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Somatotypes of the Affluent and Non-affluent Meitei Boys of Manipur, India

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ABSTRACT Anthropometric somatotypes for 969 Meitei boys aged 12-18 years have been studied following the Heath-Carter method. 488 of the boys belonged to affluent families from urban areas and 481 to non-affluent families from rural areas. The affluent boys showed higher ratings of endomorphy than their non-affluent counterparts, whereas the non-affluent boys were more ectomorphs than the affluent boys. Mesomorphic ratings have no notable difference between the two groups. All the three ratings do change with age during adolescence. But no regular trend has been seen and no distinctive change corresponding to adolescent growth spurt has also been observed. The mean somatotype for the affluent boys was calculated to be 2.5 – 3.2 – 3.7 and for the non- affluent boys 2.0 – 3.1 – 4.0. The single highest somatotype category for the affluent boys was balanced ectomorph and for the non-affluent boys, mesomorphic ectomorph. In the affluent group, somatotype changed from mesomorph-ectomorph (during 12 to 15 years) to balanced ectomorph (during 16 to 18 years). The non-affluent boys belonged to mesomorphic ectomorph at all ages except at 13 and 14 years during which, they were mesomorph-ectomorph.

INTRODUCTION

The technique of somatotyping is used to reduce the many possible body measurements to a quantitative description of physique, to assess body shape and composition independent of size, and to demonstrate similarities and differences in groups. Somatotype is expressed by a three numeral rating that represents the components of endomorphy (relative fatness), mesomorphy (relative musculoskeletal robustness) and ectomorphy (relative linearity). It is viewed not as an invariant genotype, but as a description of present morphological conformation which may respond to change according to age (Heath and Carter 1971; Walker 1978), sex (Parizkova and Carter 1976; Carter and Parizkova 1978), nutrition (Malik et al. 1986), and altitude (Singh and Bhasin 1991; Bhasin and Singh 1992). Somatotype is extensively studied in relation with performance and competitive levels of athletes and non-athletes (DeGaray et al. 1974; Carter et al. 1982; Carter 1984; Bloomfield et al. 1994; Pieter and Bercades 2009). Somatotype changes during adolescence on different Indian populations of both sexes concerning varied geographical regions, urban and rural backgrounds, tribals and non-tribals, etc. have been carried out by several researchers (Singh and Sidhu 1980; Singh and Bhasin 1990, 1991; Singh and Singh 1991; Bhasin and Singh 1992; Handa et al. 1995; Ghosh and Malik 2004; Bhasin and Jain 2007; Kaur M 2009). However, there remains, still, a dearth of scientific literature on the somatotypes of different populations of north-east India. As far as the author knows, there are no extensive data on the somatotype profile of the Meitei, one of the major populations in north-east India except one reported by Gaur et al. (1999) on urban Meiteis of Imphal, Manipur. Information on the possible impact of well-off (affluent) families and low-income (non-affluent) families on the somatotype of the Meitei adolescents is so far not available. An attempt has, therefore, been made to examine the pattern of somatotypes during adolescence of the affluent and non-affluent Meitei boys of Manipur, India.

MATERIAL AND METHODS

The sample of this cross-sectional study comprised of 969 Meitei boys aged 12 – 18 years divided into 7 age classes at one year interval. 488 of the boys belonged to affluent families (urban background with high socio-economic status) and 481 to non-affluent families (rural background with low socio-economic status). These boys who were apparently healthy and free from any congenital defects had been selected from 22 randomly selected high and higher secondary schools of the four valley districts of Manipur, viz., Imphal West, Imphal East, Thoubal and Bishnupur using randomized stratified sampling technique to arrive at the final sample for the study. The arguments for this choice have been elaborated in Kalton (1983). The birth dates were obtained either from the subjects concerned or from the parents. To ensure correct age was not a problem among the Meiteis as they customarily maintain horoscope scroll, written soon after the birth of their babies. The World Health Organization (WHO 1995) defines the age of adolescence as between 10 and 18 years. Because the numbers of subjects were small in age classes of 10 and 11 years their data have been excluded for the present study. For each subject, the decimal age was calculated using decimal calendar chart given by Tanner et al. (1966).

The Meiteis are the major ethnic group living in Manipur, India and are concentrated in the four valley districts. They are predominantly Mongoloid but in no way homogenous. Caucasoid and Australoid racial elements are also found among them. The present day Meiteis are mostly Hindu by religion. Mass proselytation of the Meiteis into Hinduism during the early part of 18th century has contributed a good deal of share in the biological and cultural complexity of the present day Meiteis. Hinduised Meitei society is divisible into two main sections, such as the Brahmins and the Kshatriyas. There are, of course, sizeable numbers of revivalist who follow pre-Hindu beliefs and practices. Predominance of Caucasoid characters is observed among the Brahmins whereas the more populous Kshatriyas and others are predominantly Mongoloid. Social proscription of inter-marriage between the Brahmin and non-Brahmin is now on the wane. In the present study, the Brahmins were excluded from the sample so as to minimize racial influence in the data.

The type of schools attended by the subjects provide a basic clue to socio-economic stratification (McMurray et al. 2002; Prista et al. 2003). The parents who cannot afford to educate their children in expensive schools normally send their children to government schools which provide practically free education. Hence, it is reasonable to assume that the students of government schools are represented by those who come from lower socio-economic strata of the society. To verify this expectation, a questionnaire pro forma (Townsend et al. 1998) was completed by the parents of the subjects to assess socio-economic status indicators: educational level, occupation and income of the parents, family size, other sources of family income and the quality of health care and access to medical services. All the boys belonging to non-affluent families were born and lived in rural villages and studied in the government schools located in rural areas. The boys in the affluent group lived in the urban areas and studied in the mission schools and public schools located in urban areas. The parents of the affluent boys comprised high ranking government officers of different statuses, doctors, engineers, university/college teachers, advocates, merchants, and higher secondary and high school teachers. The parents of the non-affluent boys consisted of cultivators, primary school teachers, fishermen, carpenters, blacksmiths, retail traders, small-scale hoteliers, unskilled labourers, unemployed, low grade government employees like clerks, chowkidars, peons, and drivers, and the deceased. Diary, poultry, piggery and small scale cottage industries like handloom, handicrafts and horticulture were practiced by some parents as subsidiary sources of income. The professional situation of the parents of these two groups contrasts markedly.

Height, weight, distal humerus and femur bone diameters, biceps and calf girths, skinfolds at triceps, subscapular, calf and supraspinal sites were obtained for each subject using standard instruments and following the techniques described by Carter (1982). Barefoot height was measured to the nearest 1 mm with an anthropometer, body weight with minimal clothing was measured to the nearest 0.05 kg with a weighing scale, and skinfolds were measured in triplicate using a Harpenden caliper having a constant pressure of 10 g/mm to the nearest 0.1 mm on the right side of the body. Bone diameters were obtained in duplicate by means of a sliding caliper and recorded to the nearest 1 mm. Biceps girths were measured in duplicate to the nearest 1 mm on both the right and left arms with a flexible steel tape while the upper arms were fully flexed. Calf girth was measured in duplicate at the greatest circumference while the subject sat with his feet on the floor and the calf relaxed. In all cases of variable measurements, mean values were taken as representative. All the measurements were taken in well-lit and well-ventilated rooms within the school premises during regular school hours by the author and two trained technicians who were all acquainted with measuring procedures. There were three measurement stations that could function simultaneously. The technical error of measurement (TEM) for both inter-tester and intra-tester measurements (Cameron 1984; Goto and Mascie-Taylor 2007) were all within acceptable limits i.e. below 5% for skinfolds, and 1% for breadths and girths. Anthropometric somatotype method of Carter and Heath (1990) was used to estimate somatotype ratings. Somatotype Attitudinal Distance (SAD) and Somatotype Attitudinal Mean (SAM) were also calculated.

RESULTS AND DISCUSSION

Table 1 demonstrates that somatotype ratings, viz., endomorphy, mesomorphy and ectomorphy do change with age during 12 to 18 years in both the affluent and non-affluent Meitei boys. The age-wise somatotypes plotted onto two-dimentional somatochart indicates that the somatotypes are scattered and do not follow regular pattern (Fig. 1). Peak adolescent growth spurts pertaining to height and weight were found during 14 and 15 years in both the socio-economic groups and no distinctive change in somatotype components corresponding to adolescent growth spurt has been observed. In case of the affluent boys, maximum and minimum mean values of endomorphic component have been seen at 17 years (2.7) and 12 years (2.4) respectively. Among the non-affluent boys, maximum endomorph rating (2.2) has been observed at 14 years and minimum (1.6) at 12 years. In general, the affluent boys were more endomorphic than the non-affluent counterparts and t - values revealed statistically significant differences at all ages. Among the affluent boys maximum mean mesomorphic rating, 3.3, has been found at 12, 13, and 15 years, and minimum rating of 2.9 at 18 years. In the non-affluent boys, the maximum mesomorphic rating, 3.3, has been shown by 13 and 14 years and minimum, 2.9, by 18 years age class. Results of t - values showed significant differences in regard to mesomorphy between the two groups at the ages 12, 14, 15, and 17 years. The affluent boys have shown ectomorphic values ranging from 3.6 to 3.8 represented by the age classes 14 and 15 years (the minimum) and 12, 16, 17, and 18 years (the maximum) respectively. In this component, the non-affluent boys have displayed a maximum value of 4.3 at 12 years and minimum value, 3.8 at three age classes i.e. 13, 14, and 17 years. The non-affluent boys have larger ectomorphic values than the affluent counterparts at all ages except 17 years where equal ectomorphic rating of 3.8 has been observed in both the boys groups. Statistical differences in this component were observed at three stages – during 12, 15, and 16 years. Considering the mean of all the ages together, the ratings of endomorphy, mesomorphy, and

Table 1: Mean and standard deviation of somatotype variables of the affluent and non-affluent Meitei boys by age group and 't' value for comparison

Age (in years)	*N*	*Endo-morphy*	*t-value*	*Meso-morphy*	*t-value*	*Ecto-morphy*	*t-value*	*SAM*	*t-value*
12	AF=68NA=69	2.4±0.64 1.6±0.35	8.81**	3.3±0.36 3.0±0.30	4.19**	3.8±0.51 4.3±0.30	7.43**	0.94±0.39 0.83±0.36	1.72
13	AF=72NA=68	2.6±0.61 2.0±0.41	6.67**	3.3±0.36 3.3±0.34	0.11	3.7±0.46 3.8±0.45	1.68	1.02±0.37 0.90±0.44	1.87
14	AF=69NA=66	2.5±0.45 2.2±0.53	3.66**	3.1±0.31 3.3±0.31	2.25*	3.6±0.33 3.8±0.60	1.94	1.08±0.34 0.98±0.40	1.56
15	AF=69NA=70	2.5±0.53 2.0±0.54	4.14**	3.3±0.45 3.0±0.60	3.49**	3.6±0.63 4.0±0.66	2.38*	1.04±0.48 0.92±0.39	1.68
16	AF=72NA=68	2.5±0.63 2.0±0.47	5.51**	3.0±0.59 3.0±0.53	0.31	3.8±0.53 4.1±0.51	2.99**	0.99±0.43 0.86±0.42	1.82
17	AF=66NA=70	2.7±0.54 2.0±0.45	7.60**	3.0±0.42 3.1±0.59	2.01*	3.8±0.60 3.8±0.58	0.20	1.10±0.39 0.99±0.38	1.57
18	AF=72NA=70	2.5±0.47 2.0±0.45	6.30**	2.9±0.56 2.9±0.51	0.07	3.8±0.49 3.9±0.48	1.09	1.08±0.33 1.02±0.39	0.95
Total	AF=488NA=481	2.5±0.63 2.0±0.49	15.78**	3.1±0.48 3.1±0.49	0.27	3.7±0.52 4.0±0.55	6.66**	1.04±0.45 0.92±0.41	4.27**

AF = Affluent Meitei boys; NA = Non-affluent Meitei boys; $p < 0.05$*; $p < 0.01$**

ectomorphy among the affluent boys were found to be 2.5, 3.2, and 3.7 respectively while those of the non-affluent boys were 2.0, 3.1, and 4.0 in the same order. Virtually no differences were noted in mesomorphy between the two groups. Differences in endomorphy and ectomorphy were significant. The average somatotype of the affluent Meitei boys was categorically mesomorph-ectomorph (2.5 – 3.2 – 3.7) whereas that of the non-affluent Meitei boys was mesomorphic ectomorph (2.0 – 3.1 – 4.0). In the affluent boys, somatotype has changed from mesomorph-ectomorph during 12 to 15 years, to balanced ectomorph during 16 to 18 years. The non-affluent boys, on the other hand, belonged to mesomorphic ectomorph at all ages except 13 and 14 years during which, they were mesomorph-ectomorph.

Single component analyses, however, fails to take into account component dominance. Three-dimensional analysis of somatopoints rectify this shortcoming. In three-dimensions, the distance between any two somatopoints is called the somatotype attitudinal distance (SAD), while the average distance of each point from the mean is known as the somatotype attitudinal mean (SAM). Two groups of the boys classed by age did not differ from each other with regard to the dispersion about their means (SAM). But when total samples were considered, the differences between the SAMs were significant. Three levels of homogeneity were established by Carter et al. (1997): elevated distance, SAM ≥1.0; moderate distance, SAM = 0.80 – 0.99; and reduced distance, SAM ≤ 0.79. Among the affluent boys, 37.1% of cases were classified as elevated distance, 57% of cases as moderate distance, and 5.9% of cases as reduced distance, whereas among the non-affluent boys, 30.7% of the cases were classified as elevated distance, 43.2% as moderate distance, and 26.1% as reduced distance.

In addition to gross body typing, the somatotypes were grouped according to component dominance into different somatotype categories (Carter et al. 1982) and are presented in Tables 2 and 3. In the tables, low frequencies in adjacent categories on the somatochart were combined for a better summary. The mesopenic categories – ectomorphic endomorph, endomorph-ectomorph, and endomorphic ectomorph – were pooled into a single category and mesomorph – endomorph and endomorphic mesomorph were combined as endo – mesomorph category. Two of the somatotype categories, viz., balanced endomorph and mesomorphic endomorph have, however, been excluded from the tables, due to non-availability of any individual belonging to these categories. Two somatotype categories, viz., mesomorphic ectomorph and balanced ectomorph were dominantly found at all ages of the affluent boys. Forty-two percent of the affluent boys were either mesomorphic ectomorphs or balanced ectomorphs, but the single highest category was the balanced ectomorph in which 25.6% of the affluent boys fell. Three somatotype categories, viz., mesomorph-ectomorph, mesomorphic ectomorph, and balanced ectomorph were found in all the age classes of the non-affluent boys, and frequency of mesomorphic ectomorph dominated over those of other categories in all ages. While 92.1% of the non-affluent boys were classified into categories 2 through 6, representing some combination of mesomorphic and/or ectomorphic dominance, only 72.1% of the affluent boys were so classified. The single highest category (47.6%) for the non-affluent boys fell into the mesomorphic ectomorph with only 3.7% of them in the endo - mesomorph and mesopenic categories together. It is noteworthy that frequency of mesomorphic ectomorph of the non-affluent boys outnumbered that of the affluent boys in all ages.

A difference of 0.5 unit in somatotype rating is considered to be of practical significance (Bailey et al. 1982). Using this criterion, the present non-affluent boys are less endomorphic than the affluent boys. However, these two groups are statistically different in endomorphy and ectomorphy components in most of the age classes. Two nested factors (rural – urban background and socio-economic condition) are responsible for variation of somatotype components. Similar trends were reported by Rahmawati et al. (2004) among Javanese adolescents of Indonesia and Pelin et al. (2010) among adolescents living in the city of Ankara, Turkey. These observations are predictable because the affluent boys from urban areas can afford good nutrition and enjoy optimum living conditions than their less privileged coevals of non-affluent families from rural areas. Comparatively, higher rate of consumption of protein and fat-rich foods coupled with less physical activities is the possible reason for heavier adipose tissue and consequently more endomorphic ratings of the affluent boys than non-

Table 2: Distribution of somatotype categories of the affluent Meitei boys of Manipur, India

Somatotype category	12 yrs		13 yrs		14 yrs		15yrs		16 yrs		17 yrs		18 yrs		12-18 yrs	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
1	4	5.9	3	4.2	-	-	3	4.4	3	4.2	2	3.0	-	-	15	3.1
2	6	8.8	9	12.5	3	4.4	9	13.0	6	8.3	4	6.1	3	4.2	40	8.2
3	6	8.8	18	25.0	9	13.0	9	13.0	6	8.3	-	-	3	4.2	51	10.5
4	8	11.8	-	-	21	(30.4)	3	4.4	3	4.2	14	21.2	6	8.3	55	11.3
5	18	(26.5)	3	4.2	6	8.7	18	(26.1)	15	20.8	6	9.1	15	20.8	81	16.6
6	14	20.6	24	(33.3)	15	21.7	12	17.4	12	16.7	24	(36.4)	24	(33.3)	125	(25.6)
7	6	8.8	6	8.3	9	13.0	15	21.7	24	(33.3)	8	12.1	15	20.8	83	17.0
8	6	8.8	9	12.5	6	8.7	-	-	3	4.2	8	12.1	6	8.3	38	7.8
Total	68	100.0	72	100.0	69	99.9	69	100.0	72	100.0	66	100.0	72	99.9	488	100.1

1 = Endo – mesomorph 2 = Balanced mesomorph 3 = Ectomorphic mesomorph 4 = Mesomorph – ectomorph 5 = Mesomorphic ectomorph 6 = Balanced ectomorph 7 = Mesopenic 8 = Central
Values in parentheses indicated highest incidence of occurrence.
Underlined values indicated second highest incidence of occurrence

Table 3: Distribution of somatotype categories of the non-affluent Meitei boys of Manipur, India

Somatotype category	12 yrs		13 yrs		14 yrs		15yrs		16 yrs		17 yrs		18 yrs		12-18 yrs	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
1	-	-	-	-	6	9.1	-	-	2	2.9	2	2.9	2	2.9	12	2.5
2	-	-	4	5.9	6	9.1	8	11.4	2	2.9	2	2.9	4	5.7	26	5.4
3	-	-	8	11.8	6	9.1	6	8.6	-	-	8	11.4	4	5.7	32	6.7
4	9	13.0	20	29.4	10	15.2	12	17.1	16	23.5	14	20.0	10	14.3	91	18.9
5	57	(82.6)	28	(41.2)	24	(36.4)	18	(25.7)	34	(50.0)	30	(42.9)	38	(54.3)	229	(47.6)
6	3	4.4	4	5.9	8	12.1	18	(25.7)	12	17.7	10	14.3	10	14.3	65	13.5
7	-	-	-	-	2	3.0	6	8.6	2	2.9	2	2.9	2	2.9	14	2.9
8	-	-	4	5.9	4	6.1	2	2.9	-	-	2	2.9	-	-	12	2.5
Total	69	100.0	68	100.1	66	100.1	70	100.0	68	99.9	70	100.2	70	100.1	481	100.0

1 = Endo – mesomorph 2 = Balanced mesomorph 3 = Ectomorphic mesomorph 4 = Mesomorph – ectomorph 5 = Mesomorphic ectomorph 6 = Balanced ectomorph 7 = Mesopenic 8 = Central
Values in parentheses indicated highest incidence of occurrence.
Underlined values indicated second highest incidence of occurrence.

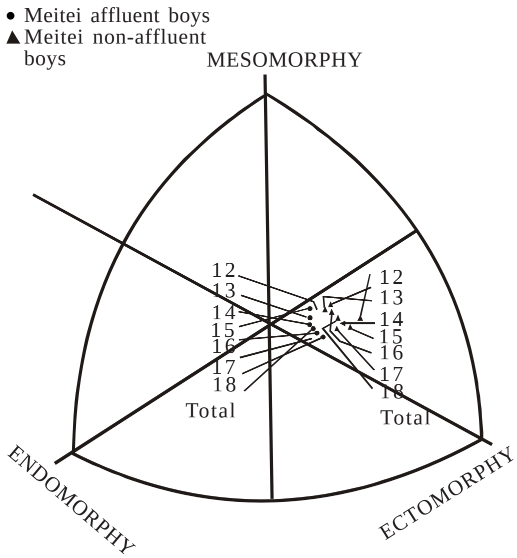

Fig. 1. Somatochart distribution of the affluent and non-affluent Meitei boys ranging in age from 12 to 18 years

affluent boys. 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 non-affluent boys. The tendency towards higher ectomorphic ratings among the non-affluent boys could also be explained that they have experienced caloric inadequacy in their diets, thus, exhibiting greater linearity. Several studies (Janes 1970; Wang 2001; Prista et al. 2003; Ghosh and Malik 2004; Wardle et al. 2006) have analyzed the relationship between environmental factors such as nutrition, the socio-cultural lifestyle, energy expenditure associated with physical work, and the individual's physical development and suggested that remarkable differences in body dimensions and physique existed between adolescents when their social background is dissimilar.

The age-wise somatotypes of the Meitei boys of the present study have been compared with the findings reported earlier. The Meitei boys of both affluent and non-affluent families have higher endomorphic values than the Gaddi boys of Chamba (Singh and Sidhu 1980), Dogra Brahmin (Singh and Bhasin 1990), Tibetan and Gujjars of Jammu and Kashmir (Singh and Bhasin 1991), Bodhs and Baltis of Ladakh (Bhasin and Singh 1992) and also Mina, Bhil, Garasia, Damor and Kathodi tribes of Rajasthan (Bhasin and Jain 2007) and have lower values than the Jat Sikh boys of Chandigarh (Handa et al. 1995), Sahariya tribe of Rajasthan (Bhasin and Jain 2007), Hungarians (Farmosi 1982) and Nigerian boys of Ile-Ife (Toriola and Igbokwe 1985). For endomorphy, the affluent Meitei boys show higher ratings than the Brahmin and Rajput boys of Chamba (Singh and Singh 1991) and of Sundarnagar (Ghosh and Malik 2004). The non-affluent Meitei boys, however, show lower values than them. In mesomorphic ratings, the affluent and non-affluent Meitei boys exhibit almost similar values with those of the Gaddis, Tibetans and Bodhs. They show lower values than the Brahmin and Rajput boys of Chamba and also of Sundarnagar, Dogra Brahmin, Jat Sikh, and Baltis and higher values than the Gujjars of Jammu and Kashmir and Mina, Bhil, Sahariya, Garasia, Damor and Kathodi tribes of Rajasthan, Hungarians, and Nigerians. Both the affluent and non-affluent Meitei boys have lower ectomorphic values in comparison with other Indian youths mentioned above, but they demonstrate higher values than their Hungarian and Nigerian counterparts. It has been observed that most of the Indian adolescents are concentrated in somatotype categories of mesomorphic ectomorph, mesomorph-ectomorph, and balanced ectomorph as against the Hungarian and Nigerian boys whose somatotypes are more concentrated in ectomorphic mesomorph, balanced mesomorph, and endomorphic mesomorph. It may also be noted that Jat Sikh boys of Chandigarh are endomorphic ectomorph and endomorph-ectomorph during the growth phase except at 13 years during which they belonged to balanced ectomorph. The inter-population variation in somatotype during adolescence may be associated with individual differences in the timing and tempo of the adolescent growth spurt, sexual maturation, food habits, dietary pattern and the level of habitual physical activity, especially the effects of physical training on subcutaneous fatness.

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