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Body Composition of the Meitei Boys of Manipur

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ABSTRACT The purpose of this paper is to study changes in body composition compartments of 969 Meitei boys ranging in age from 12 to 18 years. 488 of the boys belong to affluent families and 481 to non-affluent families. The affluent Meitei boys show greater fractional body masses, *viz.*, fat mass, skeletal mass, muscle mass and residual mass than their non-affluent counterparts. Peak adolescent spurt for all these fractional masses occur during 14 to 15 years in both the boys' groups. Analysis of body composition indices reveal that the affluent boys exhibited greater fat and residual masses due to which they demonstrated heavier body weight than the non-affluent boys.

INTRODUCTION

Body composition generally refers to the make up of the body in terms of the absolute and relative amounts of definable tissues. A two-compartment model divides the body into fat and fat-free compartments. A four-compartment model is also used desirably in which the body is divided into a fat portion and further subdivided the fat-free portion into skeleton, muscle and the remainder or residual mass (internal organs, nerves, blood vessels, and fluids). The ratio of these compartments varies in subjects of different occupations, age and sex. Procedures proposed for assessing body composition can be classified as either laboratory or field methods. The laboratory methods have been reviewed and discussed by Brodie (1988) and Wilmore (1992). The field methods use anthropometric measurements (girths, diameters and skinfolds) by establishing linear multiple regression equations. A number of factors may influence body composition such as exercise and physical activities (Dempsey, 1964; Parizkova, 1964), altitude (Surks et al., 1966; Bhardwaj, 1973; Bhardwaj et al., 1974; Bhasin and Singh, 1992), nutrition (Mayer, 1955; Jokl, 1964), age (Brozek, 1952; Forbes, 1976).

In the present paper, an attempt has been made to study changes in different body composition compartments during adolescent years among the affluent and non-affluent Meitei boys of Manipur, India.

The Meiteis represent the most populous community of the state of Manipur inhabiting mainly the central valley region. Racially, they are predominantly Mongoloid and linguistically belong to Tibeto-Burman family. Mass proselytation of the Meiteis into Hinduism during the early part of the 18th century has contributed a good deal of share in the biological and cultural complex of the present day Meiteis. Hinduised Meitei society is now divisible into two main sections, such as the Brahmins and Kshetriyas. There is also a group of revivalist who follow pre-Hindu beliefs and practices. They are populary known as "Meitei Marup". Predominance of Caucasoid characters is observed among the Brahmins whereas the more populous Kshetriyas and others are predominantly Mongoloid. The customary restriction of intermarriage between the Brahmin and non-Brahmin is, however, not strictly maintained and as such racial osmosis between them has been taking place sporadically. The samples for the present study were drawn from the non-Brahmin sections of the Meiteis.

MATERIAL AND METHODS

The subjects for this cross-sectional study comprise 969 male adolescents belonging to Meitei ethnic group, between the ages of 12 to 18 years. 488 of them belong to affluent families and 481 to non-affluent families. These boys have been obtained from various educational institutions of the four valley districts of Manipur, *viz.*, Imphal West, Imphal

East, Thoubal and Bishnupur. At the time of measurements, they were apparently healthy and had no known physical debility, illness and congenital defects. Anthropometric measurements were made following the techniques described by DeGaray et al. (1974) and Carter (1982). For estimation of body composition, a four-compartment model *i.e.* fat mass. skeletal mass, muscle mass, and residual mass designed by Drinkwater and Ross (1980) and further revised by Ross and Ward (1981) has been used. In this method, the Phantom stratagem as proposed by Ross and Wilson (1974) is utilised to work out fractional masses from body measurements. The Phantom is an arbitrary reference and is used as a metaphorical model. It is a calculatory device, not a norm. The Phantom standard deviation (s) are derived from coefficients of variation from large male and female samples obtained from various sources. The phantom consists of specification of lengths, breadths, girths, skinfold thicknesses and fractional masses for a unisex reference of human with stature and body mass (weight) of 170.18 cm and 64.48 kg, respectively. The subsets of variable required for estimation of the fractional masses are : (i) fat mass - triceps, subscapular, umbilical, and anterior thigh skinfolds; (ii) skeletal mass - humerus, femur and biacromial breadths, and wrist girth; (iii) muscle mass- relaxed upper arm, chest, thigh and calf girths, corrected for skinfold thickness *i.e.*[girth - (pi x nearest skinfold)/10]; (iv) residual mass - biacromial, bi-iliocristal and transverse chest breadths and antero-posterior chest depth. Individual 'z' values are obtained by using the Phantom formula, and mean 'z' values are calculated for each of the four subsets for each subject. The 'z' transformation is done according to the formula reported by Ross et al. (1982).

Five weight related body composition indices such as Weight-Fat mass index (Fat mass/ Weight x 100), Weight-Skeletal mass index (Skeletal mass/Weight x 100), Weight - Muscle mass index (Muscle mass/Weight x 100), Weight - Residual mass index (Residual mass/Weight x 100), and Stature - Weight index (Weight/Stature x 100) are also calculated for each of the subjects belonging to the relatively most matured boys of the present study *i.e.* 17 and 18 years' boys.

RESULTS AND DISCUSSION

Age-wise statistical constants of four components of body composition, such as fat mass, skeletal mass, muscle mass and residual mass are presented in tables 1 to 4. With regard to fat mass, table 1 depicts that average fat mass of the 12 years old affluent Meitei boys is 3.50 kg and that of the non-affluent boys is 2.96 kg. Hence onward, fat mass gains weight for every addition of years achieving a mean weight of 6.17 kg at 18 years among the affluent boys, and 5.58 kg among the non-affluent boys. The absolute weight gain from 12 to 18 years is slightly higher among the affluent boys (2.67 kg) than the non-affluent boys (2.62 kg). Average fat mass, considering all the ages together is 5.01 kg for the affluent boys and 4.46 kg for the non-affluent boys. Peak growth spurt of fat mass occurs at 14 to 15 years period in both the socio-economic groups (Fig. 1).

Table 1: Descriptive statistics pertaining to fat mass (kg) of the affluent and non-affluent Meitei boys by age group and 't' value for comparison

Age (in	*Meitei Affluent Boys*					*Meitei Non-affluent Boys*					*'t' value*
years)	*N*	*Mean*	±	*SE*	*SD*	*N*	*Mean*	±	*SE*	*SD*	
12	68	3.50	±	0.08	0.67	69	2.96	±	0.04	0.30	6.10 *
13	72	3.96	±	0.09	0.75	68	3.43	±	0.05	0.39	5.22 *
14	69	4.56	±	0.08	0.65	66	4.00	±	0.07	0.60	5.21 *
15	69	5.25	±	0.11	0.94	70	4.59	±	0.07	0.60	4.94 *
16	72	5.61	±	0.10	0.82	68	5.10	±	0.11	0.90	3.54 *
17	66	6.00	±	0.08	0.64	70	5.49	±	0.12	0.97	3.66 *
18	72	6.17	±	0.08	0.65	70	5.58	±	0.09	0.75	5.01 *
Total	488	5.01	±	0.05	1.20	481	4.46	±	0.05	1.17	7.22 *

* Statistically significant at 0.05 level

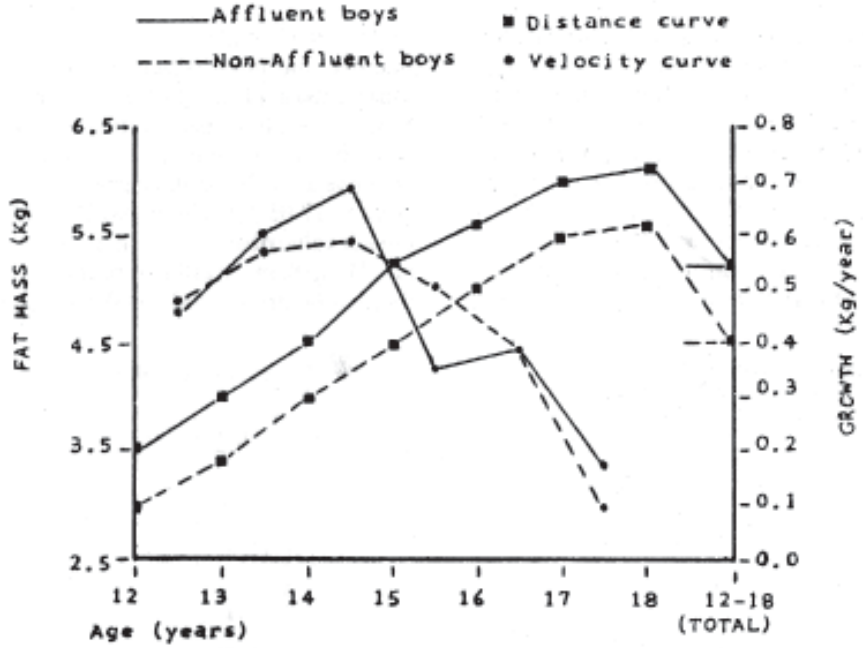

Fig. 1. Distance and velocity curves for fat mass in the affluent and non-affluent Meitei boys

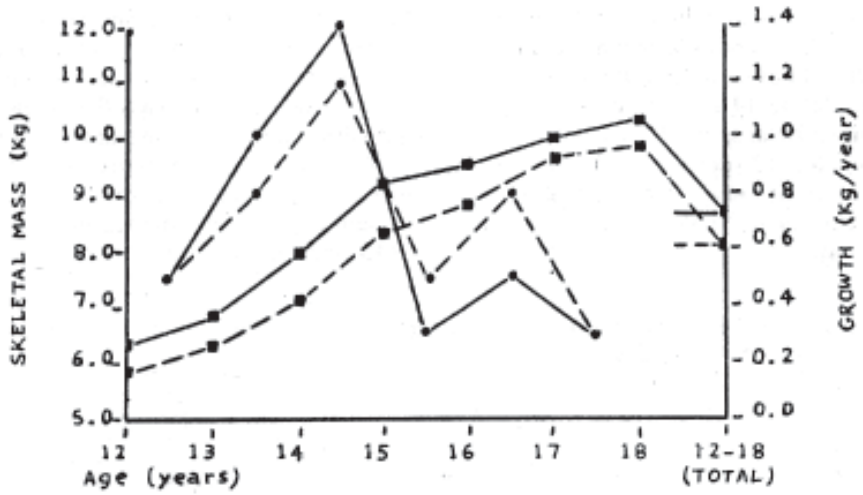

Fig. 2. Distance and velocity curves for skeletal mass in the affluent and non-affluent Meitei boys

Skeletal mass also shows a gradual increment for every successive year in both the boys belonging to the affluent and non-affluent families (Table 2). Its mean value at 12 years is 6.31 kg for the affluent boys and 5.86 kg for the non-affluent boys. Mean skeletal mass of the 18 years old affluent boys is 10.29 kg, while that of the non-affluent boys is 9.87 kg. The overall average value of skeletal mass among the affluent boys is 8.55 kg and the absolute gain during 12 to 18 years is 3.98 kg. The non-affluent boys give an average value of 7.99 kg and their absolute gain is 4.01 kg. Absolute gain from 12 to 18 years is therefore higher among the non-affluent boys than the affluent boys. Adolescent peak growth spurt occurs during 14 to 15 years in both the cases. Second growth spurt of lower intensity is noted during 16 to 17 years (Fig. 2).

Mean value of muscle mass (Table 3) for 12 years old affluent Meitei boys is found to be11.88 kg while the 18 years boys show the highest mean value of 22.03 kg. In the same manner, the non-affluent boys' lowest mean muscle mass (11.29 kg) is shown by 12 years boys and highest mean value (21.60 kg) by 18 years boys. Average muscle mass of the affluent boys is 17.72 kg and that of the non-affluent boys is 17.05 kg. The non-affluent boys show greater value of absolute gain from 12 to 18 years (10.31 kg) than the affluent boys (10.15 kg). Like those of fat mass and skeletal mass, peak growth spurt of muscle mass occurs during 14 to 15 years in both the affluent and non-affluent boys. Among the affluent boys, spurt of low intensity is again seen during 16 to 17 years (Fig. 3).

The affluent boys, as in the other cases, show greater residual mass than their counterparts the non-affluent boys at every age (Table 4). Mean value of residual mass for 12 years old affluent boys is 8.72 kg while that of the non-affluent boys of the same age group is 8.14 kg. At 18 years, mean residual mass for the affluent

Table 2: Descriptive statistics pertaining to skeletal mass (kg) of the affluent and non-affluent Meitei boys by age group and 't' value for comparison

Age (in years)	*Meitei Affluent Boys*					*Meitei Non-affluent Boys*					*'t' value*
	N	*Mean*	±	*SE*	*SD*	*N*	*Mean*	±	*SE*	*SD*	
12	68	6.31	±	0.07	0.59	69	5.86	±	0.06	0.47	2.25 *
13	72	6.79	±	0.07	0.63	68	6.34	±	0.07	0.60	4.32 *
14	69	7.81	±	0.08	0.67	66	7.08	±	0.08	0.67	6.29 *
15	69	9.17	±	0.10	0.86	70	8.32	±	0.10	0.82	6.00 *
16	72	9.49	±	0.08	0.67	68	8.78	±	0.07	0.62	6.49 *
17	66	9.99	±	0.10	0.81	70	9.57	±	0.08	0.68	3.25 *
18	72	10.29	±	0.10	0.82	70	9.87	±	0.10	0.87	3.04 *
Total	488	8.55	±	0.07	1.64	481	7.99	±	0.07	1.61	5.38 *

* Statistically significant at 0.05 level

Table 3: Descriptive statistics pertaining to muscle mass (kg) of the affluent and non-affluent Meitei boys by age group and 't' value for comparison

Age (in years)	*Meitei Affluent Boys*					*Meitei Non-affluent Boys*					*'t' value*
	N	*Mean*	±	*SE*	*SD*	*N*	*Mean*	±	*SE*	*SD*	
12	68	11.88	±	0.20	1.64	69	11.29	±	0.17	1.40	2.24 *
13	72	13.06	±	0.17	1.48	68	12.81	±	0.16	1.32	1.07
14	69	15.78	±	0.27	2.25	66	14.57	±	0.25	2.03	3.27 *
15	69	19.45	±	0.22	1.83	70	17.87	±	0.29	2.39	4.37 *
16	72	20.16	±	0.21	1.81	68	19.67	±	0.20	1.67	2.68 *
17	66	21.66	±	0.22	1.80	70	21.25	±	0.21	1.77	1.31
18	72	22.03	±	0.27	2.33	70	21.60	±	0.21	1.79	1.23
Total	488	17.72	±	0.19	4.27	481	17.05	±	0.19	4.25	2.45 *

* Statistically significant at 0.05 level

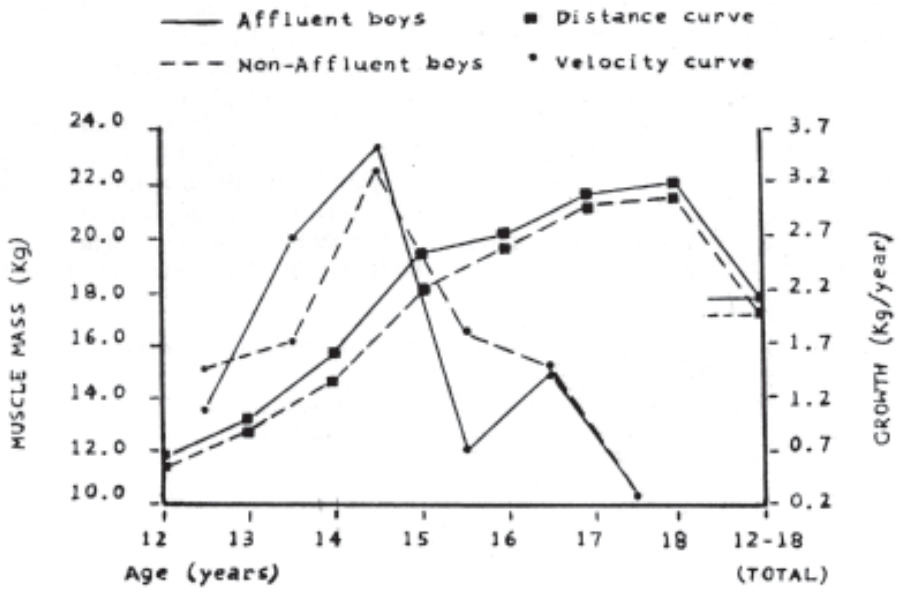

Fig. 3. Distance and velocity curves for muscle mass in the affluent and non-affluent Meitei boys

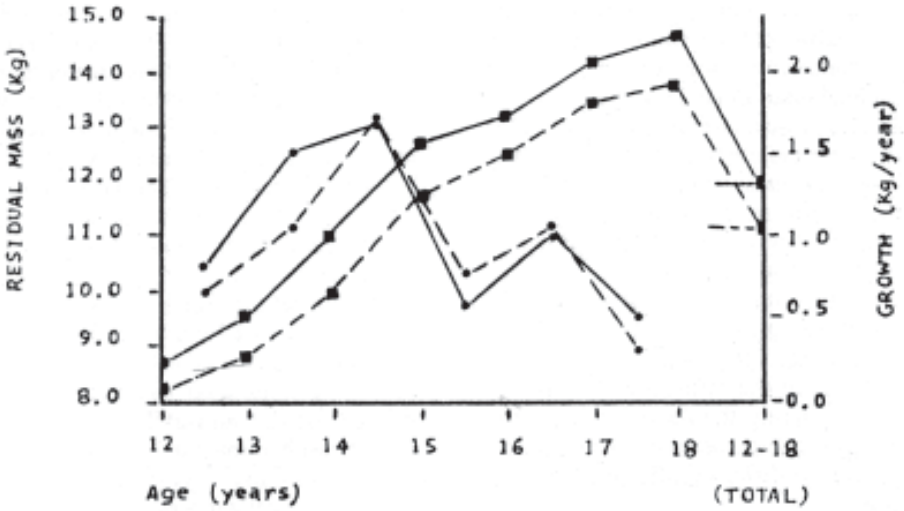

Fig. 4. Distance and velocity curves for residual mass in the affluent and non-affluent Meitei boys

boys is 14.78 kg and that of the non-affluent boys is 13.88 kg. The affluent boys display an average value of 12.05 kg, while that of the non-affluent boys is 11.25 kg. The affluent boys show higher gain of absolute growth from 12 to 18 years (6.06 kg) than the non-affluent boys (5.74 kg). Peak growth spurts for both the socio-economic groups occur during 14 to 15 years. Post peak growth spurt is also witnessed in both the groups during 16 to 17 years (Fig. 4).

Table 4: Descriptive statistics pertaining to residual mass (kg) of the affluent and non-affluent Meitei boys by age group and 't' value for comparison

Age (in years)	*Meitei Affluent Boys*					*Meitei Non-affluent Boys*					*'t' value*
	N	*Mean*	±	*SE*	*SD*	*N*	*Mean*	±	*SE*	*SD*	
12	68	8.72	±	0.11	0.90	69	8.14	±	0.09	0.78	4.05 *
13	72	9.54	±	0.11	0.96	68	8.82	±	0.09	0.70	5.03 *
14	69	11.03	±	0.13	1.09	66	9.97	±	0.13	1.02	5.77 *
15	69	12.73	±	0.12	0.99	70	11.74	±	0.13	1.05	5.69 *
16	72	13.28	±	0.09	0.77	68	12.51	±	0.09	0.74	5.99 *
17	66	14.24	±	0.14	1.16	70	13.57	±	0.13	1.07	3.44 *
18	72	14.78	±	0.17	1.43	70	13.88	±	0.13	1.09	4.19 *
Total	488	12.05	±	0.11	2.41	481	11.25	±	0.11	2.32	5.23 *

* Statistically significant at 0.05 level.

It has been observed that the affluent Meitei boys are ahead of the non-affluent boys in all the four components of body composition. However, the non-affluent boys exhibit larger increment of absolute growth for 12 to 18 years concerning skeletal mass and muscle mass, whereas reverse is true in respect of fat mass and residual mass. Differences in the three components, *viz.*, fat mass, skeletal mass, and residual mass are statistically significant at all age groups (considering the absolute value of 2 for significance at 0.05 level). Statistical similarity between the two groups of the Meitei boys is shown by muscle mass at three age stages only, *viz.*, 13, 17 and 18 years. Other age groups show statistical difference between the affluent and non-affluent boys. Considering the mean values for all the age groups together for each component, the two groups of boys differ significantly in all four components.

Statistical constants of five body composition indices along with actual body weight and calculated weight (*i.e.* sum of fat mass, skeletal mass, muscle mass, and residual mass) of the boys belonging to 17 and 18 years of age are given in table 5. The affluent boys are heavier than the non-affluent boys and the older boys are heavier than the younger ones. The average actual body weight of 17 years old affluent Meitei boys is 51.68 kg while the calculated weight is 51.87 kg. The average actual body weight and calculated weight of the non-affluent Meitei boys of the same age are 49.81 kg and 49.89 kg, respectively. The average actual body weight of 18 years old affluent boys is 53.31 kg and calculated weight is 53.46 kg. The non-affluent boys of the same age group display their average actual body weight as 50.60 kg and the calculated weight is 50.77 kg. It is observed that the calculated weight is greater than the actual body weight. The affluent boys show higher values of weight - fat mass index, weight - residual mass index and stature - weight index than the non-affluent boys. The latter, on the other hand, show larger index values of weight - skeletal mass and weight - muscle mass. This is true in both the 17 years and 18 years' groups. Average weight-fat mass index value of 17 years affluent boys is 11.61 while that of the non-affluent boys is 10.85. In the 18 years group, the affluent boys' weight- fat mass index value is 11.60 and that of the non-affluent boys is 10.63. Weight-residual mass index values of the affluent boys of 17 and 18 years are 27.43 and 27.62 respectively, while those of their respective non-affluent counterparts are 27.17 for 17 years and 27.36 for 18 years. Stature - weight index values of 17 and 18 years affluent boys are 31.62 and 32.26, respectively, while those of the non-affluent boys are 30.78 and 31.03 in the same

Table 5: Descriptive statistics of the weight and the indices : weight-fat mass, weight-skeletal mass, weight-muscle mass, weight-residual mass ans stature-weight of 17 and 18 years old affluent and non-affluent Meitei boys

Measurement/Index	*17 years*					*18 years*				
	N	*Mean*	±	*SE*	*SD*	*N*	*Mean*	±	*SE*	*SD*
Affluent Meitei Boys	66					72				
Weight (Kg)		51.68	±	0.45	3.65		53.31	±	0.52	4.42
Calculated weight* (kg)		51.87	±	0.45	3.64		53.46	±	0.52	4.43
Weight-Fat mass Index*		11.61	±	0.16	1.33		11.60	±	0.16	1.37
Weight-Skeletal mass Index*		19.26	±	0.09	0.75		19.28	±	0.08	0.70
Weight-Muscle mass Index*		41.76	±	0.18	1.49		41.55	±	0.16	1.32
Weight-Residual mass Index*		27.43	±	0.08	0.61		27.62	±	0.10	0.88
Stature-Weight Index		31.62	±	0.19	1.52		32.26	±	0.21	1.78
Non-affluent Meitei Boys	70					70				
Weight (kg)		49.81	±	0.43	3.62		50.60	±	0.41	3.40
Calculated Weight* (kg)		49.89	±	0.43	3.57		50.77	±	0.42	3.50
Weight-Fat mass Index*		10.85	±	0.20	1.66		10.63	±	0.17	1.46
Weight-Skeletal mass Index*		19.43	±	0.11	0.94		19.49	±	0.11	0.88
Weight-Muscle mass Index*		42.69	±	0.23	1.93		42.71	±	0.19	1.56
Weight-Residual mass Index*		27.17	±	0.11	0.89		27.36	±	0.11	0.94
Stature- Weight Index		30.78	±	0.20	1.65		31.03	±	0.18	1.52

* Calculated Weight = Fat mass + Skeletal mass + Muscle mass + Residual mass

order. Weight - skeletal mass index values of 17 and 18 years old non-affluent boys are 19.43 and 19.49, respectively, while those of the affluent boys are 19.26 and 19.28, respectively. Weight - muscle mass index of the non-affluent boys are 42.69 for 17 years and 42.71 for 18 years. This index among the affluent boys are 41.76 for 17 years and 41.55 for 18 years. It is evident from the value of weight- fat mass and weight - residual mass indices that heavier body weight of the affluent boys than the non-affluent boys are reasonably due to fat mass and residual mass. Greater stature-weight index values of the affluent boys are the influences of these two masses.

Individuals having the same body weight may differ from each other in terms of fat mass, muscle mass, skeletal mass, residual mass and stature. Heavier body weights of the affluent boys than the non-affluent boys are, more reasonably, due to fat mass and residual mass. This is vividly demonstrated by the indices : weight - fat mass and weight - residual mass. Greater stature - weight index values of the affluent boys are supposed to be the influence of these two fractional masses. It can be assumed that the boys of affluent families probably consume moe protein and fat-rich food stuffs such as oil, milk and its products, egg, meat, etc. than their less privileged counterparts of non-affluent families. Moreover, the affluent boys may be living more luxurious life which involves less physical activities. Comparatively higher rate of consumption of protein and fat-rich foods coupled with less physical activities is the possible reason for heavier fat mass and residual mass of the affluent boys than the non-affluent boys. Keys and Brozek (1957), Brozek et al. (1963), and Sodhi (1976) have advocated that individuals living in an active and vigorous life styles have stronger, and more supple muscles with studier physiques and less adipose (fat) tissue than those individuals who follow a sedentary existences.

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