International Journal of Research in Social Sciences
Vol. 9 Issue 9, September 2019,
ISSN: 2249-2496 Impact Factor: 7.081
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gage as well as in Cabell's Directories of Publishing Opportunities, U.S.A

ADOLESCENT GROWTH OF SCHOOL BOYS IN RENIGUNTA

Dr.E.Rameshbabu M.Sc.Ph.D.*

INTRODUCTION

A cross-sectional study of growth on school boys, aged between 10.5 to 15.5 years, from the semi-urban area of Renigunta, about 7 miles to the north of Tirupati, Chittoor district, Andhra Pradesh has been studied in this dissertation. Growth, for this purpose, has been defined as measurable permanent increase in size of the body or its parts, and pubescence, as appearance of public and axillary hair. The scope of this study is limited to:

(a) Pubescence,

(b) Stature

(c) Weight of the body

(d) Chest circumferences

(e) Sitting height-stature index

As the entire study covered a period of less than two months it has been necessary to limit the analysis to 250 individuals. The data is slightly heterogeneous in respect of

* Dept.of Anthropology, S.V.University, Tirupati 517502

endogamous groups, economic and nutritional levels. But these limitations are minimized by taking 50 boys of each year of age and recording details of caste, income and diet which seem to be reasonably represented in the sample. Although it is purely cross-sectional study, this approach has a priority in the matter of constructing norms and reference standards for growth and pubescence at each age of "adolescence spurt" which is a purpose of this study.

In spite of these limitations, the results of this study seem to provide,

(a) The first series of growth data on the population of this area.

(b) The first study of growth at adolescence and pubescence in boys in a small area in India.

(c) The base line information for ethno-regional variation in adolescence spurt in boys when compared to ICMA report on All India growth studies.

(d) Further data on anthropological variation of Indian population and

(e) Norms and standards for adolescent growth and puberty for male children of the local population.

The results are discussed in a comparative manner, after a brief review of existing literature and reference to the population and procedure adopted for this study.

REVIEW OF LITERATURE

A. The Problems of Growth at Adolescence:

There is a universal pattern of growth curve in man all over the world which reflects accelerated growth at early childhood and at adolescence, each followed by a period of slow rate of increment. (Beas 1931, 1932; Bard 1946; Barker and Stone 1936; Steggarda 1941, Garn 1950, Kogman 1941, Meredith 1945, Wilde 1950, Sontag & Reynolds 1945, Tanner 1962, 1968 and others). Hooton (1932) described this as the rhythm of growth. But a wide variation of individuals and groups in this rhythm have also been suggested. The differences are more marked during the period of adolescent spurt beginning in boys at about 11 years and in girls about 9 years of age.

There are more numerous studies on adolescent growth and puberty among girls than among boys due to technical difficulties in the latter although there is little doubt that puberty is later in males (Hogben et al, 1948). Ellis (1946); Borrecit (1941); Schonfield (1943), Grenlich and Tanner (1962) have however reported detailed studies on male puberty and growth. Pubescence and adolescent growth appears to be faster in temperate climate and retarded in warm and moist tropical Africa (Mills 1937, Ellis 1950). But Ellis (ibid) finds a similar degree of maturity among the Nigerian and British school boys in different ages; while the Nigerian girls have a distinctly higher age of puberty. Ethnic differences in rate of growth or onset of puberty fails to show up in similar socio-economic and climatic conditions (Michelson 1944 and Hogben et al 1948) and this may partly explain Ellis's observation on male adolescence. Secular trends in adolescent growth suggested by Mills have been amply supported by observations of increasingly heavier and taller children with earlier adolescence for last 158 years in

Europe and America (Tanner 1962, 1968; Brown 1966 and others, China (Ni 1966) and Japan (Takahashi 1966). But the trend is less clear in the male. The last authors have also shown a depression of growth rate in Asia during the period of Second World War which strongly support the importance of nutritional factors in growth. Tanner (1968) has suggested that the best-off children of U.S.A. are approaching maximal rate of growth. Whether the trend is still continuing is rather uncertain. Brown (1966) for instance has warned against sampling error of distribution in such studies. Recently Maresh (1972) has failed to find a secular trend of earlier maturation for 88 boys and 92 girls born between 1924 to 1957.

Hereditary influence on growth at adolescence is not denied but requires further clarification. Recently Vandonberg and Falkner (1965) have reported that the hereditary influence appears to be of greater importance for deceleration of the growth rate of moderate, importance for the rate of growth but not statistically significant for the initial status. Relative affects of heredity, ethnic composition, hormonal and climatic factors of adolescence growth remains to be studied satisfactory in a fairly homogenous population from a small area. The study of the growth sequence and the period of maximal growth during adolescent spurt and factors thereof is important for greater understanding of man's physical variation and for its practical implications. The growth norms are also urgently required for different populations of India who differ widely in genetical and environmental background and more so for the period of adolescence in which the adult size of the body is determined. Suggestions of inbreeding depression of growth also require verification by intensive studies.

B. Growth Studies in India:

Rao, S. (1961) in his survey of existing literature Indian Growth studies has emphasized the lack of uniform methods, positive direction and normal standards of growth in India. Some recent growth studies are also concerned with preadolescent children and socio-economic influence on growth rather than with constructing norms for different communities and parts of the country (Rao, M.N; Bhattacharya, 1952, 1953; Madhavan, 1967; Rao, M.N. et al., 1947; R.K.Mukherjee, 1963; Gupta and Bowmik, 1973). Data on adolescence of Indian boys are relatively absent. Berry (1965) has presented data on height and weight of college men in Nagpur. But the age of his subjects vary from 18 to 28. M.N.Rao and C.R. Rao (1966) reported a pilot survey of growth rates of Indian school boys. Phadke (1968) has included the mean heights and weights of some adolescent children aged 10, 14, 19, in the preliminary report of the ICMR growth study scheme from the Poona unit. The later suggested a lower growth rate in Maharastrian Indian boys, who are found lighter and shorter than the British and American. But it is difficult to accept the average values of heterogeneous samples to represent the entire population of India. Lack of accounts background information and accurate determination of the age make them unsuitable for constructing normal standards.

In the ICMR report of (1971-72) on the consolidated results of the All India study on Growth and development of children, some attention has been given to the problems of growth at adolescence in this country as whole. But although it establishes All-India norms of growth for each year compared to Western countries, and it is based upon adequate cross-sectional data collected from a large portion of the country by uniform

methods, it has only limited application in view of the large environmental and genetical variation in Indian populations. It may serve as a reference norm for further regional studies on Growth, which are much needed. However, it brings to light some general features such as interstate difference, highest growth rate among Sikhs and lowest among Jains considering religious groups and marked deviation of the growth curve from linearity similar to that of Japan (Takahashi) observed in Europe-American children. The growth curve shows a convexity for longitudinal measurement of height, sitting height, etc., upto 11 year for boys after which it becomes concave up the 15th year. But for weight and chest girth in males this concavity extends further at both ends. In general the velocity of growth shows an acceleration from about the 10th to the 14th year. Combining different velocities in both sexes, the maturing time seems to extend from 9 to 15 years. But some of its observations seem to deviate from the existing knowledge. For example, the rural boys appear to attain puberty earlier than urban and puberty signs range from 13 to 18 years in boys instead of 11 to 18 years in boys instead of 11 to 18 as reported from other publications.

The present study has been planned in this background to verify some apparent deviations of the ICMR data with regard to attainment of puberty, the year of maximal growth and pubescence in boys and also to find out how far regional and ethnic variations in adolescent growth deviate from the hypothetical all India growth norms. This is particularly important because no growth studies have so far been reported directly for the populations covered in the present study.

MATERIAL AND METHOD

Population:

The material for this study has been collected from 250 boys from one of the two Zilla Parishad High Schools of Renigunta in the first half of May 1973. Renigunta has grown into a semi-urban business centre due the Railway Junction and its Railway link with the important pilgrim town of Tirupati. The students of the school have been recruited from Renigunta and nearby villages. Fifty per cent of them belong to middle class families with a monthly income Rs.150 to 300. Thirty per cent come from poor cultivators; the rest represent a richer section engaged in business with a few exception, of the sons of Railway porters. Seventy five per cent of the students represent the native population while the rest come from a distance of 10 to 50 miles due to employment of their Guardians.

Composition of the Sample:

The population is to some extent heterogeneous and consists of fair Telugu speaking communities of Reddi-Kapus, Kammas, Balijas, Muslims, Brahmins, and Mudaliars who trace Tamil origins. They are not only endogamous groups which may have different gene pools but they also differ in their food habits and family occupations which may influence physical growth of the children. However, the sample collected represents a fair proportion of each of these components as shown in the table. **Table-1**

The number of boys of different communities in each year of age in the sample

Age group	Kapu	Muslim	Naidu	Balija	Mudaliar	Others
11	9	5	8	7	5	16
12	9	7	7	10	4	13
13	10	8	7	8	4	13
14	6	6	9	10	4	15
15	5	14	5	8	5	13

In order to restrict the study to the problem of adolescence spurt, data on 250 individuals were collected in respect of the following items.

(a) Name

(b) Date of birth

(c) Place of birth

(d) Community

(e) Order of birth

(f) Father's income per month

(g) Diet patterns

(h) The frequency of taking milk, meat, etc.

(i) Appearance of public and axillary hair

(j) Height of vertex

(k) Sitting height

(l) Thoracic girth

(m) Body weight.

The first 50 names of each yearly age beginning from 10.5 to 15.5 years were selected from the school registers in which the dates of birth were recorded. It was not possible to verify the age records. But the distribution of dates of birth for each year appears to be fairly uniform throughout the year in the collected sample suggesting minimum distortion.

Table-2

The distribution of months of birth in each year of age in the sample

Months	**10**	**11**	**12**	**13**	**14**	**15**
January		7	5	7	7	9
February		6	5	2	6	3
March		6	1	-	4	2
April		1	-	2	3	2
May		1	-	2	2	-
June		1	2	-	1	4
July	4	7	12	3	3	
August	3	4	5	3	3	
September	8	2	4	4	4	
October	8	8	1	3	5	
November	4	5	5	4	1	
December	1	11	9	10	14	

The students were stripped off their clothes and shoes and the measurements were taken with the help of Anthropometer and a malleable steal steel tape following Martin's

method (1928). The criteria of pubescence given by Ellis (1950) has been followed in assessing puberty signs. But his classification of adolescence by means of pigmentation of pubic hair has not been found suitable for this study due to its subjective nature.

Method of Analysis:

During the processing of the data, all communities have been combined except in the case of stature for which growth trends of individual groups have been observed separately in addition to the combined sample. The composition of dietary patterns rather than economic classes have been kept in mind at the time of interpreting the results (Graphs-1 & 2).

At the first stage of the analysis the frequency distribution of each measurement has been studied for each year of age with the help of the distribution curve and the means, standard deviations and mean standard errors calculated for them. The frequency of boys who showed puberty signs were also calculated for each age. Growth curves have been drawn on the basis of mean values and the years of maximal and minimal of growth estimated by the angle of the curve on the zero line. The significance of the difference between successive age has been tested by means of the 't' value, on the assumption of normal distribution which is not strictly applicable. The velocity of growth has also been computed for each character. Subsequently, the growth trends have also been studied by means of percentile curves which are particularly advantageous because of the non-normal distribution of some characters, and are also more useful for finding norms and variations of growth.

Finally by comparative study the relative trends of growth in different dimensions are assessed. The coefficient correlation between height and weight has been calculated for different ages to show the relative velocity of growth in these features at adolescence.

Height and weight are considered as the good indicators of the growth, because they sum up a number of increments in size and because comparable data are available for them. Puberty signs has been selected for study because of its critical value. Chest circumference has been taken to reflect the transverse growth and stockyness in children. But the data on sitting height has been utilized in calculating sitting height-stature index upon the advice of my Professor, Dr.D.P.Mukherjee, as this can reflect a proportionate growth in limbs and trunk, if they occur, better than the direct measurement of sitting height or limbs.

RESULTS & DISCUSSION

A. Attainment of Puberty Signs:

The frequency of non-pubescent boys for each age group who did not show axillary and pubic hair in this sample have been compared with others (Ellis 1950).

Table-3

Frequency of non-pubescent boys in each age group of Renigunta compared with that of Britain and Nigeria.

Age Group	Size of the Samples			Non-Pubescent		
	Renigunta	Nigeria	Britain	Renigunta	Nigeria	Britain
10-11		31	40		93.5	95
11	50			100		
11-12		73	74		78.8	86.5
12	50			90		
12-13		76	95		57.9	64.2
13	50			92		
13-14		36	135		44.4	47.4
14	50			74		
14-15		35	120		17.1	12.5
15	50			30		
15-16		32	78		3.1	1.3
16-17		30	33		3.3	6.1
17-18		29	35		0.0	0.0

Table-4

Frequency of pubescent boys in each age group of Renigunta compared with that of Britain and Nigeria. (Sample size is same as in table-4)

Age Group	Size of the Samples			Pubescent		
	Renigunta	Nigeria	Britain	Renigunta	Nigeria	Britain
10-11		31	40		6.5	5.0
11	50			0		
11-12		73	74		21.2	13.5
12	50			10.0		
12-13		76	95		42.1	37.1
13	50			8.0		
13-14		36	135		55.5	52.1
14	50			26.0		
14-15		35	120		82.8	87.5
15	50			70.0		
15-16		32	78		86.8	98.5
16-17		30	33		96.7	93.9
17-18		29	35		100	100

Results of All India Growth Survey (ICMR 1972) suggest the onset of puberty in 13 years in Indian boys. But the puberty signs appear at the age of 12 (11.5 to 12.4 years) in the present sample; which is non-comparable to other results of other studies outside India. There is an insignificant fall in the next age group of 13 years, followed by a steady trend of significant increment. The age group 14 to 15 years shows the maximal increment of 44 per cent in the frequency of pubertal boys (Table-5).

Table-5

Frequency of Pubescent boys in each year of age and the results of 't' test between each suggestive years

Age group	Percentage	±S.E	Difference of percentage	S.E. of difference	't' value
11	0	±0.00			
			10	±4.25	2.35
12	10	±4.25			
			2	±5.71	0.34
13	8	±3.80			
			18	±7.21	2.47
14	26	±6.20			
			44	±9.09	4.83
15	70	±6.53			

This is high significant as shown by the 't' value.

It is evident (table-4) and (graph-3) that the attainment of puberty sign is considerably retarded in the present sample at each age group compared to other data studies.

The highest rate of maturation however in the non-Indian samples, is observed between 13.5 to 14.5 years of age which correspond to the trend of present sample. The maturation rate in Britain boys shows a more steady rise throughout adolescence than in the other two; probably due to sampling errors in respect of nutritional status. The curve for pubescence is sigmoid in all samples; but the Indian curve shows a larger concavity towards the bottom; and a relatively steaper rise between 14 and 15 years.

The depression instead of a rise in 13 years age group is obviously due to sampling fluctuations. The distribution of pubescent children in different ages closesly

correspond to the curve (graph 1 & 2) showing the proportion of individuals having animal protein in their diet in each age. This correspondence is more striking with the distribution of regular meat eaters than with milk takers. The protein intake by majority in 12 and 15 years age samples and by a relatively smaller proportion in the 13 years sample can partly explain slopes of the pubescence curve.

Further more puberty signs are related to the attainment of height and weight in each age as shown by the average values of these two measurements and in the pubescent boys of each year their corresponding percentile positions for the age group and the growth rate in the pubscent boys in relatively smaller than in others (Table 6&7) (Graph 4). The average values of the sexually mature boys gradually spread downwards from 96th percentile in each successive year of growth except 13 years (Table-8).

Table-6

Means, ± Standard Errors with Standard Deviations of stature for pubescent boys in each age group and its position in percentile growth curve

Age group	Number	Mean	±S.E	S.D.	Percentile
12	5	1555.00	25.61	43.25	96th
13	4	1537.50	20.73	41.45	97th
14	13	1555.77	20.72	74.75	91st
15	35	1583.77	12.09	71.55	84th

Table-7

Means, ± Standard Errors with Standard Deviations of body weight of pubescent boys in each age group and its position in the percentile growth curve

Age group	Number	Mean	±S.E	S.D.	Percentile
12	5	79.00	6.23	13.95	96th
13	4	72.00	6.25	12.5	92nd
14	13	82.76	4.27	15.42	83rd
15	35	87.14	2.23	13.20	71st

Table-8

Percentile values of the sexually mature boys in each successive year of growth

	Age groups			
	12	**13**	**14**	**15**
Stature	96^{th}	97^{th}	91^{st}	84^{th}
Body weight	96^{th}	92^{nd}	83^{rd}	71st

STATURE

The means with standard errors, standard deviations of height vertex and the rate of increment for each age group are shown in Table-9.

Table-9

Means, ± S.Es, S.Ds, 't' values and growth increments of stature in boys of different age group of the sample

Age group	No.	Mean	±S.E	S.D	't' value	Growth increment
11	50	1338.50	9.35	67.50		
12	50	1417.50	12.87	91.00	4.80	5.90
13	50	1422.46	11.60	82.00	2.86	0.35
14	50	1466.50	11.60	82.00	2.68	3.09
15	50	1552.50	11.40	80.50	5.38	5.89

The growth curve based on the mean values show comparable trends of acceleration between 14 to 15 years and 11 to 12 years and retardation ('t' value is insignificant) between 12 to 13 years and may be again related sampling fluctuation of nutritional levels. The increment rate at 12 years is slightly greater and that at 13 and 14 years smaller than the All India data, which show a more steady growth. But the All India (ICMR) norms approach similar values to this sample (Graph-5) at the beginning and end of the period of study adolescent spurt and shows only small overall deviation. This suggests the representative nature of the present sample in spite of its relatively small size covered in this study.

The frequency distributions of stature in each age (Graph-6, 7 & 8) suggest a gradual shift in each year of the modal value by a process of broadening and bifurcate as in 13^{th} year. the distribution gradually moves from a nearly symmetrical to a negative by skewed curve, and therefore the mean and standard deviation values do not reflect the

trends adequately and truly. The higher range in the 12 year age group may again reflect the affect of protein-rich diet in this respective sample. The percentile curves for Renigunta boys show a higher variability in the 15th year when compared to All India data, which show more uniform trends of growth. The acceleration of growth in 12th year and relative retardation in 13th is more apparent in 95th percentile of the Renigunta boys. For boys of each level of height the present sample shows a distinctly smaller value of height when compared to the All India data and this difference is magnified in the higher percentiles. In All India data boys of all grades of heights show almost similar trends of growth in different age groups with a relative slower rate for the shorter 5th percentile. But in the Renigunta sample there is a greater variation in the growth trends of boys of different heights. In order to locate the genetic implications a preliminary attempt has been made to compare the growth patterns of stature in the major communities in this sample, in spite of their small but rather uniform sizes (Table-10).

Table-10

Means of stature in boys of different age according to communities

Community	11 years		12 years		13 years		14 years		15 years	
	No.	Mean	No.	Mean	No.	Mean	No.	Mean	No.	Mean
Kapu-Reddy	9	1370.00	9	1458.00	10	1475.00	6	1433.00	5	1505.00
Muslim	5	1335.00	7	1453.55	8	1387.50	6	1458.00	14	1525.00
Naidu	8	1300.00	7	1382.00	7	1475.00	9	1498.00	5	1495.00
Balija	7	1582.00	10	1380.00	8	1387.50	10	1465.00	8	1494.00
Mudaliar	5	1335.00	4	1412.40	4	1437.50	4	1450.00	5	1625.00

Broadly the Mudaliar group tend to show the highest total growth followed by Naidus and Muslims who both show retardation of growth at one stage or other. The Kapus show a consistent trend of moderate growth followed by the Balija sample who show display retarded growth up to 13th year. the trends are however are not conclusive and may show influenced of socio-economic conditions.

C. WEIGHT

Growth in respect of weight (Table-11, Graph 7) again shows a similar trend of greater acceleration in the initial and terminal yours of the period of study, and also an insignificant difference between the 12th and 13th year, partly reflecting the nutritional variation in the samples drawn (Graph 1 & 2).

Table-11

Means, Standard Errors, Standard Deviations, 't' Values and Growth Increments of Body Weight in boys of different age groups

Age group	No.	Mean	±S.E	S.D	't' value	Growth increment
11	50	52.10	0.93	6.61	6.86	18.71
12	50	61.85	1.10	8.03	0.02	–8.08
13	50	61.80	1.31	9.31	2.12	8.75
14	50	67.21	2.19	15.53	5.99	21.41
15	50	81.60	1.87	12.84		

The mean curve for each year lies constantly at a lower level in comparison to the All India (ICMR) curve. The clear approach of the two curves in the 12th year suggest the nutritional effect.

The distribution of weight seems to deviate from normality in each age being more or less platykurtotic and positively skewed in each age. Therefore the trends of growth has been also studied by percentile curves (Graph 8). The weight in Renigunta boys also as in height always fall short of the Indian average in each percentile, so much so that the 95th percentile curve shows a steady trend of growth comparable to All India trend, growth rates of median and lower levels of height in Renigunta show greater fluctuations comparable to the mean curves.

It should be mentioned the rates of increment in growth curve is much higher than both longitudinal and transverse increments of the body which are represented height and chest-girth respectively.

D. THORACIC CIRCUMFERENCE

The means and standard deviations, the values of 't' tests between each year, increment rates and the velocity of growth per year of the thoracic circumference as well as the growth curve based on mean values suggest the trend of growth with highest acceleration between 14th and 15th year, as in other characters. The special features are significant fall in the chest girth between 12 and 13 years after a degree rise at 11th year, and a steady trend of growth after the 13th year. The frequency distribution curve shows only slight increments between 11th to 14th year which has almost similar peak values and an abrupt shift of the modal value in the 15th year. The mean values however fall short of the All India standards of Growth curve in all ages.

Table-12

Means, Standard Errors, Standard Deviations, 't' Values and Growth Increments in boys of different age groups (Thoracic circumference)

Age group	No.	Mean	±S.E	S.D	't' value	Growth increment
11	50	567.5	5.37	38.80	2.76	4.40
12	50	592.5	7.28	51.50	2.63	–4.22
13	50	577.5	6.08	43.00	2.86	4.67
14	50	604.5	7.21	51.00	3.91	6.61
15	50	644.5	7.25	51.50		

This trend of increment is maintained in almost all sections of the Renigunta children, and the growth rate is the smallest among the leanest children of the 5th percentile except in the terminal year of study. The general feature of lesser stockiness' in the Renigunta boys in comparison to the All India standard seem to be accentuated in this section of shortest boys.

E. SITTING HEIGHT/STATURE INDEX

The mean values, standard deviations, standard errors, the 't' values between years and the rate of increment per year are shown (Table-13) (Graph-9).

Table-13

Means, Standard Errors, Standard Deviations, 't' values and Growth Increments of Sitting Height-Stature Index in boys of different age groups

Age group	No.	Mean	±S.E	S.D	't' value	Growth increment
11	50	504.5	2.75	19.00	0.71	0.59
12	50	507.5	3.16	24.00	0.42	–0.39
13	50	505.5	3.45	24.60	0.42	0.39
14	50	507.5	3.20	24.00	1.91	1.49
15	50	515.5	2.68	19.00		

It is evident that there is no significant annual change in the average value of the Index although the difference between the mean values of the 15^{th} and 11^{th} or 13^{th} year appear to be statistically significant at 5 per cent level of probability. This may suggest the very slow rate of growth in this character compared to individual measurements, as the distribution curves for difference age groups almost remain constant in their negative skewedness and constant position of mode. The curve for the 15^{th} year shows a trend of Leptokurtosis and a shift away from the lower extreme f the curve. The trend of growth in this index although minute in degree seems to follow the pattern of growth in other characters. The percentile curves also show very little increment for boys with different degrees of limb proportions except in these in the lower first quartile who show an acceleration from the 14^{th} year.

It is not possible however, to compare the rate of this relative growth of the trunk with other populations, the purpose of studying age changes in this character is to find out

how far the trait under goes change in adolescence, as there is supposed to be hormonal influence on the character which is known to have sex difference. Mukherjee (1971) has observed bimodal distributions of this Index among a number of populations from Central India and have suggested the possibility of mendelian segregation of the trait. Genetical studies on this character require background information about the influence of age on this trait and the present data may throw some light on this problem.

The significance of the present results seem to be that during the period of maximal growth at 14^{th} to 15^{th} year in this sample there is relatively greater a trunk growth compared to the lower limbs. However, this may also be a reflection of the sampling fluctuation with respect to the genetic constitution and or nutritional status of the sample.

GENERAL OBSERVATIONS, SUMMARY AND CONCLUSION

General Trends and Differential Growth:

A more or less uniform pattern of acceleration and retardation of growth seem to emerge for Renigunta boys, when the increment curves for different characters are compared together. The growth rate is rather slow in these adolescents in comparison to All India trends and more so to British and American boys for each dimension. Where in All India sample a uniform rate of growth maintained at adolescence; in the Renigunta boys there are abrupt increments and falls. Breaking up the data for height by community, it is found that the Muslim boys who usually depend upon meat diet are also smaller in size at 13 years of this sample.

This retardation of growth in comparison to All India norms is more conspicuous in the case of chest girth, then in stature. Generally the smallest or the lightest boys of 5th percentile show a smaller rate of growth in comparison to the largest or heaviest section of the boys. This is more clear in respect of weight than in other characters.

Each character shows the maximal growth between the 14th year and 15th and to some extent between 11-12 years also. There is a tendency of growth retardation at 13 years which of course can be due to the inclusion of more boys with poorer diet in the sample drawn for this age-group. The affect is more striking in the upper 95th percentile in the case of height and chest girth but not in weight. Perhaps the increase of sitting-height-stature index during 14-15 years indicate differential growth rates for lower limbs and trunks, and the latter may become more important in the 14 and 15 years.

A comparison of the increment rates of different dimension shows the highest average velocity of growth in weight followed by height and chest girth in order (Table-14).

Table-14

Growth Increments in Boys of Different Age Groups in Each Year

(In percentage)

Age group	Height	Weight	Thoracic circumference	Sitting-height-stature index
11-12	5.90	18.71	4.41	0.59
12-13	0.35	-8.08	-4.22	-0.39
13-14	3.09	8.75	4.67	0.39
14-15	5.89	21.47	6.61	1.49

It can be also seen that the effect of protein deficiency on transverse growth of Thoracic circumference and body weight is more appreciable than linear growth of stature. Rounding up the growth rates between 11-12 and 12-13 years together to avoid the sampling errors for nutrition; it may be observed that there is a continuous acceleration of growth from 11 to 15 years in the Renigunta boys also. The velocity curve of course is more concave on the left side than that of the All India date. In order to assess the interdependence of growth in height and weight the coefficience of correlation between these two measurements for each age is shown in Table-15.

Table-15

Correlation for Height and Weight in 11 years

Weight (lbs)→	**40-44**	**45-49**	**50-54**	**55-59**	**60-64**	**65-69**	**70-74**	**75-79**	**80-84**
Height (mm)↓									
1450-1499					1				1
1400-1449			1	2	1	2			
1350-1399			9	2	1		1		
1300-1349	1	4	9	3					
1250-1299	4	4	1	1					
1200-1249	1	1							

Coefficient Correlation = 0.7261

S.E. of r = ± = 0.06687

Table-16

Correlation for Height and Weight in 12 years

Weight (lbs)→	**40-44**	**45-49**	**50-54**	**55-59**	**60-64**	**65-69**	**70-74**	**75-79**	**80-84**	**100-104**
Height (mm)↓										
1650-1699										1
1600-1649									1	
1550-1599									1	
1500-1549						2	1			
1450-1499					3	1	1		1	
1400-1449			2	2	5	5				
1350-1399			5	3	4	2				
1300-1349		1	3	1						
1250-1299	1		2	1						
1200-1249		1								

Coefficient Correlation = 0.7469

S.E. of r = ± = 0.07874

Table-17

Correlation for Height and Weight in 13 years

Weight (lbs)→	**40-44**	**45-49**	**50-54**	**55-59**	**60-64**	**65-69**	**70-74**	**75-79**	**80-84**
Height (mm)↓									
1550-1599								1	1
1500-1549						3			2
1450-1499					3	1	5	1	
1400-1449				2	6	1	1		
1350-1399			3	3	6				
1300-1349		1	5	2					
1250-1299	1			1					
1200-1249	1								

Coefficient Correlation = 0.7861

S.E. of r = ± = 0.0.05403

Table-18

Correlation for Height and Weight in 14 years

Weight (lbs)→	**50-54**	**55-59**	**60-64**	**65-69**	**70-74**	**75-79**	**85-89**	**90-94**	**95-99**	**100-104**
Height (mm)↓										
1600-1649								1	1	3
1550-1599						2	1			
1500-1549					2		1	1	2	
1450-1499			4	4	4					
1400-1449	2		3	4	2					
1350-1399	3	2	4	1						
1300-1349	3									

Coefficient Correlation = 0.7865

S.E. of r = ± = 0.05416

Table-19

Correlation for Height and Weight in 15 years

Weight (lbs)→	**60-64**	**65-69**	**70-74**	**75-79**	**80-84**	**85-89**	**90-94**	**95-99**	**100-104**	**105-110**
Height (mm)↓										
1700-1749										2
1650-1699									3	1
1600-1649			1		2	1	2	2	1	
1550-1599			2	1	6		1			2
1500-1549			4	1	1	2		1		
1450-1499	2	1	1	2						
1400-1449	5									
1350-1399	3									

Coefficient Correlation = 0.831

S.E. of r = ± = 0.04379

Table-20

Correlation for Height and Weight in all Age-groups of the Sample

Weight (lbs)→	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	100-104	105-110
Height (mm)↓														
1700-1749														2
1650-1699													3	1
1600-1649							1		2	1	4	2	4	
1550-1599							1	4	9	1	1			2
1500-1549						7	6	1	6	2	2	2		
1450-1499					11	6	14	2	1					
1400-1449			4	8	21	9	3							
1350-1399			19	10	20	2	1							
1300-1349		5	21	7										
1250-1299	6	4	4	3										
1200-1249	3	1												
1150-1199	1													

Coefficient Correlation = 0.9177

S.E. of r = ± = 0.00102

There is definite trend of increasing correlation between height and weight in each year of adolescent growth. This suggests that growth in height continuous to influence weight or overall growth and rather more towards the later part of adolescence than earlier. This may be due to considerable compensatory growth in stature later years, or deceleration of the growth of other characters at this time.

SUMMARY AND CONCLUSIONS

This study on growth at adolescence from 11 to 15 years from Renigunta on a sample of 250 boys distributed equally for each age brings out certain prominent features.

1. There are abrust changes in body dimensions and appearance of puberty signs at the later part of this period of study and the curve of the velocity of growth is rather concave in appearance.
2. The rate of growth and sexual maturation of Renigunta boys is considerably slower in comparison to Indian and non-Indian data.
3. Nutrition, especially milk and animal protein intake, is suspected as a factor directly responsible for variations of growth in height and weight (Takahashi, 1996).
4. There is an insignificant change towards the opposite direction in the 13 year which must be due to sampling error and can be easily explained by lower protein and milk intake in the sample drawn from this age group. The effects of urban-rural residence and socio economic status on growth in height and weight are partially interpreted.

5. The growth rate for height seems to be more continuous then other characters such as limbs, and the highest acceleration of growth accurs in weight which depends more and more upon attainment of height in elder boys.
6. Usually the smaller and higher children grow at a slower rate than the larger and heavier ones.

It remains to be found out by further and extensive studies whether these unfavorable deviations of growth rate of Renigunta boys is due to genetical or ethnic background of the population or simply due to the higher temperature and climate of drought in the area or the composition of the soil or due to the so called inbreeding depression because of the known higher incidence of consanguineous marriages among the rural populations of Andhra Pradesh. The indication of the effect of protein deficiency in some sections of the population from the present study suggests the need of immediate attention both from anthropologists, clinicians and welfare administration.

LITERATURE CITED

1. Boas, F. 1932. "Studies in Growth", Human Biology, 4, 307-350.
2. Brown, P.E. 1966. "The age at menarche", Brit, J.Prev.Soc.Med., 20:9-14.
3. J.N.Berry, 1957-58. "Height and Weight of Male college students in Central India in 1957-58". Ind.J.Med.Resl-55, 4.Apr.
4. Eiji Takahashi, 1966. "Growth and Environment Factors in Japan", Human Biology, , 112-130.
5. Gupta, T.K.and Bhowmik, K.L. 1973, "Bodily Growth of children in slum areas of Calcutta", Study and Culture 121-126.
6. Hardlicka, A. 1941. "Height and Weight in Eskimo Children", Amer.J.Phy. Anthrop. 28, 331-341.
7. Garn, S.M. "Physical growth and development", Amer, J.Phy.Anthrop. N.S.10:169-192, 1952.
8. Greulich, W.M., Day, H.G., Lachman, S.E., 1938 "A hand book for the study of Adolescent children", Monog.Soc.Res.Child Develop, Vol.3, No.2.
9. Hamilton Hogben, J.A. et al. 1950. "Studies on Puberty", The year book of Physical Anthropology, pp.29-49.
10. Hooton, E.A. 1946. Up from the Age, Macmillan, New York.