	95.64	12.27
60 - 69	8	177.50	19.88	74.75	8.54	8	94.75	14.77

blood pressure is a most fluctuating character and quite linked with the psyche of the people. That is the reason why age is observed to show impact on the rise of blood pressure levels but the other factors are not observed to exhibit their impact on blood pressure. This may be due to the reason that Khond tribe is hard working and are in the process of acculturation. These standards suggest introduction of preventive measures such as weight control, dietary changes and physical activity especially for hypertensive subjects. The deviations from the expected trend observed in the present study must have been due to the differences in body composition, habitual physical activities, cholesterol, diet, income, smoking, alcoholism etc. (Table 4)

These results are general and universal in character and are observed in many populations (Johnston et al., 1975). The findings generated in this study can therefore be utilized as reference material for the Khond boys and girls in Visakhapatnam district of Andhra Pradesh. Goldstein and Tanner (1980), Busi and Dharma Rao (2003) have pointed out that the findings generated from such studies would be useful as an alternative to the growth standards. Further, the research conducted among Khonds may help to suggest suitable programmes and strategies to improve the nutritional status and proper management of health

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