

Somatotypes of High Altitude Spitian Boys

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ABSTRACT The present study has been conducted with the objective of exploring the age changes in somatotypes of high altitude Spitian boys. The study has been conducted on 636 Spitian boys, in the age range of 5 to 20 years during 1996-1998 from various areas of Spiti valley, Himachal Pradesh, India. The altitudes of these areas range between 3500 - 4200 metres above mean-sea-level. Body measurements taken on each subject followed a basic protocol of measurements which included weight, height, circumferences, bony diameters and skinfolds. Endomorphy, mesomorphy and ectomorphy ratings were later obtained from body measurements with the help of equations. The physique of Spitian males is found to be endo-mesomorphic at the age of 5 years which is transformed into ecto-mesomorphic at the age of 20 years. Thus a change in component dominance of somatotype takes place during the growing years in this population which means major changes taking place in the physique of the individuals. The dispersion of individual somatotypes enlarges within the somatocharts with the advancing age especially during and after the adolescence implying physiques which are highly variable.

INTRODUCTION

Somatotyping is a technique used for assessing human body physique. The term was first used by Sheldon et al. (1940) to describe physique in three numeral rating, where the first numeral represented endomorphy (relative fatness), the second numeral represented mesomorphy (relative muscularity) and the third numeral represented ectomorphy (relative linearity). The basic tenets emphasized the immutability of the somatotype. However, Walker (1978) reported from his analysis of the somatotype photographs that anybody studying the photographs of children could not predict the adult somatotype with accuracy. This has highlighted the fundamental flaw of a static constitution in somatotype as given by Sheldon and his colleagues. Since this method was based on the evaluation of nude photographs of the subjects, therefore its utility was greatly reduced. Later on Heath and Carter (1967) devised a method for assessing human physique from body measurements. This method was very easy and hence was quickly accepted by the scientific community. Many authors used this method to study age changes in the physique of children. Singh and Sidhu (1980) reported changes in the component dominance of the moderate altitude Gaddi boys of Himachal Pradesh from mesomorphic to ectomorphic component. Bhasin and Singh (1992) found that the high altitude Bodhis and Baltis of Ladakh undergo similar changes to those of Gaddi children in somatotype during the growing years. Many populations of the plains as well low

and moderate altitudes of northern India have shown transformations in somatotype with advancing age clearly reflecting somatotypes which become different as the age increases (Bhasin and Singh, 1991; Mandira, 1992; Singal and Kaur, 1993; Singal et al., 1990; Singh and Singh, 1991; Singh and Bhasin, 1990; Sidhu et al., 1982).

The high altitude Spitian children live under numerous types of stresses which include hypoxia, cold climate, higher UV radiations doses, arid and desert conditions, rough and difficult terrain. It would be interesting to find out how their physique as reflected in somatotype undergoes changes during growing years. The present study has been conducted with the objective of exploring the age changes in somatotypes of high altitude Spitian boys.

MATERIAL AND METHODS

Data on 636 Spitian boys, ranging in age from 5 to 20 years were collected during 1996-1998 from various areas of Spiti valley by PPS. The altitudes of different areas of Spiti valley which were investigated range between 3500 - 4200 metres above mean-sea-level. Body measurements taken included a basic protocol of measurements given by Heath and Carter (1967) which included weight, height, circumferences, bony diameters and skinfolds. Endomorphy, mesomorphy and ectomorphy ratings were later obtained from body measurements with the help of equations provided by Carter and Heath (1990). Somatotype

Dispersion Mean (SDM) and Somatotype Attitudinal Mean (SAM) were also calculated. SDM and SAM provide information about the dispersion of individual somatotypes from the mean somatotype for the group and is a representation in two dimensional spaces in the former and in the three dimensional space in the later. The ages of the subjects were calculated from the dates of birth which were taken from the school registers in case of school going children and from the parents of those children who did not attend the school. Age groups were formed in such a way so as the mid-point of each group coincided with the whole year figure, e.g., all subjects from 4.500 to 5.499 years were included in 5- year age group, those from 5.500 to 6.499 years in the 6- year age group and so on.

RESULTS

Table 1 of endomorphy depicts a curve of declining values from the age of 5 years to the age of 8 years. A general trend of slight increase is witnessed thereafter, however, the value of endomorphy at the age of 20 years is 1.73 which does not reach that of its value of age 5 years. In proportional terms endomorphy decreases by 56.23% at 8 years from that of the age of 5 years. Thereafter it increases only by 23.57%. It shows that the percentage increase in endomorphy between 8 and 20 years is just about one half of the decrease which took place between 5 and 8 years.

A trend similar to that of endomorphy has been observed in case of mesomorphy (Table 2). There is a sharp decrease from 6 years up to

the age of 8 years. The decline of 18.07% is observed from the age of 5 years to 8 years. As the age advances, values of mesomorphy remain almost stable till about 14 years. There is a trend of increase in mesomorphy after 15 years. At the age of 20 years it somewhat reaches at the same point as that of its values at the age of 5 years.

Table 2: Mesomorphy of Spitian males.

Age	Number	Mean	S.D.	S.E.M.	C.V.	Gain/yr.
5	37	4.04	0.52	0.09	12.87	-
6	37	4.06	0.73	0.12	17.98	0.02
7	40	3.51	0.94	0.15	26.78	-0.55
8	40	3.31	0.54	0.08	16.31	-0.20
9	36	3.40	0.69	0.11	20.29	0.09
10	36	3.31	0.79	0.13	23.87	-0.09
11	46	3.12	0.82	0.12	26.28	-0.19
12	70	3.20	1.40	0.17	43.75	0.08
13	37	3.05	0.86	0.14	28.20	-0.15
14	33	2.59	1.05	0.18	40.54	-0.46
15	38	2.90	0.93	0.15	32.07	0.31
16	45	2.91	1.40	0.21	48.11	0.01
17	40	2.92	0.92	0.15	31.51	0.01
18	38	2.94	1.18	0.19	40.14	0.02
19	33	3.33	1.18	0.21	35.44	0.39
20	30	4.02	1.20	0.22	29.85	0.69

Ectomorphy component of Spitian males shows the opposite trend to that of endomorphy and mesomorphy. It generally increases to the age of 18 years and thereafter it slightly decreases (Table 3). This shows that the children at younger age group are less ectomorphic as compared to the adults.

At the age of 5 years the value of Somatotype Dispersion Mean (SDM) is 2.32 which increases to 3.04 at the age of 20 years (Table 4). Somatotype

Table 1: Endomorphy of Spitian males.

Age	Number	Mean	S.D.	S.E.M.	C.V.	Gain/yr.
5	37	3.13	0.69	0.11	22.04	-
6	37	3.02	0.50	0.08	16.56	-0.11
7	40	2.32	0.37	0.06	15.95	-0.70
8	40	1.37	0.36	0.06	26.28	-0.95
9	36	1.40	0.35	0.06	25.00	0.03
10	36	1.50	0.46	0.08	30.67	0.10
11	46	1.49	0.54	0.08	36.24	-0.01
12	70	1.55	0.62	0.07	40.00	0.06
13	37	1.63	0.39	0.06	23.93	0.08
14	33	1.52	0.47	0.08	30.92	-0.11
15	38	1.54	0.31	0.05	20.13	0.02
16	45	1.58	0.33	0.05	20.89	0.04
17	40	1.78	0.49	0.08	27.53	0.20
18	38	1.76	0.42	0.07	23.86	-0.02
19	33	1.86	0.43	0.07	23.12	0.10
20	30	1.73	0.36	0.07	20.81	-0.13

Table 3: Ectomorphy of Spitian males.

Age	Number	Mean	S.D.	S.E.M.	C.V.	Gain/yr.
5	37	1.50	0.84	0.14	56.00	-
6	37	1.42	0.64	0.11	45.07	-0.08
7	40	1.47	1.49	0.24	101.4	0.05
8	40	2.58	1.07	0.17	41.47	1.11
9	36	2.86	0.86	0.14	30.07	0.28
10	36	2.98	1.19	0.20	39.93	0.12
11	46	3.72	0.97	0.14	26.08	0.74
12	70	3.70	1.01	0.12	27.30	-0.02
13	37	3.85	1.07	0.18	27.79	0.15
14	33	3.90	1.04	0.18	26.67	0.05
15	38	4.12	1.15	0.19	27.91	0.22
16	45	4.06	1.44	0.21	35.47	-0.06
17	40	3.82	0.81	0.13	21.20	-0.24
18	38	4.08	1.29	0.21	31.61	0.26
19	33	3.30	1.00	0.17	30.30	-0.78
20	30	3.27	1.28	0.23	39.14	-0.03

Table 4: Somatotypes, X, Y, somatotype dispersion mean and somatotype attitudinal mean, value of Spitian males.

<i>Age (yrs)</i>	<i>Endo- morph</i>	<i>Meso- morph</i>	<i>Ecto- morph</i>	<i>X</i>	<i>Y</i>	<i>SDM*</i>	<i>SAM**</i>
5	3.13	4.04	1.50	-1.63	3.45	2.32	1.06
6	3.02	4.06	1.42	-1.60	3.68	1.98	0.94
7	2.32	3.51	1.47	-0.21	1.66	2.59	1.60
8	1.37	3.31	2.58	1.02	2.25	2.31	1.07
9	1.40	3.40	2.86	1.46	2.53	2.15	0.98
10	1.50	3.31	2.98	1.48	2.15	2.72	1.26
11	1.49	3.12	3.72	2.23	1.02	2.42	1.15
12	1.55	3.20	3.70	2.15	1.14	2.77	1.32
13	1.63	3.05	3.85	2.22	0.60	2.73	1.22
14	1.52	2.59	3.90	2.47	-0.23	2.56	1.29
15	1.54	2.90	4.12	2.64	0.38	2.54	1.22
16	1.58	2.91	4.06	2.49	0.17	2.83	1.26
17	1.78	2.92	3.82	2.04	0.24	2.34	1.16
18	1.76	2.94	4.08	2.32	0.04	3.28	1.55
19	1.86	3.33	3.30	1.44	1.51	2.89	1.44
20	1.73	4.02	3.27	1.55	3.04	3.04	1.52

*Somatotype Dispersion Mean

**Somatotype Attitudinal Mean

Attitudinal Mean (SAM) of Spitian males is 1.06 which reaches a value of 1.52 at the age of 20 years. Thus there is a general trend of increase in the values of SAM and SDM with advancing age. It reflects that the dispersion of individual somatotypes enlarges within the somatocharts with the advancing age especially during and after the adolescence implying physiques which are highly variable.

DISCUSSION

The physique of Spitian males is found to be endo-mesomorphic at the age of 5 years. Thereafter it is transformed into ecto-mesomorphic at the age of 20 years. In between, from 11 to 18 years, the physique is meso-ectomorphic. Thus during the growth period under study, there has been a change in the 'component dominance' in Spitian males. The change in component dominance suggests that major qualitative changes take place in the physique of a child during the growing years. These findings of dynamic changes in the physique of boys is not unique to this population only but has been found in other populations as well. Many studies point in the direction of alteration of a general endomorphic physique of early childhood to mesomorphic and ectomorphic physique and a combination of both during young adulthood (Zuk, 1958; Hunt and Barton, 1959; Barton and Hunt, 1962; Heath and Carter, 1971; Parizkova and Carter, 1976; Walker, 1978; Singh

and Sidhu, 1980; Singh, 1989; Singal et al., 1990; Bhasin and Singh, 1992). Regarding individual variations in physique Carter and Heath (1990) suggested that majority of individual children observe significant changes in their physique during childhood and adolescence whereas some children show stable somatotypes. It has also been suggested that genetic factors are responsible for the development of endomorphy and mesomorphy but nutrition and exercise do play an important role in the fulfilment of their genetic potential. It is worth mentioning that the original concept of somatotype given by Sheldon et al. (1940, 1954, 1969) emphasize its immutability throughout the life span of an individual which is contrary to the findings reported above.

The endomorphy rating of Spitian males are similar to those of Gaddi children (Singh and Sidhu 1980) as well as Bodhs and Baltis (Bhasin and Singh, 1992) but lower than those of Manus children of Papua New Guinea (Heath and Carter, 1971). Similarly mesomorphic ratings are almost identical in the Spitian, Gaddi and Ladakhi children but the Manus children are highly mesomorphic. Spitians are not as ectomorphic as the Gaddis are, however, both of them rate higher than the Manus in ectomorphy (Table 5).

Lower endomorphy ratings found among Spitians as compared to other populations of the plains would imply relatively smaller body fat especially the adipose tissue. The high altitude cold environment would suggest the presence of

Table 5: Comparison of somatotypes of Spitian males with other population.

Age (Yrs)	Endomorphy			Mesomorphy			Ectomorphy		
	Present Study	Manus ¹	Gaddi ²	Present Study	Manus ¹	Gaddi ²	Present Study	Manus ¹	Gaddi ²
5	3.13	3.40	2.90	4.04	4.90	4.31	1.50	1.40	1.27
6	3.02	2.10	2.37	4.06	5.00	4.35	1.42	1.40	1.64
7	2.32	1.30	2.02	3.51	5.30	3.86	1.47	1.70	2.64
8	1.37	1.50	1.86	3.31	5.10	3.74	2.58	2.10	3.21
9	1.40	1.30	1.80	3.40	5.00	3.63	2.86	2.10	3.30
10	1.50	1.90	1.66	3.31	5.10	3.40	2.98	2.30	3.72
11	1.49	1.60	1.63	3.12	5.10	3.26	3.72	2.30	4.06
12	1.55	1.70	1.42	3.20	5.00	3.08	3.70	2.80	4.75
13	1.63	1.80	1.49	3.05	5.20	3.01	3.85	2.60	4.72
14	1.52	1.60	1.57	2.59	4.80	3.10	3.90	3.10	4.83
15	1.54	2.00	1.65	2.90	4.60	3.18	4.12	3.10	4.59
16	1.58	1.50	1.64	2.91	5.50	3.28	4.06	3.00	4.46
17	1.78	2.60	1.73	2.92	6.20	3.40	3.82	2.00	4.47
18	1.76	-	1.87	2.94	-	3.35	4.08	-	4.08
19	1.86	-	1.72	3.33	-	3.50	3.30	-	3.95
20	1.73	2.10	1.84	4.02	6.10	3.18	3.27	1.60	3.92

1. Heath and Carter (1971)

2. Singh and Sidhu (1980)

thicker fat folds which could act as insulators for heat loss. However, the findings are contrary to this adaptability rule. The adipose tissue would be gained only if there is a surplus of nutrient intake and a positive energy balance. But in the case of present population the nutritional stresses restrict carbohydrate and fat intake and therefore the necessary adipose tissue is not laid down in the body.

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