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Original Research Article

Body physique in Bengali adolescent boys from west Tripura district, Tripura, India.

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Abstract: In this study an attempt has been made to grow information on age differences in body physique among Bengali boys from rural areas of West Tripura district, Tripura during adolescent growth period. Cross-sectional data on 247 Bengali boys aged 8+ to 16+ years were collected using multistage cluster sampling method. Anthropometric somatotyping, the method forwarded by Heath and Carter, is followed in the present study. Descriptive statistics for all ten anthropometric measurements shows increasing trend with age. The results suggest that the Bengali boys are predominately ectomorphic in their body physique. Mean somatotype of Bengali boys were 2.14–3.83–4.27. During the nine years there was an overall increase of 0.22 units in endomorphy, 0.17 units in ectomorphy, and a decrease of 0.3 units in mesomorphy. Highest percentage of Bengali boys were mesomorphic ectomorph. Majority of the somatotype categories are in the field of somatochart where ectomorphy dominates, thus reflecting their relative linearity or slenderness.

Key Words: Body physique; Ectomorphy; Bengali boys; Tripura; India.

INTRODUCTION

The concept of human physique and its quantification was critically studied by Sheldon[1] and its modern methods are devised by Heath and Carter[2], which has found wide applications throughout the world. A somatotype is a convenient shorthand descriptor of overall physique in terms of body shape and composition independent of body size[3]. Somatotyping is a well-established and excellent tool to explore the spatial and temporal variations in human body form and to monitor the human body physique[3,4,5]. It can be used to record changes in physique and to estimate gross biological differences and similarities among human beings.

Three basic components of physique are endomorphy, mesomorphy and ectomorphy. Each individual has varying degrees of development of these three components. Investigators suggested that adults' physique and body dimension were influenced by various factors, such as genetic factors, diet, environment, occupation and physical activity[2,6,7]. The differences in physique between populations in different regions were of importance, especially to underlie the cultural differences between populations[8]. Somatotypes vary between population groups as well as during growth in the same population[9, 10, 11].

In the north-eastern part of India very few studies have been done on the somatotype of children and adolescents[12, 13,14,15,16]. Report on the physique of the Bengali children and adolescents of Tripura are rare. Moreover, studies on variation in body physique of the Bengali populations from the other parts of India are also limited. The present study aims to delineate age changes in body physique and its three components, viz., endomorphy, mesomorphy and ectomorphy among rural Bengali boys from West Tripura district, Tripura in the adolescent age range of 8+ to 16+ years.

MATERIALS AND METHODS

Study population

The Bengalis belongs to Indo-Aryan linguistic family. Ethnically, the Bengali population is a heterogeneous group comprising of the Caucasoid, Proto Australoid and Mongoloid strains[17]. In India, they are primarily concentrated in the state of West Bengal and Tripura. Bengalis represent almost 70% of Tripura's total population.

Study area

Tripura is the second smallest state of north-eastern part of India. Tripura is a land-locked state, bounded on three sides by Bangladesh. It has a total area of 10451 sq. km. 60% of the total area consists of hilly land while the

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remaining 40% constitute flat land. Along with numerically major Bengalis, more than nineteen classified tribes and ethnic groups with diverse languages and cultures reside in the state[18].

The Sample

Two hundred and forty-seven (247) Bengali boys in the age group of 8+ to 16+ years were selected for the present study. Data were collected from Government schools located in rural areas of West Tripura districts of Tripura. Sampling strategy applied here was the multistage cluster sampling method. Date of births of subjects were collected from the school registers, and confirmed from the subjects. Age was recorded in complete years; those who had completed 8 years of age but were less than 9 years were grouped under 8+ age group[19].

Anthropometric somatotyping

Ten anthropometric measurements were taken following the internationally accepted standards[20]. Barefoot height was measured to the nearest 1 mm with an anthropometer, body weight with minimal clothing was measured to the nearest 0.5 kg in a weighing scale, and skinfolds were measured in triplicate using a Holtain skinfold caliper to the nearest 0.1 mm on the right side of the body. Bone diameters were obtained by means of a sliding caliper and recorded to the nearest 1 mm. Upper arm fully flexed girth was measured to the nearest 1 mm with a flexible steel tape. Medial calf girth was measured at the greatest circumference. All the measurements were taken within the schools by the trained author. Anthropometric somatotyping was done with the help of all the measured anthropometric variables using Heath and Carter's anthropometric somatotype method[2].

Endomorphy: As the first component of physique, endomorphy represents the relative fatness in an individual's physique. It was calculated using the following equation:

$$\textbf{Endomorphy} = -0.7182 + 0.1451\,(X) - 0.00068(X)^2 + 0.0000014\,(X)^3$$

Where, X is the sum of skinfolds at triceps, subscapular and suprailiac.

Mesomorphy: The second component of physique, mesomorphy represents the relative musculo-skeletal development per unit of length. It was calculated using the following formula:

Mesomorphy = (0.858* Bicondylar humerus + 0.601*Bicondylar femur + 0.188* Corrected arm girth +0.161* Corrected calf girth) – (Height* 0.131) + 4.50.

Where, corrected upper arm girth = upper am Circumference (in cm) – Triceps skinfold (in mm)/10; and Corrected Calf girth = Calf circumfence – Calf skinfold/10

Ectomorphy: The third component of physique, ectomorphy refers to the relative linearity of individual physique. It was calculated using the following formula. Before calculating ectomorphy, Height-weight ratio (HWR) was calculated using the following equation:

HWR = Height / $\sqrt[3]{\text{weight}}$

When HWR ≥ 40.75, then

Ectomorphy = HWR * 0.732 – 28.58

When HWR< 40.75 > 38.25, then

Ectomorphy = HWR * 0.463 – 17.63

When HWR ≤ 38.25, then

Ectomorphy = 0.1

Using the formula given by Carter[21], Individual somatotypes were plotted on a somatochart by calculating values of X and Y-axis.

X = Ectomorphy - Endomorphy

Y = 2 * Mesomorphy - (Endomorphy + Ectomorphy)

The values thus obtained were plotted on a two- dimensional somatochart. Individual Somatotypes of Bengali boys were classified into thirteen categories following Carter's classification[21]. Also age group wise mean somatotypes were identified in different categories.

Ethical consideration

The procedures followed were in accordance with the Helsinki Declaration of 1964, as revised in 2000[22]. The study was approved by the Institutional Ethical Committee, Tripura University. Necessary approval was obtained from the school authorities prior to the beginning of the study. Informed consent was also obtained from all of the participants.

Data analysis

The technical error of measurement (TEM) for intra-observer measurements was calculated and was found below the maximum acceptable TEM reference values[23]. Descriptive statistics were calculated for three

somatotype components, height, weight, bicondylar breadths of humerus and femur, flexed upper arm & medial calf girths and skinfolds at four sites using Microsoft Excel 2010 software.

RESULTS

Descriptive statistics for height and weight of Bengali boys shows increasing trend with age (Table 1). Similar trend is observed for other anthropometric measurements. Soft tissue related measurements shows irregular pattern after 12 years of age, by and large, shows a general increasing trend. In somatotype characteristics, Bengali boys were found to be predominately ectomorphic in their body physique (Figure 1). Dominance of ectomorphic component among Bengali boys is also apparent from the somatochart (Figures 2). Of the other two components of somatotype, mesomorphy dominates endomorphy. This trend is observed across all the age groups.

Distribution of Bengali boys in various somatotype categories indicates a substantial concentration around ectomorphic and mesomorphic components (Table 2). Highest percentage of Bengali boys were mesomorphic ectomorph (48.58%), followed by mesomorph-ectomorph (17.41%) and ectomorphic mesomorph (10.53%), suggesting Bengali boys to have linear physique. A sizable number of them are either endomorphic mesomorph (7.69%) or balanced mesomorph (6.88%). Thus, Bengali boys are generally linear with a tendency towards linear-muscular physique.

Table 1: Descriptive statistics of anthropometric measurements in Bengali boys.

Measurements		Age in years								
		8+	9+	10+	11+	12+	13+	14+	15+	16+
Height	Mean	124.2	128	132.2	138	144.5	152	158.8	160.4	163.8
	SD	4.33	3.85	4.79	7.4	9.12	7.53	7.73	7.08	5.98
Weight	Mean	21.67	23.34	26.12	30.24	35.13	38.1	45.17	45.11	48.94
	SD	3.21	3.18	2.41	6.18	10.35	7.79	7.79	7.47	6.72
Flexed upper arm girth	Mean	18.44	18.56	19.84	20.64	21.82	22.71	24.61	24.76	26.3
	SD	1.71	1.75	1.21	2.06	3.06	2.46	2.22	2.52	2.21
Calf girth	Mean	23.44	24.26	25.07	26.4	28.1	28.92	31.02	30.49	31.34
	SD	1.59	1.47	1.33	2.46	3.35	2.52	2.56	2.51	2.28
Bicondylar humerus	Mean	4.96	5.04	5.25	5.52	5.89	6.17	6.35	6.41	6.42
	SD	0.28	0.24	0.19	0.37	0.5	0.44	0.31	0.39	0.31
Bicondylar femur	Mean	7.4	7.6	7.84	8.21	8.45	8.75	8.96	8.84	8.94
	SD	0.41	0.25	0.32	0.53	0.59	0.47	0.43	0.37	0.41
Triceps shinfold	Mean	6.36	6.84	7.71	8.2	8.58	7.35	8.68	7.07	7.75
	SD	2.26	2.21	2.44	3.8	4.04	2.55	4.63	2.67	3.93
Subscapular skinfold	Mean	4.8	5.3	5.61	6.57	7.68	6.44	7.77	7.53	8.26
	SD	1.2	1.78	1.44	2.73	4.02	2.11	2.75	2.06	2.46
Suprailiac skinfold	Mean	3.36	3.8	4.12	5.22	5.42	4.69	5.34	4.54	5.16
	SD	0.83	1.31	1.41	2.79	3.11	1.59	2.15	1.36	2.61
Medial calf skinfold	Mean	6.09	6.46	7.57	8.33	9.21	8.15	8.97	7.5	7.51
	SD	1.78	2.05	1.85	2.74	4.07	2.1	3.87	2.28	3.02

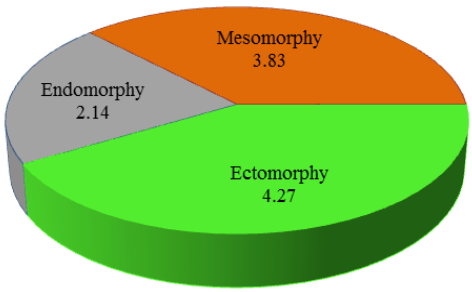

Figure 1: Somatotype components among Bengali boys.

The mean somatotypes of rural Bengali boys from West Tripura district were found 1.9-3.95-4.13 at 8+ years and 2.12-3.65-4.30 at 16+ years of age (Table 3). During these nine years there was an overall increase of 0.22 units in endomorphy and 0.17 units in ectomorphy, but an decrease of 0.3 units in mesomorphy. All the three ratings change with age during adolescence (Figure 3). The mean endomorphy increases up to the age of 12+ years and there after shows irregular pattern. Mean ectomorphy shows no regular pattern, but overall increasing from 4.13 at age 8+ to 4.30 at age 16+ years. While the mean mesomorphy shows an overall decreasing pattern. The maximum and minimum mean values of endomorphic component has been seen at 12+ years (2.47) and 8+ years (1.9) respectively. Maximum mean mesomorphic rating, 4.02, was found at 12+ years, and minimum rating of 3.61 at 15+ years. Maximum ectomorphic

values of 4.66, was found at 13+ years and the minimum (4.03) at 11+ years of age. The somatoplot of mean somatotypes were plotted in the mesomorphic ectomorph region of the somatochart. The average somatotype for rural Bengali adolescent boys was 2.14-3.83-4.27.

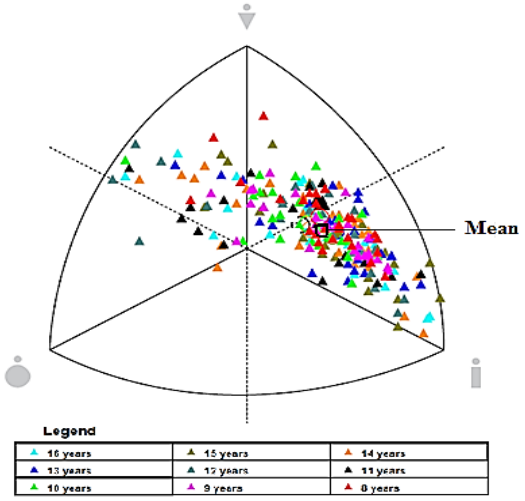

Figure 2: Somatochart of Bengali boys.

DISCUSSION

The age-related changes in physique of Bengali boys were more marked for ectomorphy. Endomorphy and mesomorphy component showed comparatively lower rating during the age group from 8+ to 16+ years. No characteristic change corresponding to adolescent growth spurt has been observed. There is also an indication that the three components of body physique do not vary on regular basis with age. This finding was supported by some other studies[24,25,26]. Since endomorphy refers to relative fatness and ectomorphy is largely based on the height/weight relationship which would also be influenced by fat as a component of weight, low ratings for endomorphy and high ratings for ectomorphy would be expected in the Bengali boys of Tripura. The tendency towards higher ectomorphic ratings among the Bengali boys could also be explained that they may have experienced caloric inadequacy in their diets along with lower physical activity, thus, exhibiting greater linearity. Several studies[27, 28, 29] have been reported the relationship between the socioeconomic status, diet and the individual's physical activity. Low endomorphy with high ectomorphic component results into large amount of body surface area. It helps to dissipate greater amount of heat through evaporation, especially in tropical environmental conditions where this population inhabits.

Table 2: Incidence of occurrence of Bengali boys in different somatotype categories.

Somatotype category	No.	%
Mesomorphic endomorph	1	0.4
Mesomorph-endomorph	6	2.43
Endomorphic mesomorph	19	7.69
Balanced mesomorph	17	6.88
Ectomorphic mesomorph	26	10.53
Mesomorph-ectomorph	43	17.41
Mesomorphic ectomorph	120	48.58
Balanced ectomorph	6	2.43
Central	9	3.64
Total	247	100

Table 3: Mean and standard deviation (SD) of somatotype characteristics of Bengali boys.

Age (years)	Endomorphy	Mesomorphy	Ectomorphy
	Mean ± SD	Mean ± SD	Mean ± SD
8+	1.90 ± 0.61	3.95 ± 0.72	4.13 ± 1.02
9+	2.04 ± 0.70	3.78 ± 0.56	4.30 ± 1.06
10+	2.20 ± 0.73	3.90 ± 0.61	4.09 ± 0.95
11+	2.39 ± 1.09	3.93 ± 0.72	4.03 ± 1.19
12+	2.47 ± 1.15	4.02 ± 0.92	4.12 ± 1.53
13+	1.97 ± 0.68	3.81 ± 0.71	4.66 ± 1.10
14+	2.27 ± 1.08	3.83 ± 0.93	4.23 ± 1.36
15+	1.94 ± 0.66	3.61 ± 0.94	4.56 ± 1.36
16+	2.12 ± 0.99	3.65 ± 0.85	4.30 ± 1.44
Total	2.14 ± 0.85	3.83 ± 0.77	4.27 ± 1.22

When somatotypes were grouped according to component dominance into different somatotype categories, it was found that a small segment (0.4%) of the boys has fall under mesomorphic endomorph. Five somatotype categories, viz., endomorphic mesomorph, balanced mesomorph, ectomorphic mesomorph, mesomorph-ectomorph and mesomorphic ectomorph, were found in all the age classes of the Bengali boys. Somatotype category mesomorphic endomorph was found only in 12+ year age. No boys were found to fall under four somatotype categories, viz., endomorph-ectomorph, ectomorphic endomorph, balanced endomorph, and endomorphic ectomorph.

Our studied rural Bengali boys from West Tripura District have been compared with tribal boys reported from the same region. The present Bengali boys are more endomorphic and ectomorphic but less mesomorphic than rural tribal school boys of West Tripura district of Tripura[16]. This inter-population variation in body physique may be associated with differences in the ethnicity, adolescent growth spurt, dietary pattern, and physical activity level.

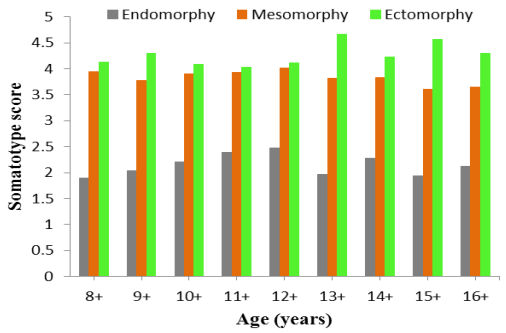

Figure 3: Mean values of somatotype components score in Bengali boys

CONCLUSION

From the above results, it can be concluded that the age-related changes in physique of Bengali boys were more marked for ectomorphy. Rural Bengali boys were showing generally linear physique with a tendency towards linear-muscular physique. Factors like socio-economic status, dietary pattern and physical activity may be playing an essential role in these boys. However, future study covering more study area and including girls across the adolescent age groups would provide clearer picture regarding the sex differences and the effect of different factors on the variation of physique of Bengali population from Tripura.

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