CHANGES IN CHEST AND CALF CIRCUMFERENCES AND BICEPS AND SUPRA-ILIAC SKINFOLDS OF BENGALI BOYS

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ABSTRACT : The paper reports data on cross-sectional growth in chest circumference (N=761), calf circumference (N=770), biceps (N=788) and supra-iliac skinfolds (N=758) of Bengali boys, aged 7.0 to 16.0 years. Both the chest and calf circumferences exhibited the maximum mean increments between 13.0 — 14.0 years to coincide with the adolescent growth spurt. Skinfold sites of trunk and limb have manifested "preadolescen fat wave" as well as the adolescent loss in thickness. Bengali boys haze larger chest and calf circumferences than the average Indian and Punjabi boys respectively. They also have thicker subcutaneous fat deposits than the Punjabi and Haryanvi boys. The findings of the study can be used as a reference material for Bengali boys.

INTRODUCTION

The first longitudinal growth study based on Bengali children has already published results on growth velocity, important landmarks of adolescent growth spurts and sib resemblance in growth curves in height (Hauspie et al. 1980, 1982). However, no cross-sectional data on the growth of Bengali children is available, although "Longitudinal and cross-sectional studies are complementary and both are required to a full understanding of the growth process" (Eveleth and Tanner, 1976). Moreover, the Indian Council of Medical Research (ICMR, 1972) in their nationwide growth survey, did not include the Bengali children from West Bengal. A cross-sectional growth study of Bengali children was, therefore undertaken in 1982-83 in the Indian Statistical Institute, covering twentysix measurements and Pakrasi et al. (1986, 1988) reported the results of height, weight, skinfolds (at triceps and subscapular areas) and arm circumference. Subsequently Dasgupta (1990) reported cross-sectional growth of six dimensions, namely biacromial diameter, bi-iliocristal diameter, transverse chest-width, anteroposterior chest-depth, bicondylar femur-diameter, and wrist breadth. The present paper, reports the other four measurements namely, (i) Chest circumference,

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(ii) Calf circumference, (iii) Biceps skinfold thickness and (iv) Supra-iliac skinfold thickness, derived on the same sample of the Bengali boys.

MATERIAL AND METHODS

The data are based on 825 middle to upper middle class Bengali school boys aged 7.0 to 16.0 years of Calcutta city. The socio-economic and demographic characteristics of the subjects and their families have already been published by Pakrasi et al. (1988). The methods employed for anthropometric measurements have also been described by Pakrasi et al. (1988), and Dasgupta (1988).

As boys with known dates of birth alone were included in the present study, it was possible to classify them as falling under each age ranging from 7 to 16 years since the measurements were taken on or about their date of birth.

Circumferences were taken with a steel tape while skinfolds were measured with the help of Lange's skinfold caliper. Skinfold measurements were recorded to the nearest 0.5 mm. while other measurements were taken to the nearest millimeter. Calf circumference, and skinfolds were measured on the left side of the subjects.

The technique of measurement was followed exactly as suggested in Weiner and Lourie (1969). The measurements were taken by the present author.

The technical error of the anthropometric measurements as computed by the formula

$$\left(\sqrt{\Sigma \frac{D^2}{2N}} \right)$$ from double observations on a sample of boys were 0.46 for chest circumference,

0.08 for calf circumference, 0.05 for both biceps and supra-iliac skinfolds.

Age specific means, medians, standard deviations were calculated for all the anthropometric characters. The whole year mean increments have been calculated by subtracting the mean of the preceding age group from that of the suceeding age group.

The skewness and kurtosis of the distribution of the anthropometric characters at each level were computed and their significance were tested by standard statistical methods. Our information on normality patterns of the characters considered here are meagre. However, the distribution of skinfolds are known to be positively skewed (Edwards et al. 1955) as also noticed in the present study. Therefore, their logarithmic transforms were also tested. The results are discussed below. Processing of data, tabulations and statistical analysis were performed using a Russian Third Generation Computer (EC 1033) and the BMDP package programme (Dixon and Brown 1978).

The results were compared, with boys from other parts of the country, wherever possible,

TABLE 1

Age specific sample size, means, medians, standard deviations, annual increments (mean and median), skewness and kurtosis of the distribution of Chest circumference (cm.) of the Bengali boys

Age	N	Mean	Md	SD	Annual increments Mean	Md	Skewness	Kurtosis
7.0	58	55.72	55.0	4.98			1.47+	4.67+
					1.28	1.2		
8.0	79	57.00	56.2	3.96			0.89+	0.90
					2.47	2.0		
9.0	92	59.47	58.2	5.47			1.58+	4.12+
					1.13	1.3		
10.0	67	60.60	59.5	6.15			0.90+	1.56+
					2.93	3.2		
11.0	92	63.53	62.7	6.61			0.95+	1.26+
					1.80	1.3		
12.0	91	65.33	64.0	6.60			0.98+	0.62
					1.80	2.6		
13.0	93	67.13	66.6	5.62			0.43	0.29
					3.26	3.7		
14.0	89	70.39	70.3	6.08			0.69+	0.85
					3.22	2.9		
15.0	68	73.61	73.2	6.58			−0.17	0.80
					1.71	0.9		
16.0	32	75.32	74.1	5.18			0.53	−0.42

+Significant at the 5% level.

TABLE 2

Age specific sample size, means, medians, standard deviations, annual increments (mean and med:an), skewness and kurtosis of the distribution of Calf circumference (cm.) of the Bengali boys

Age	N	Mean	Md	SD	Annual increments Mean	Md	Skewness	Kurtosis
7.0	58	22.22	22.2	2.05			0.49	−0.35
					0.78	0.8		
8.0	82	23.00	23.0	2.12			−0.14	2.56+
					1.34	1.0		

Age	N	Mean	Md	SD	Mean	Md	skewness	Kurtosis
9.0	93	24.34	24.0	2.38			0.78+	0.35
					0.53	0.5		
10.0	66	24.87	24.5	2.41			0.69+	−0.09
					1.00	1.3		
11.0	95	25.87	25.8	3.50			0.46	2.33+
					0.88	0.4		
12.0	94	26.75	26.2	2.77			0.63+	−0.05
					0.86	2.0		
13.0	91	27.61	28.2	3.02			−0.78+	2.05°
					1.38	0.6		
14.0	89	28.99	28.8	2.93			0.88+	1.49+
					1.04	1.4		
15.0	69	30.03	30.2	3.21			−1.07+	2.90+
					0.98	0.4		
16.0	33	31.01	30.6	0.56			0.82	2.10+

+Significant at the 5% level.

TABLE 3

Age specific sample size, means, medians, standard deviations, annual increments (mean and median), skewness and kurtosis of the distribution of Biceps skinfold thickness (mm.) of the Bengali boys

Age	N	Mean	Md	SD	Annual increments		skewness	Kurtosis
					Mean	Md		
7.0	61	4.56	4.5	1.49			0.69+	0.29
		(0.64)	(0.6)	(0.14)			(0.0)	(−0.74)
					0.26	−0.5		
					(0.02)	(−)		
8.0	84	4.82	4.0	1.85			1.59+	3.40+
		(0.66)	(0.6)	(0.15)			(0.55+)	(−0.03)
					−0.10	—		
					(−0.02)	(−)		
9.0	90	4.72	4.0	2.12			1.70+	3.91+
		(0.64)	(0.6)	(0.17)			(0.44)	(0.06)
					0.80	1.0		
					(0.05)	(0.1)		

Age	N	Mean	Md	SD	Mean	Md	skewness	Kurtosis
10.0	75	5.52 (0.69)	5.0 (0.7)	3.05 (0.20)			2.26+ (0.58+)	7.52+ (0.15)
					0.16 (0.01)	−0.5 (−0.1)		
11.0	95	5.68 (0.70)	4.5 (0.6)	2.97 (0.20)			1.39+ (0.43)	1.73+ (−0.51)
					−0.24 (−0.01)	0.5 (0.1)		
12.0	92	5.44 (0.69)	5.0 (0.7)	2.66 (0.19)			1.57+ (0.52+)	2.96+ (−0.39)
					−0.60 (−0.04)	−1.0 (−0.1)		
13.0	94	4.84 (0.65)	4.0 (0.6)	2.06 (0.15)			1.90+ (0.84+)	3.79+ (0.62)
					−0.54 (−0.05)	— (−)		
14.0	92	4.30 (0.60)	4.0 (0.6)	1.81 (0.15)			2.05+ (0.77+)	5.94+ (0.46)
					0.15 (0.01)	— (−)		
15.0	71	4.45 (0.61)	4.0 (0.6)	2.04+ (0.17)			1.90+ (0.70+)	3.81+ (0.55)
					−0.52 (−0.04)	−0.3 (−)		
16.0	34	3.93 (0.57)	3.7 (0.6)	1.46 (0.15)			1.13+ (0.38)	0.82 (−0.44)

(i)   Figures in parentheses pertain to $\log_{10}$ transformed values.

(ii) +Significant at the 5% level.

TABLE 4

Age specific sample size, means, medians, standard deviations, annual increments (mean and median), skewness and kurtosis of the distribution of supra-iliac skinfold thickness (mm.) of the Bengali boys

Age	N	Mean	Md	SD	Annual increments Mean	Md	skewness	Kurtosis
7.0	59	4.08 (0.57)	3.5 (0.5)	1.97			2.20+ (0.69+)	6.95+ (0.41)
					0.25 (0.03)	— (−)		

Age	N	Mean	Median		Mean gain	Median gain	Skewness	Kurtosis
8.0	81	4.33 (0.60)	3.5 (0.5)	2.21			2.24+ (0.77+)	8.22+ (0.67)
					−0.06 (−0.01)	− (−)		
9.0	90	4.27 (0.59)	3.5 (0.5)	2.20			2.57+ (1.15+)	8.72+ (1.10+)
					0.73 (0.05)	0.5 (0.1)		
10.0	69	5.00 (0.64)	4.0 (0.6)	2.86			1.66+ (0.83+)	2.17+ (−0.21)
					0.12 (0.03)	− (−)		
11.0	88	5.12 (0.67)	4.0 (0.6)	2.34			1.00+ (0.34)	0.29+ (−0.93)
					0.33 (0.01)	0.2 (−)		
12.	90	5.45 (0.68)	4.2 (0.6)	2.94	−0.36		1.54+ (0.54+)	2.30° (−0.41)
					(−0.01)	(−) —		
13.0	90	5.09 (0.67)	4.2 (0.6)	2.69			3.30+ (1.68+)	11.91+ (3.84+)
					0.13 (0.01)	0.3 (−)		
14.0	90	5.22 (0.68)	4.5 (0.6)	2.30			1.69+ (0.73+)	2.88+ (0.09)
					0.89 (0.06)	0.5 (0.1)		
15.0	71	6.11 (0.74)	5.0 (0.7)	3.05			1.48+ (0.46)	1.91+ (−0.02)
					−0.51 (−0.03)	− (−)		
16.0	30	5.60 (0.71)	5.0 (0.7)	2.39			1.10+ (0.29)	1.01 (−0.86)

(i)   Figures in parentheses pertain to $\log_{10}$ transformed values.

(ii) +Significant at the 5% level.

RESULTS

Age specific sample sizes, means, medians, S.D.'s, mean and median annual gain, skewness and kurtosis of each of the four anthropometric characters are presented in tables 1 to 4. From these tables it is clear that all the four characters show significantly non-normal distributions at several ages, and therefore, in addition to the mean, the median values are also included in the results.

Tables 1 to 4 show that apart from the skinfolds, the circumferences have increased progressively over the ages 7.0 to 16.0 years.

In the circumferential dimensions of chest and calf, which give the composite measures of bone, muscle and fat, the maximum mean annual increase has occured between 13.0 to 14.0 years (tables 1 and 2). Standard deviations for these characters have not shown any consistent pattern as found earlier in the linear and transverse measures (Pakrasi et al. 1988, Dasgupta, 1990, Dasgupta and Das 1990). The highest value of S.D. (6.60-6.61 cm.) for chest circumference was found at 11.0 and 12.0 years. For calf circumference these are 3.50 cm. and 3.21 cm. occuring at 11.0 and 15.0 years respectively.

From table 3 it is evident that biceps skinfold thickness increases gradually with minor irregularities in the means from 7.0 to 11.0 years reaching a peak value of 5.68 mm. at 11.0 years. From 12.0 to 14.0 years again a gradual downward trend in thickness is clearly noticed. The slight increase as observed at 15.0 years (fig. 3) may be due to sampling variation. The highest annual gain (+0.80 mm. per year) has occurred between 9.0 to 10.0 years while the maximum mean annual loss of thickness (-0.60 mm. per year) is found between 12.0-13.0 years. The median values through several fluctuations have reached the peak value 5 mm. at 12.0 years. The highest gain of 1 mm. per annum is noticed between 9.0 and 10.0 years while the same magnitude of loss is noticed between 12.0 and 13.0 years. The decline of fat thickness particularly in the upper arm, between 12.0-14.0 years clearly reflects thinning of the fat layer which has concomitantly occurred due to increased adolescent growth in height, as observed in the present sample of boys by Pakrasi et al. (1988).

Data in table 4 show that mean supra-iliac skinfold thickness manifests in general, an upward trend from 7.0 to 12.0 years. Between 12.0 to 13.0 years a decline in the form of a clear plateau is noticed (fig. 4). Thereafter it records a rise at 14.0 years followed by a decline at 16.9 years. The highest annual gain (+0.89 mm. per year) has been observed between 14.0-15.0 years the maximum annual loss (-0.51 mm. per year) is noticed between 15.0-16.0 years. Median values, do not exhibit any decline over the ages. Instead the values remain constant between 7-9, 10-11, 12-13 and 15-16 years, although the overall increasing trend is noticed between 7.0 to 16.0 years. The maximum annual gain of 0.5 mm. is noticed between 9.0 to 10.0 as well as 14.0 to 15.0 years.

DISCUSSION

While comparing our results with those of the previous growth studies on Indian children, we must take into account the underlying differences with respect to the statistical design, experimental methodology and analysis used in the various studies,

The Calcutta boys have been found to have larger chest circumference than the average Indian boys (ICMR 1972) belonging to 'Socio-economic class 1', at all ages. But their larger chest circumference than the high altitude Gaddi boys (Singh 1980) needs further explanation since all high altitude populations tend to have larger chest circumference than those of the plains. But the Patiala boys (Singh et al. 1987) and the Hindu Khatri boys (Singh 1970) do not exhibit a consistent trend with the Bengali boys during comparable ages (fig. 1).

The Punjabi Hindu Khatri boys (Singh 1970) manifested the highest mean annual increments in chest circumference two years earlier (i.e., 11-12 years) than the Bengali boys followed by the Assamese Brahmin (Das and Das 1969) and Maharastrian boys (Sharma 1970) who have shown it only one year before (i.e., 12-13 years).

The Patiala boys from Punjab (Kansal et al. 1982) have smaller calf circumference than the Calcutta boys during 12-15 years and they achieve its highest mean annual gain of 3.4 cm. two years later, i.e., 15-16 years than the Calcutta boys, who, however, show a significantly lower peak value of 1.4 cm between 13-14 years. Gaddi boys (Singh 1980) and Hindu Khatri boys (Singh 1970) have smaller calf circumference than the Calcutta boys while the Assamese boys (Das and Das 1969) do not show parallel results (fig. 2). Punjabi Singh, 1970) and Assamese boys (Das and Das 1969) have achieved highest annual increments for this dimension two years before the Calcutta boys i.e., in 11-12 years while the Gaddi boys of Himachal Pradesh (Singh 1980) are two years behind i.e. 15-16 years.

The occurrence of 'preadolescent fat wave' reported by Falkner (1975) and the adolescent loss of fat in trunk and in arm as recorded in Cronk et al. (1983) and Wit et al. (1984) confirm the present findings. The greater deposition of subcutaneous fat in trunk than limb (as observed in the means and medians of supra-iliac in comparison to biceps) from 13.0 years onwards (tables 3 and 4) appears to have indicated a "centripetal distribution" of body fat of males as reported also by Mueller (1982) and Baumgartner et al. (1986).

With respect to accumulation of subcutaneous fat at the biceps, the Calcutta boys have manifested greater values than both the Gaddi boys of Himachal Pradesh (Singh 1980) and Faridabad boys of rural Haryana state (Sood and Kapil 1984). Similarly in the lower trunk site (supra-iliac) the Bengali boys have shown greater deposition of subcutaneous fat than both the Punjabi (Singh et al. 1987) and the Haryanvi boys (Sood and Kapil 1984) during the comparable ages.

The results generated in this paper can therefore be utilized as reference material for the urban middle Bengali boys. Goldstein and Tanner (1980) have recently pointed out that the findings obtained from such studies would be useful as an alternative to the growth standard.

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