

# Growth Progression in Physical and Physiological Variables Among Relli's of Visakhapatnam District of Andhra Pradesh

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## INTRODUCTION

Several studies in rural and urban populations have observed that with the advancement in age there is a tendency for accelerations in all the physical traits except skin folds (Singh, 1980; ICMR, 1984; Nath, 1987; Bharati et al., 1991; Sharma, 1991; Nath et al., 1991, Dharma Rao and Busi, 1996- 2000.). 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, 1993), 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 variation. In India very few researches have been conducted in this field (Padmavathi and Gupta, 1959; Das and Mukherjee, 1963; Gangopadhay et al., 1988; Nirmala and Chengal Reddy, 1991; Dharma Rao and Busi, 1996, 2000) among others. However there is dearth of published data related to growth progression and blood pressure of Relli boys and girls and the Indian Council of Medical Research (ICMR, 1984) in their nation wide growth survey did not include the Relli boys and girls of Visakhapatnam district. A cross-sectional survey on growth study of Relli boys and girls was therefore undertaken in August 2000 to July 2001 covering 17 body measurements.

In the present study an attempt has been made to study the effect of age from 0+ to 18+ on seventeen body measurements throughout the growth period and also to study the adolescent growth spurt. It is further aimed to understand the association between blood pressure with stature, body weight, circumferences and skinfold thickness, and its implications for health of the population and to compare this data with other available data from India in order to find out the population

differences of physical and physiological variations.

## MATERIAL AND METHODS

Rellis are scheduled castes and distributed in ten districts of Andhra Pradesh. They are also known as Sachcharis, chachatis or Relli chachadis but prefer to call themselves sapis or sapru. The term Relli in Telugu means a kind of grass. As their primary occupation was selling of grass earlier. But now these are fruit and vegetable vendors. Some of them have taken up other occupations like scavenging and service employees in public and private organizations. Their population in Andhra Pradesh is 76329 and in Visakhapatnam district is 45000 according to 1981 census. Thurston (1909) says the Haddis may be divided into Haddis proper, Relli and chachadis, which are endogamous. Their mother tongue is a dialect of the Indo-Aryan language Oriya. In Andhra Pradesh Rellis are conversant with Telugu. The Rellis are non-vegetarians and their staple food is finger millet, brush millet, rice and wheat. During the present investigation Relli (vegetable and fruit vendors) and Thoti (Scavengers) have been found. They have adopted gotras like Naga and Ganga, but they also have surnames. Marriages do not take place within same surname group. Marriage by negotiation is the usual practice though marriage by elopment also has social sanction. The Rellis are predo-minantly Hindus though a few of them have converted to Christianity. Their attitude towards modern medical care family planning is favourable. They have received benefits from special nutritional programmes through the ICDS, SNP and other schemes.

The material for the present study was based on a cross-sectional data collected on 640 Relli boys and 671 Relli girls drawn from 10 schools of Visakhapatnam (urban) mandal of Visakhapatnam district of Andhra Pradesh during the months of August 2000 to July 2001. The age of these sub-

jects 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 municipal corporation. The doubtful cases were excluded from the present sample. All the subjects between ages 0.00 to 0.99 years were in 0+ age group, 1.00 to 1.99 years were in 1+ age group, 2.00 to 2.99 were in 2+ age group, and so on up to 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 second author took the measurements and blood pressure. Blood pressures 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 practiced for a week in the presence of cardiologist. 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 subject. For normal resting human beings the blood pressure is usually found to be 120/80mm of mercury. The hypertension was followed after W.H.O. (1962).

Heart rate was conveniently measured as pulse rate by palpation of 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 by using stop watch. (Weiner and Lourie, 1981). The American Heart Association accepts between 50 and 100 heartbeats per minute as the normal range (Bell et al., 1972). The values for growth velocity of a measurement are obtained by subtracting for that variable, say at age A' from its mean values age (A+1 year) is as below:  $Velocity (V) = X(A+1) - X.A$

The usual statistical analysis was carried out using S.P.S.S.8.0 Program Package of our Intel Pentium III, 600 MHZ computers. The t-Test significances were estimated after Fisher and Yates (1963). Distance curves are plotted after Tanner et al. (1966) to estimate the amount of growth progression.

**RESULTS AND DISCUSSION**

The mean values and standard deviations for all the anthropometric measurements have been shown in tables 1 to 4. It can be inferred from the tables 1 and 2 and figures 1-7 that the mean

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

Age No. in Years	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	
0+	31	6.700	1.28	64.82	4.00	41.78	1.98	41.18	2.05	39.58	3.55	13.48	1.11	16.10	1.67
1+	39	9.500	1.17	75.65	5.15	45.66	1.25	45.97	1.25	44.23	2.44	14.26	0.94	17.15	1.41
2+	34	11.247	1.64	84.20	4.64	47.00	1.39	47.15	2.17	46.02	2.87	14.11	0.87	17.74	1.57
3+	30	12.665	1.34	91.89	7.95	47.64	1.10	49.02	2.35	48.35	3.32	14.32	0.69	18.57	1.29
4+	33	13.859	1.28	96.86	3.95	48.15	1.78	50.33	1.75	46.93	6.02	15.03	1.24	19.66	1.92
5+	33	16.030	2.16	105.45	5.89	48.96	1.18	52.21	3.15	49.15	3.02	14.88	1.06	20.46	1.81
6+	34	17.205	2.72	108.57	6.47	49.08	1.30	52.88	2.79	49.66	3.65	14.90	1.14	21.36	2.64
7+	33	18.848	2.05	116.23	4.67	49.11	1.37	53.25	1.85	50.14	2.91	15.08	1.15	21.49	1.60
8+	30	20.628	2.64	120.62	5.97	49.96	2.40	56.30	3.16	51.56	3.96	15.61	0.87	22.30	1.60
9+	30	22.250	2.35	125.02	4.96	50.38	2.34	56.48	3.20	51.48	3.75	15.70	1.08	23.25	1.87
10+	39	23.946	3.24	128.40	6.20	50.46	1.42	57.76	3.47	53.40	5.05	16.54	1.54	23.22	1.86
11+	36	27.059	4.27	136.00	6.77	50.76	1.74	59.95	4.31	54.51	4.80	17.31	1.78	24.87	2.50
12+	40	28.070	4.62	137.15	7.45	51.46	2.21	61.46	7.72	55.44	4.49	17.20	1.62	25.04	2.31
13+	31	34.700	6.36	148.26	6.68	51.66	1.77	65.01	5.61	56.71	4.31	18.10	3.47	27.16	2.51
14+	30	35.103	4.57	149.83	6.39	51.58	2.56	65.29	7.42	58.60	4.39	18.52	1.43	27.14	1.74
15+	30	45.321	5.79	159.54	5.58	53.77	2.88	73.37	6.48	62.08	6.95	21.06	1.60	30.05	1.90
16+	31	48.867	5.62	162.48	6.67	53.59	1.68	77.22	5.17	64.20	4.84	21.64	1.70	31.11	2.23
17+	30	49.111	5.35	162.15	5.24	53.27	1.63	77.86	4.29	65.66	5.18	22.81	1.74	30.91	2.30
18+	46	54.782	7.80	166.01	6.98	54.06	1.53	81.45	6.12	68.78	7.63	24.07	3.02	32.03	2.59

**Table 2: Mean and standard deviation of seven body measurements among Relli girls of Visakhapatnam district of 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
0+	39	6.587	1.67	62.10	5.38	40.95	2.15	40.84	3.19	39.46	2.70	13.37	1.08	15.48	1.93
1+	33	8.710	1.64	72.31	4.60	44.15	1.53	43.90	1.86	41.68	2.47	13.78	1.09	16.91	1.86
2+	37	10.617	1.11	83.11	4.77	45.74	1.22	47.30	1.94	45.48	3.42	14.04	0.93	17.78	1.25
3+	42	12.241	1.46	89.18	6.43	47.07	1.16	49.21	5.08	48.37	5.51	14.68	0.81	18.54	2.40
4+	36	13.845	1.28	95.44	6.28	47.28	1.29	49.78	2.50	47.25	3.21	14.99	0.77	19.53	1.61
5+	30	14.760	2.16	103.77	4.58	47.86	1.20	49.84	2.71	47.02	2.87	14.34	0.66	19.74	0.97
6+	30	16.563	2.72	108.30	7.87	48.04	1.59	51.70	3.82	50.11	3.46	15.31	1.05	20.77	1.51
7+	41	18.124	2.05	112.60	5.45	48.78	1.81	52.96	2.36	49.70	2.70	15.45	1.11	21.66	1.48
8+	39	20.445	2.64	118.98	4.96	49.36	1.42	54.44	3.10	50.96	4.23	16.11	1.39	22.25	1.77
9+	34	22.764	2.35	123.80	6.86	49.53	1.72	56.13	4.17	52.21	4.39	16.48	1.61	23.45	2.22
10+	40	25.562	3.24	130.08	5.28	50.32	1.23	58.45	3.78	53.23	4.87	16.91	1.49	24.14	1.82
11+	39	28.707	4.27	135.46	6.41	51.06	1.98	60.44	5.07	54.46	4.76	17.92	1.61	25.41	1.88
12+	34	32.981	4.62	140.61	6.67	50.70	2.61	65.14	7.79	58.05	6.31	19.01	2.14	27.01	2.94
13+	37	36.183	6.36	146.10	5.82	51.41	1.51	65.74	5.57	58.06	4.98	19.44	1.88	27.49	2.43
14+	31	41.067	4.57	148.46	7.96	51.57	1.84	71.08	6.33	60.96	6.06	22.29	9.34	28.87	3.13
15+	29	44.246	5.79	152.05	6.13	53.51	1.94	73.08	6.05	62.28	7.11	23.52	11.0	29.83	3.95
16+	30	44.924	5.62	147.71	25.7	52.87	3.64	71.91	8.71	60.33	6.14	21.19	2.29	29.76	2.50
17+	31	50.517	5.35	151.99	5.27	53.13	1.90	74.56	14.9	67.22	10.1	23.39	3.75	30.92	5.34
18+	39	50.850	7.80	152.71	5.54	53.26	2.51	76.46	7.63	67.05	7.29	23.23	3.09	31.86	3.31

values for all the body measurements except skinfold thicknesses are progressively accelerating with advancement of age from 0+ to 14+ years in boys, and 0+ to 11+ years in girls and

showed clearly steady pattern of growth and afterwards almost stationery pattern with decelerating trend of growth progression in both sexes. From the Table-3 and 4 it is clear that all

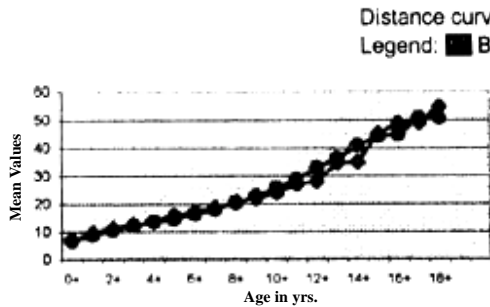


Fig. 1. Distance curve of body weight

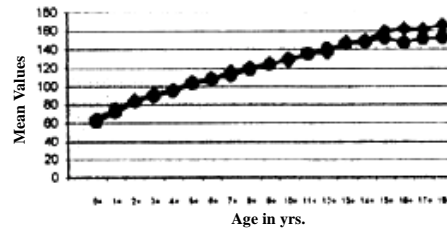


Fig. 2. Distance curve of stature

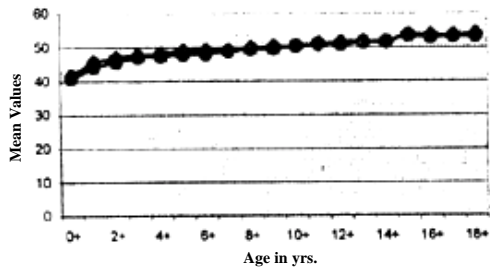


Fig. 3. Distance curve of head circumference

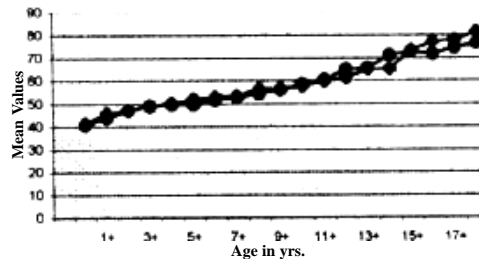


Fig. 4. Distance curve of chest circumference

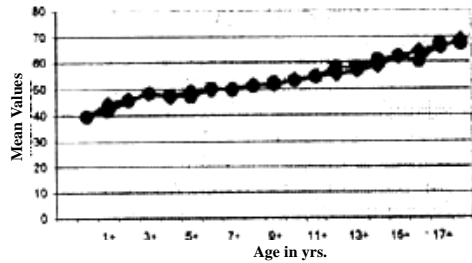


Fig. 5. Distance curve of abdominal circumference

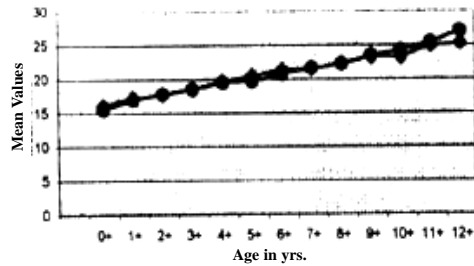


Fig. 7. Distance curve of Cell circumference measurements (Dharma Rao and Busi,2000)



Fig. 6. Distance curve of upper arm circumference

the eight skin fold characters shows non normal distributions at several ages. Standard deviations for these characters have not shown any consistent pattern found earlier in linear, transverse and circumferential and skin fold

The mean body weight of Relli infants at 0+ age group is about 6.700 kg in boys and 6.587 kg in girls. It is doubled by 4+ years, and thrice by 8+ years in boys and girls and 5 times by 13+ years in boys and 12+ years in girls and 6 times by 15+ years in boys and 14+ years in girls .The highest mean annual gain has occurred between 14+ and 15+ years in boys (+10.21kg per year) and earlier by two years (11+ and 12+ year) in girls (+4.28 kg per year). The mean stature of infants at 0+ years age group is about 64.82cm in boys and 62.10cm in girls and doubled by 10+years in both sexes. The highest mean annual increments has occurred between 12+ and 13+ years in boys (+11.12cm per year) and earlier by

Table 3: Mean and standard deviation of eight skin fold measurements among Relli boys of Visakhapatnam of Andhra Pradesh

Age in Yrs.	No.	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+	31	9.14	1.32	6.84	1.53	7.92	1.92	7.64	2.20	9.44	2.21	15.49	3.38	13.45	3.68	9.80	1.51
1+	39	9.99	1.60	7.28	1.40	7.14	2.55	7.14	2.55	8.95	2.94	13.44	2.85	11.82	2.52	10.01	2.32
2+	34	10.03	2.02	7.80	1.82	6.65	2.99	6.65	2.29	6.87	2.34	11.48	2.95	11.48	2.32	8.60	1.83
3+	30	10.00	1.27	7.60	1.78	7.12	1.66	6.73	2.91	7.71	3.19	10.86	2.24	10.55	1.48	8.26	1.41
4+	33	10.12	1.65	7.81	2.68	7.51	1.54	6.92	3.15	6.83	1.89	11.75	2.02	11.46	3.33	7.72	1.58
5+	33	9.32	1.53	6.71	1.32	7.34	1.79	5.60	2.20	6.65	1.92	10.22	1.75	9.27	1.62	7.11	1.09
6+	34	9.04	1.91	6.03	1.58	6.44	1.34	5.44	2.06	5.94	2.05	11.00	2.98	9.61	2.47	6.70	1.79
7+	33	8.81	1.35	7.67	8.11	6.76	1.71	5.04	1.31	6.10	1.97	9.84	1.99	9.55	2.55	6.34	1.37
8+	30	9.03	1.83	6.02	1.66	6.70	1.42	5.88	1.96	6.32	1.75	10.23	2.28	9.59	1.57	6.55	1.59
9+	30	8.27	1.78	7.45	1.13	6.68	1.45	5.16	1.54	5.36	1.50	9.40	2.38	9.52	2.04	6.04	1.22
10+	39	9.63	2.84	6.67	2.33	7.22	2.36	6.02	2.72	7.11	3.14	11.61	3.62	10.55	2.65	6.50	2.00
11+	36	8.80	2.17	5.57	1.48	7.46	1.94	6.07	2.23	7.18	3.37	11.65	3.73	11.22	3.02	6.43	1.39
12+	40	9.05	3.17	5.59	1.88	7.47	1.91	6.69	2.67	6.93	2.57	11.19	3.47	11.01	2.97	6.08	1.47
13+	31	9.45	3.26	6.43	2.97	8.87	3.36	8.46	4.58	8.87	4.86	12.46	4.47	11.67	3.42	6.47	2.03
14+	30	7.92	2.23	5.26	1.92	7.54	2.47	6.83	2.35	7.98	4.20	11.74	3.92	11.85	2.90	6.30	2.88
15+	30	7.90	2.48	5.89	1.54	8.28	2.47	7.70	2.55	8.58	4.09	12.26	3.77	10.70	2.37	5.95	1.25
16+	31	8.40	2.40	5.65	1.74	8.70	2.50	8.16	3.62	8.62	3.31	11.92	3.94	11.41	2.71	5.90	1.18
17+	30	9.84	10.20	5.10	1.41	10.69	3.92	8.76	3.94	9.92	5.52	12.38	4.97	11.16	2.63	5.86	1.40
18+	46	7.26	1.95	5.74	3.46	10.50	3.35	8.77	3.23	10.21	4.80	11.82	4.09	11.19	3.05	5.60	1.28

**Table 4: Mean and standard deviation of eight skinfold measurements among Relli girls of Visakha-patnam**

Age in Yrs.	No.	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+	39	9.57	1.79	7.45	1.79	8.80	1.35	8.51	1.56	9.58	1.88	15.96	2.48	13.04	3.28	10.41	1.52
1+	33	9.51	1.97	7.44	2.06	7.53	2.57	7.53	2.57	8.40	1.93	13.10	2.63	11.49	2.16	9.28	2.29
2+	37	10.74	1.79	8.77	1.84	7.08	1.77	7.08	1.77	8.21	2.51	12.14	3.10	11.61	2.49	8.92	1.61
3+	42	10.71	1.37	8.36	1.92	8.06	1.40	7.57	2.23	8.53	2.42	12.20	2.75	11.71	2.81	8.61	1.82
4+	36	11.07	1.96	8.32	1.89	8.21	2.23	7.93	2.88	8.13	2.45	13.09	2.78	11.62	1.93	8.41	1.71
5+	30	10.13	1.08	7.48	1.33	7.84	1.93	6.38	2.05	6.90	2.30	11.40	1.89	10.25	1.63	7.20	1.47
6+	30	10.66	1.80	7.55	1.71	8.34	1.53	7.61	2.05	8.58	2.79	13.18	2.28	10.64	1.89	7.60	1.20
7+	41	12.21	13.22	7.34	1.51	8.48	1.63	6.98	3.05	8.21	2.82	13.56	3.45	11.10	2.15	7.31	1.65
8+	39	10.36	2.55	8.12	3.20	8.32	2.11	8.09	2.64	9.35	3.05	13.88	3.94	11.34	3.18	7.12	1.52
9+	34	10.26	2.70	6.88	2.14	8.52	2.34	8.49	3.48	9.89	4.06	14.22	4.76	12.14	2.89	7.18	1.53
10+	40	10.25	2.49	7.72	1.81	9.11	2.81	8.28	3.19	10.27	4.90	15.04	3.89	11.69	1.99	7.45	1.67
11+	39	11.09	2.63	7.67	2.74	10.38	4.00	9.60	4.62	14.15	19.30	16.56	4.18	12.20	2.73	7.59	1.77
12+	34	11.59	3.41	8.24	2.62	11.35	3.74	10.95	3.88	13.16	5.37	18.02	5.71	13.37	3.73	8.10	1.77
13+	37	11.69	4.95	7.98	3.19	12.49	4.07	12.17	4.37	14.03	5.78	18.81	6.50	14.23	4.29	7.88	2.20
14+	31	13.03	3.89	8.77	2.60	15.39	4.86	13.27	4.42	16.66	5.68	23.16	6.40	16.12	4.15	7.90	1.79
15+	29	14.22	3.26	9.92	2.49	16.91	6.52	14.42	3.45	17.25	5.49	22.90	5.47	17.08	2.39	9.02	1.94
16+	30	15.70	5.88	10.52	2.94	17.40	4.77	16.11	5.51	20.74	7.17	25.78	7.11	16.93	5.79	9.28	2.07
17+	31	15.56	5.58	10.83	4.24	19.09	7.15	17.82	5.99	20.14	7.08	25.56	8.23	18.86	6.50	10.56	3.62
18+	39	17.60	13.15	10.77	3.56	18.47	6.50	16.53	4.59	19.70	6.16	24.58	5.42	20.36	5.65	9.99	3.44

two years 9+ and 10+ years (+6.27cm. per year) in girls while the maximum mean annual loss is found between 16+ and 17+ years in boys (-0.33cm per year) and 15+ and 16+ years in girls (-4.34cm per year). The mean Head circumference of infants at 0+ years age group is about 41.78 cm in boys and 40.95cm in girls. The highest mean annual gain has occurred between 14+ and 15+ years in boys (+2.19 cm per year) and girls (+1.94 cm per year) while the maximum mean annual loss is found between 16+ and 17+ years in boys (-0.32 cm per year) and 15+ and 16+ years in girls (-0.64 cm per year) (Tables 1 and 2).

The mean chest circumference of infants at 0+ year age group is about 41.18cm in boys and 40.84cm in girls. It is one and half times by 11+ years in both the sexes. The maximum mean annual increase has occurred between 14+ and 15+ years in boys (+8.08cm per year) and earlier by one year 13+ and 14+ years in girls (+5.34cm per year) while the maximum mean annual loss and deceleration (-1.17cm per year) is found between 15+ and 16+ years in girls. The mean abdominal circumference of infants at 0+ years age group is 39.58cm in boys and 39.46cm in girls. It is one and half times by 14+ years in both sexes. The highest mean

annual gain has occurred between 14+ and 15+ years in boys (+3.48cm per year) and earlier by three years in girls i.e. 11+ and 12+ years, (+ 3.59cm per year) and while the maximum mean annual loss is found between 3+ and 4+ years in boys (-1.42cm per year) and 15+ and 16+ years (-1.95cm per year) in girls (Tables 1 and 2).

The mean upper arm circumference of infants at 0+ years age group is about 13.48cm in boys and 13.37cm in girls. It is one and half times by 14+ years in girls and 15+ years in boys. Later an increment of 4cm, and 3cm is noticed in boys and girls respectively. The mean calf circumference of infants at 0+ year age group is about 16.10cm in boys and 15.48cm in girls. It is one and half times by 11+ years in boys and 9+ years in girls. Later an increment of 8cm is noticed in both the sexes. The maximum mean annual increase of Upper arm (+2.54cm per year) and calf circumference (+2.61cm per year) has occurred between 14+ and 15+ years in boys. And in girls it is found in upper arm circumference between 13+ and 14+ years (+2.85cm per year) and in calf circumference between 11+ and 12+ years (+1.60cm per year) (Tables 1 and 2).

Fat fold at Triceps region increased gradually



Fig. 8. Distance curve of triceps skin fold

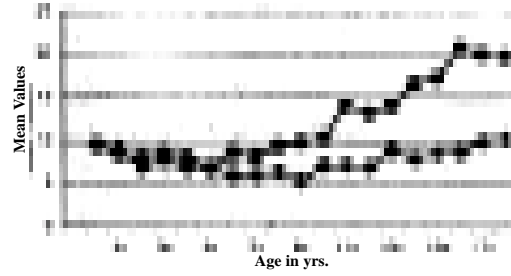


Fig. 12. Distance curve of abdominal skin fold

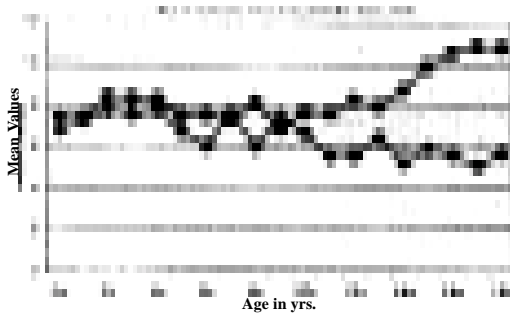


Fig. 9. Distance curve of biceps skin fold



Fig. 13. Distance curve of anterior thigh

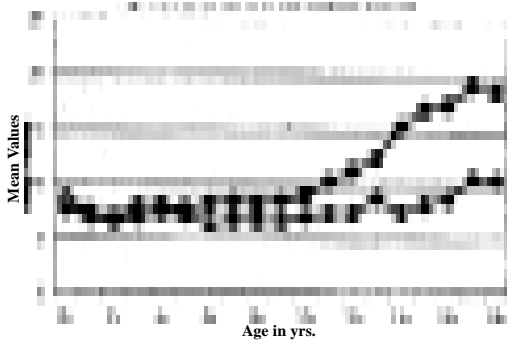


Fig. 10. Distance curve of subscapular skinfold



Fig. 14. Distance curve of medial calf



Fig. 11. Distance curve of supra iliac skinfold

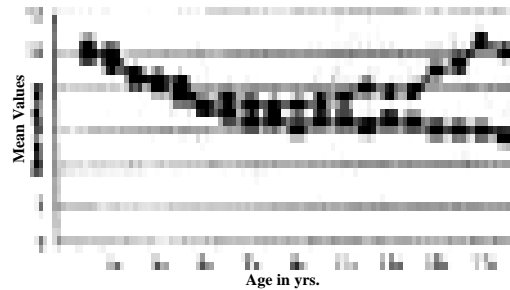


Fig. 11. Distance curve of forearm

from 0+ to 4+ years and almost stationary in boys and little accelerated in girls. The highest mean annual gain has occurred between 16+ and 17+ years (+1.44 mm per year) in boys and 13+ and 14+ years in girls (+1.34 mm per year) while the maximum mean annual loss is found between 13+ and 14+ years (-1.54 mm per year) in boys and 7+ and 8+ years (-1.85 mm per year) in girls. The mean biceps increases gradually with minor irregularities in the means from 0+ to 18+ years in girls but in boys it increases from 0+ to 4+ remaining almost stationary. The highest mean annual gain has occurred between 12+ and 13+ years in boys (+0.84 mm per year) and 14+ and 15+ years in girls (+1.15 mm per year) while the maximum mean annual loss is found between 7+ and 8+ years (-1.65 mm per year) in boys and 8+ and 9+ years (-1.24 mm per year) in girls. The mean subscapular skin fold of infants at 0+ years age group is 7.92 mm in boys and 8.80 mm in girls and then gradually increased with minor irregularities from 0+ to 18+ years in both sexes. The highest mean annual gain has occurred between 16+ and 17+ years in boys (+1.99 mm per year) and 13+ and 14+ years (+2.90 mm per year) while the maximum mean annual loss is noticed between 5+ and 6+ years (-0.90 mm per year) in boys and 0+ and 1+ year in girls (-1.27 mm per year) (Tables 3 and 4).

The mean suprailliac skin fold of infants at 0+ years age group is about 7.64 mm in boys and 8.51 mm in girls, gradually declines by 4+ years in both the sexes and increases by 18+ years with minor fluctuations in both the sexes. The highest mean annual gain (+1.77 mm per year) has attained between 12+ and 13+ years in boys and it is earlier by one year in girls 11+ and 12+ years (+1.35 mm per year) while the maximum mean annual loss is noticed between 13+ and 14+ years in boys (-1.63 mm per year) and 4+ and 5+ years (-1.55 mm per year) in girls. The abdominal and anterior thigh skin folds of infants from 0+ to 18+ years in both sexes accelerating trend is noticed with minor fluctuations. The highest mean annual gain of abdominal and anterior thigh skin fold is (+1.94 mm per year) and (+1.27 mm per year), respectively, both occurred in between 12+ and 13+ years in boys and it is earlier by two years in former 10+ and 11+ years (+3.88 mm per year) and in the latter by one year 13+ and 14+ years in girls

(+4.35 mm per year) (Tables 3 and 4).

The medial calf skin fold of infant at 0+ age group is about 13.45 mm in boys and 13.04 mm per year in girls. It decreases from 0+ to 5+ years and accelerates by 18+ years in both sexes with minor fluctuations. The highest mean annual gain has attained between 15+ and 16+ years (+0.71 mm per year) in boys and it is earlier by two years 13+ and 14+ years in girls (+1.89 mm per year) while the maximum mean annual loss is noticed between 14+ and 15+ years (-1.15 mm per year) in boys and 0+ and 1+ year in girls (-1.55 mm per year). The mean fore arm skin fold declines by 5+ years and it is almost stationary by 18+ years in both sexes. The highest mean annual gain has attained between 12+ and 13+ years (+0.39 mm per year) in boys and it is delayed by two years 14+ and 15+ years (+1.12 mm per year) while the maximum mean annual loss is observed between 1+ and 2+ years (-1.41 mm per year) in boys and 4+ and 5+ years (+1.21 mm per year) (Tables 3 and 4).

The juvenile spurt of body weight (+2.17 kg), stature (+8.59 cm), head circumference (+0.81 cm), chest circumference (+1.81 cm), abdominal circumference (+2.22 cm) in Relli boys is attained between 4+ and 5+ years which is delayed by a year than upper arm circumference (+0.71 cm), Calf circumference (+1.09 cm), sub scapular skin fold (+0.78 mm), supra iliac (+0.19 mm) skin fold and medial calf (+0.93 mm) skin fold i.e. (3+ and 4+ years) and which is earlier by a year than anterior thigh skin fold (5+ and 6+ years) and which is earlier by two years than biceps (+1.64 mm) skin fold, abdominal (+0.16 mm) skin fold (6+ and 7+ years) and also earlier by three years than triceps (+0.19 mm) and fore arm (+0.21 mm) skin fold (7+ and 8+ years) The juvenile spurt of stature (+7.33 cm), head circumference (+0.58 cm) of Relli girls is attained between 4+ and 5+ years, which is earlier by a year than body weight (+1.80 kg), chest circumference (+1.86 cm), abdominal circumference (+3.09 cm), upper arm circumference (+0.97 cm) and calf circumference (+1.03 cm) suprailliac (+1.23 mm), anterior thigh (+1.78 mm), Forearm, abdominal (+1.68 mm) skin fold (5+ and 6+ years) and it is attained earlier by two years than triceps (+0.78 mm) medial calf (+0.46 mm) skin fold (6+ and 7+ years) and also earlier by three years than biceps skin fold (+0.78 mm) (7+ and 8+

**Table 5: t-test comparison between fifteen measurements of Relli boys versus girls according to age**

7Age in yrs.	Body weight	Stature	Head circumference	Chest circumference	Abdominal circumference	Upper arm circumference	Calf circumference	Triceps+	Biceps+	Sub-scapular+	Supra-iliac+	Abdominal+	Anterior thigh+	Medial calf+	For arm+
0+	0.30	2.34***	1.65*	0.46	0.16	0.40	1.43*	1.13	1.52*	2.23**	1.92*	0.28	0.67	0.48	1.66*
1+	2.36**	2.86***	4.59***	4.65***	4.38***	1.99*	0.61	1.13	0.39	0.96	0.63	0.91	0.52	0.59	1.32
2+	1.90*	0.96	4.05***	0.31	0.71	0.30	1.35	1.57*	1.52	1.70*	0.73	2.32**	0.92	0.23	0.79
3+	1.24	1.59*	2.08**	0.19	0.01	1.93*	0.70	2.23*	1.68*	2.59**	1.38	1.23	2.21*	2.06**	0.86
4+	0.03	1.14	2.31**	1.05	0.28	0.17	0.30	2.16*	0.90	1.49	1.39	2.44**	2.27**	0.24	1.73*
5+	2.60**	1.25*	3.66***	3.18***	2.85***	2.39**	1.95*	2.40**	2.29**	1.06	1.43	0.47	2.57**	2.37**	0.28
6+	0.99	0.15	2.87***	1.42	0.49	1.48*	1.07	3.44**	3.66***	5.25***	4.21***	4.33***	3.25***	1.84**	2.32**
7+	1.37	3.03***	0.84	0.56	0.66	1.39*	0.47	1.46*	0.25	4.40***	3.39***	3.62***	5.48***	2.81***	2.69***
8+	0.28	1.23	1.28	2.44***	0.59	1.70*	0.11	2.42**	3.27***	3.62***	3.83***	4.83***	4.52***	2.75***	1.47
9+	3.97***	2.08**	1.36	2.03**	2.07*	4.13***	3.20***	3.31***	5.04***	5.73***	5.56***	5.61***	6.32***	3.02***	5.34***
10+	1.97	1.29	0.48	0.83	0.14	1.08	2.21**	1.03	2.23**	3.23***	3.37***	3.39***	4.04***	2.16**	2.29**
11+	1.56	8.29***	0.75	0.45	0.05	1.57	1.04	4.08***	4.07***	3.97***	4.14***	2.13**	5.34***	1.46	3.13***
12+	3.97***	2.08**	1.36	2.03**	2.07*	4.13***	3.20***	3.31***	5.04***	5.73***	5.56***	6.51***	6.32***	3.02***	5.34***
13+	0.88	1.42*	0.64	0.53	1.18*	2.01*	0.55	2.15***	2.05**	3.92***	3.40***	3.94***	4.59***	2.68***	2.72***
14+	3.90***	0.73	0.05	3.28***	1.74*	2.18**	2.65***	6.26***	5.96***	7.90***	7.06***	6.78***	8.36***	4.64***	2.61**
15+	0.71	4.91***	0.31	0.18	0.11	1.20	0.28	8.37***	7.47***	6.75***	8.50***	6.89***	8.71***	10.25***	7.24***
16+	2.48**	3.09***	0.99	2.90**	2.73***	0.88	2.33*	6.38***	7.88***	8.95***	6.67***	8.50***	9.45***	4.78***	7.86***
17+	0.63	7.53***	0.29	1.16	0.75	0.77	0.06	2.70***	7.02***	5.65***	6.94***	6.27	7.53	6.02***	6.63***
18+	2.01**	9.60***	1.79**	3.34***	1.06*	1.26	0.25	5.27***	6.59***	7.24***	9.10***	7.97	12.33	9.49***	8.01***

\*significant at 5% level

\*\*significant at 1% level

\*\*\*significant at 0.1% level+ skin fold thickness

years) (Figs. 1to15).  
 The adolescent growth spurt or highest peak velocity of Relli boys of body weight (+10.21kg), stature (+9.71cm), head circumference (+2.19cm), chest circumference (+8.08cm), abdominal circumference (+3.48cm), upper arm circumference (+2.54cm), and calf circumference (+2.91cm) is attained between 14+and15+ years which is earlier by a year than medial calf (+0.71mm) skin fold (ie.15+and16+years) and which is earlier by two years than triceps, (+1.44mm) sub scapular (+1.99mm) and abdominal (+1.30mm) skin folds (16+and17+ years) and also which is delayed by a year than biceps (+0.84 mm), suprailiac (+ 1.77mm), anterior thigh skin folds and fore arm skin folds (ie.12+ and 13+ years). The adolescent growth spurt of Relli girls in stature (+6.27cm) is attained between 9+ and 10+ years which is earlier by a year than abdominal skin fold (+3.88mm) (10+ and 11+ years) and which is earlier by two years than body weight (+4.28kg), chest circumference (+4.70cm), abdominal circumference (+3.59cm), calf circumferences (+1.60cm), suprailiac (+1.35mm) skin fold (11+and12+ years) and which is earlier by three years than upper arm circumference (+2.85cm), triceps (+1.34mm), subscapular (+2.90mm), anterior thigh (+4.35mm) and medial calf(+1.89mm) skin folds (ie.13+ and 14+years) and which is earlier by four years than biceps (+1.15mm) and fore arm (+1.12mm) skin folds (ie. 14+ and 15+years). The t-test comparison between fifteen measurements of Relli boys versus girls according to age shows significant differences (Table5) (Figs. 1to 15).

In the present study stature, body weight and all circumferences (0+ and18+years) as well as systolic blood pressure, diastolic blood pressure and pulse rate (12+ to 69+ years) is

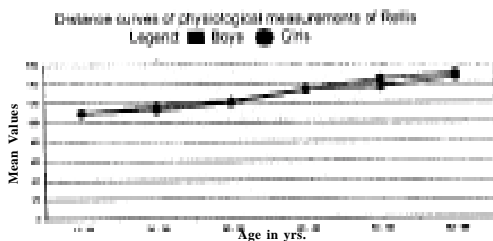


**Table 6: Mean, standard deviation of blood pressure and pulse rate of Relli men by age**

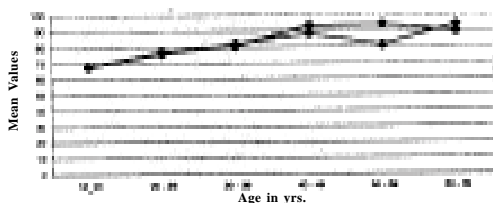
Age in yrs	N	Systolic blood Pressure		Diastolic blood pressure		N	Pulse rate	
		$\bar{X}$	S.D	$\bar{X}$	S.D		$\bar{X}$	S.D
12 - 20	226	109.25	13.17	67.61	15.87	212	91.00	13.37
20 - 29	78	116.85	15.22	76.21	15.03	69	88.75	14.44
30 - 39	27	121.96	23.48	81.85	20.19	21	92.19	12.29
40 - 49	16	134.69	14.99	88.13	16.00	12	87.66	8.60
50 - 59	9	136.37	34.28	81.11	16.91	7	95.42	13.55
60 - 69	7	147.14	32.51	94.29	15.11	7	83.00	18.00

**Table 7: Mean, standard deviation of blood pressure and pulse rate of Relli women by age**

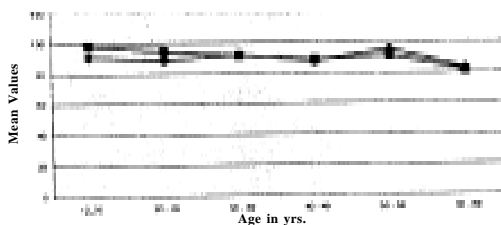
Age in yrs	N	Systolic blood pressure		Diastolic blood pressure		N	Pulse rate	
		$\bar{X}$	S.D	$\bar{X}$	S.D		$\bar{X}$	S.D
12 - 20	222	109.70	12.16	68.06	16.92	177	98.10	13.99
20 - 29	84	112.41	13.79	77.21	11.54	60	94.50	10.31
30 - 39	47	120.43	20.97	80.63	18.92	32	91.81	11.38
40 - 49	25	133.10	35.22	93.20	15.47	18	88.66	13.46
50 - 59	17	144.70	28.53	94.11	12.79	10	91.20	9.00
60 - 69	10	150.50	28.52	89.50	12.57	5	81.60	10.43



**Fig. 16. Distance curve of systolic blood pressure**



**Fig. 17. Distance curve of diastolic blood pressure**



**Fig. 18. Distance curve of pulse rate**

progressively accelerated with advancement in age with few fluctuations. The incidence of hypertension is greater in females (3.04%) than in males (1.38%). And it may suggest to introduce

preventive measures such as weight control, dietary changes and increased physical activity especially for Hypertensive (Tables 7 and 8). It supports that the systolic blood pressure in boys (98.15 mmHg) and diastolic blood pressure (55.18 mmHg) in 13+ years and pulse rate (85.40 per second) in 17+ years is below the normal range. The highest peak velocity or the maximum mean annual increase of the systolic blood pressure in Relli boys (115.21 mmHg) and in girls (111.82 mmHg) and diastolic blood pressure in boys (72.17 mmHg) and in girls (72.63 mmHg) attained respectively in between 17+ and 18+ years (Hofman et al., 1982) and pulse rate in boys (95.11 per second) i.e. 12+ and 13+ years and in girls 104.07 per second i.e. 15+ and 16+ years. The systolic blood pressure in Relli Girls (106.00 mmHg) and diastolic blood pressure (68.00 mmHg) and pulse rate (77.50) in 12+ years is below the normal range. It is well known that the blood pressure is influenced by 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, cholesterol, diet, income, smoking, alcoholism etc. (Table 6-7) (Figs. 16 to 18).

It will be apparent from the foregoing discussion that the findings on Relli boys and girls who are heavier in body weight and taller in stature than the findings obtained by Singh (1980) and Sharma (1991), Bharati et al. (1991) and

Dharma Rao and Busi (1991,1992, 1993, 1994, 1997, 1998) and also shorter than the findings of Hauspie et al. (1980). These boys and girls are taller and heavier with broader head and chest circumferences than the I.C.M.R (1984) observations. These results are general and uni-versal in character and are observed in many populations (Jhonston et al., 1975; Dharma Rao and Busi, 1999-2000). These boys are more or less similar to the finding of Tanner et al. (1966), Dharma Rao and Busi (1997a,b,1998b). The findings generated in this paper can therefore be utilized as reference material for the Relli boys and girls in Visakhapatnam district of Andhra Pradesh. Goldstein and Tanner (1980), Dharma Rao and Busi (2000) have pointed out that the findings observed from such studies would be useful as an alternative to the growth standards, this research conducted among Relli Boys and girls may help to suggest suitable programmes and strategies to improve the nutritional status and proper management of health.

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**KEY WORDS** Relli. Growth Progression. Body Weight. Stature. Blood Pressure. Pulse Rate. Andhra Pradesh.

**ABSTRACT** A cross sectional study was undertaken on 640 Relli boys and 671 Relli girls age between 0+ to 18+ years in urban schools situated in Visakhapatnam district of Andhra Pradesh (South India) during August 2000 to July 2001. In this paper data on body weight, stature, head, chest, abdominal, upper arm and calf circumferences and skin folds at triceps, biceps, sub scapular, supra iliac, abdominal, anterior thigh, medial calf, forearm sites and blood pressures are presented including patterns of change in these physical and physiological traits with advancement of age. It has been observed that there is progressively accelerating trend in all the dimensions with advancement in age except skin folds. The study reveals the Relli girls attained maximum mean annual increase between 10+ and 12+ years and boys between 14+ and 16+ years. Blood pressure and pulse rate increased with advancement in age with few fluctuations. Analysis of the data reveals that all the measurements show significant differences by sex according to age. Relli boys

and girls are taller and heavier than ICMR (1984) National standards. The findings of the study can be used as reference materials for Relli boys and girls of Visakhapatnam district.

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