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PHYSIQUE IN THALASSEMIA MAJOR

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Abstract: *Physique of a sample of 97 north Indian children (30 girls and 67 boys) suffering from transfusion dependent thalassemia major and ranging in age from 4 to 15 years is described and compared with 335 (117 boys and 158 girls) normal healthy controls. Each individual was somatotyped by Heath-Carter anthropometric rating method. The overall mean somatotypes of thalassemia patients were 2.9–3.2–2.9 and 3.4–3.3–2.6 for boys and girls, respectively. One-way ANOVAs indicated significant differences between mean somatotypes of thlassemics and controls in both sexes. Component specific ANOVAs suggest that thalassemia patients of both sexes were significantly less mesomorphic than control children. Thalassemic males were significantly less endomorphic than controls. No significant differences were noticed in ectomorphy. Results indicate that thalassemia major may adversely affect the musculo-skeletal development.*

Keywords: *Physique; Somatotype; Thalassemia; Indian Children.*

Introduction

Somatotyping is a useful method to scientifically describe physique and the human body form as a whole. A somatotype is a 3 – numerical rating of the size – dissociated shape and the relative composition of physique (Carter et al. 1982). Over the years, somatotyping has become an established tool in physical anthropology, human biology, and sports sciences. It has been found useful in describing variations in human populations (Dupertuis 1963, Carter and Heath 1990), in studying the age changes in body morphology (Newman 1952, Parizkova and Carter 1976, Singh and Sidhu 1980, Bailey et al. 1982, Gaur and Singh 1997) in investigating the relationship between somatotype and occupation (Damon and McFarland 1955), physical performance of top athletes (Tanner 1964, Carter 1970, Carter et al. 1982), and growth (Petersen 1967, Clarke 1971, Heath and Carter 1971). In addition, somatotypes have also been employed to understand the relationship between physique and medical disorders, such as cardiovascular diseases (Carter et al. 1965, Seltzer 1966, Damon 1970, Stukovsky et al. 1983), Diabetes (Lister and Tanner 1955, Fredman 1972, George 1985), and genetic disorders (Buday and Eiben 1982, Eiben et al. 1985). Although a couple of studies have focused on the relationship between physique and blood disease or condition (Ansley et al. 1957, 1963), little is known about physique in thalassemia major.

Thalssemia major or homozygous β-thalassemia is characterised by an inherited defect in the β-chain synthesis of hemoglobin resulting in severe chronic hemolytic anaemia. The patients require regular blood transfusions for survival. Untreated patients develop clinical symptoms such as severe anaemia, hepatosplenomegaly, mongoloid faces, growth retardation, malnutrition and retardation in bone age, and may eventually die at a very young age (Weatherall and Clegg 1972). Though a generally retarded status is mentioned, the growth patterns of thalassemic children treated with blood transfusions have not been precisely defined (Kattamis et al. 1970). No literature is

available on physique of thalassemia major patients in India. In view of the paucity of literature on the growth patterns, in general, and somatotypes in particular, the authors investigated the physique and physical growth of transfusion dependent North Indian thalassemia major children in comparison with a sample of normal, healthy controls. In this report, however, we present data on the physique characteristics only.

Materials and methods

The present cross-sectional study is based on a sample of 97 (67 boys and 30 girls) north Indian thalassemia major patients receiving treatment at thalassemia clinic of the Post Graduate Institute of Medical Education and Research (PGI), Chandigarh. A sample of 335 (177 boys and 158 girls) normal healthy north Indian public and convent school children from Chandigarh and Ludhiana cities served as controls. All the patients included in this study were diagnosed by the PGI as suffering from transfusion dependent thalassemia major through various clinical tests, namely quantification of Hb A_2 and HbF, starch gel Hb electrophoresis for β-thalassemia trait in both parents, etc. The thalassemia clinic at PGI, Chandigarh received patients not only from the Chandigarh city but also from neighbouring states of Panjab, Haryana, Himachal Pradesh, Jammu and Kashmir, etc.

The subjects ranging in age from 4 to 15 years in case of boys and 4 to 13 years in case of girls were divided into 6 and 5 age groups of two years each for boys and girls, respectively. Thus, the first age group consisted of children with decimal age falling between 3.5 to 5.49 years.

Physique was determined through anthropometric somatotypes of each individual using the Heath–Carter somatotype method (Heath and Carter 1967). Anthropometric measurements on thalassemics were taken during 1993 by second author (PS) employing the techniques given in Carter and Heath (1990). Somatotype component ratings were calculated following the methods of Carter et al. (1983). The endomorphy rating was adjusted for stature following the recommendations of Hebbelinck et al. (1973) and Carter and Heath (1990). The individual and mean age-sex specific somatotypes were plotted on a somatoplot using X and Y co-ordinates on a superimposed grid system (Carter et al. 1983). Somatotype altitudinal distance (SAD) and somatotype altitudinal means (SAM) were computed following Carter et al. (1983).

Age and sex-specific means and standard deviations for each somatotype component for the thalassemics and the controls were determined. One-way ANOVAs were employed to test the differences between mean somatotypes of controls and thalassemics using SADs, as recommended by Carter et al. (1983). One-way ANOVAs were also used to test the significance of differences between component means of various age groups of controls and thalassemics. To data yielding significant F-ratios ($P<0.05$), Tukey test was applied to find out which means were significantly different.

Results and discussion

Table 1 shows the descriptive statistics of the three somatotype components and SAM by age and sex of transfusion dependent thalassemia major children from north India. On the average, ectomorphy showed an increasing trend with age in thalassemic boys as well as girls; the reverse was the trend in case of mesomorphy. Endomorphy

showed a fluctuating pattern and no definite trend could be noticed among thalassemic children.

Table 1: Somatotype characteristics (± SD) of north Indian children with thalassemia major

Age group (years)	N	Mean ± SD Endomorphy	Mesomorphy	Ectomorhy	SAM ± SD
		B O Y S			
4–5	12	3.58 ± 0.63	4.64 ± 0.65	1.08 ± 0.76	1.04 ± 0.49
6–7	22	2.79 ± 0.86	3.60 ± 0.78	2.27 ± 1.03	1.35 ± 0.67
8–9	11	3.00 ± 0.67	3.44 ± 1.06	2.68 ± 1.35	1.52 ± 0.82
10–11	9	2.61 ± 0.93	2.50 ± 1.19	4.39 ± 1.34	1.69 ± 0.78
12–13	7	2.71 ± 0.91	2.36 ± 0.94	4.42 ± 1.54	1.78 ± 0.48
14–15	6	2.83 ± 0.52	2.32 ± 1.08	4.67 ± 1.47	1.44 ± 1.05
Ages combined	67	2.94 ± 0.82	3.18 ± 1.20	2.85 ± 1.69	–
		G I R L S			
4–5	3	2.83 ± 0.76	4.00 ± 0.50	1.16 ± 0.57	0.87 ± 0.14
6–7	9	3.22 ± 0.75	3.39 ± 0.33	2.17 ± 0.61	0.83 ± 0.38
8–9	3	3.00 ± 0.87	3.17 ± 0.76	3.33 ± 1.15	1.31 ± 0.30
10–11	9	3.78 ± 0.97	3.11 ± 0.82	2.78 ± 0.79	1.28 ± 0.63
12–13	6	3.67 ± 0.98	3.17 ± 0.88	3.00 ± 1.34	1.56 ± 0.79
Ages combined	30	3.42 ± 0.89	3.30 ± 0.69	2.55 ± 1.03	–

The average somatotypes for the sample as a whole were 2.9–3.2–2.9 and 3.4–3.3–2.6 for thalassemic boys and girls, respectively. These are classified as central somatotypes. The mean somatotype changed from 3.6–4.6–1.1 at 4–5 years to 2.8–2.3–4.7 at 14–15 years in thalassemic boys, showing net loss of 0.8 and 2.3 units in endomoprhy and mesomorphy, respectively, and a net gain of 3.6 units in ectomorphy. In case of thalassemic girls, mean somatotype changed from 2.8–4.0–1.2 at 4–5 years to 3.7–3.2–3.0 at 12–13 years, registering a total gain of 0.9 units in endomoprhy and 1.8 units in ectomorphy, and a total loss of 0.8 units in mesomorphy. Figure 1 shows the individual somatotypes and the sex-specific means of thalassemic children plotted on a two-dimensional somatochart. The mean somatotypes of the control sample as a whole were 3.6–4.1–2.8 for boys and 3.1–4.0–3.0 for girls which could be classified as mesomorph-endomorph and central somatotypes for boys and girls, respectively.

Figure 2 shows a comparative somatochart of mean somatotypes of different age groups of thalassemic and control children. From 4 to 15 years there was a movement along the ectomorphy axis from endomorphic mesomoph sector at 4–5 years to balanced ectomorph at 14–15 years in thalassemic boys. In control boys, the mean somatotype showed a movement from endomorphic mesomorph sector at 4–5 years to balanced mesomorph sector at 14–15 years. Among thalassemia and control girls, the mean somatotype moved from endomorphic mesomorph sector at 4–5 years to central sector at 12–13 years. The differences were more evident between thalassemic and control boys as compared to girls.

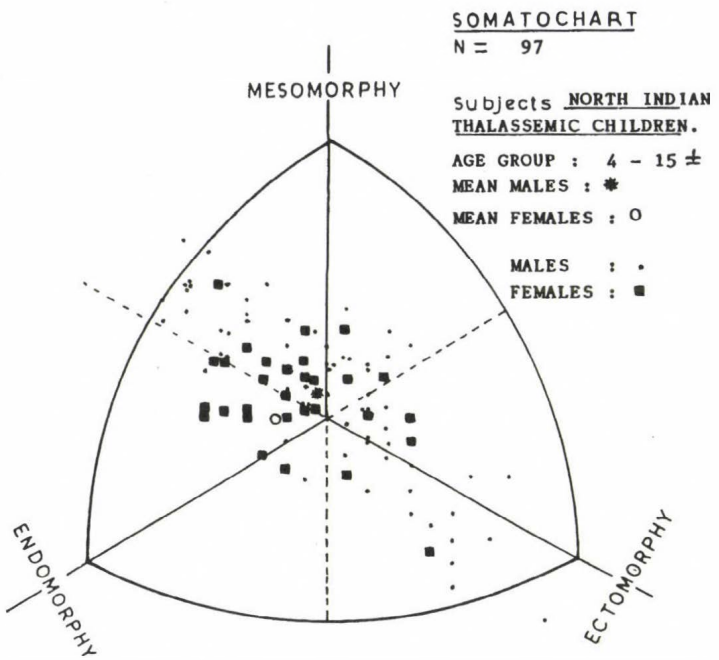

Fig. 1: Somatotype distribution of north Indian children with thalassemia major

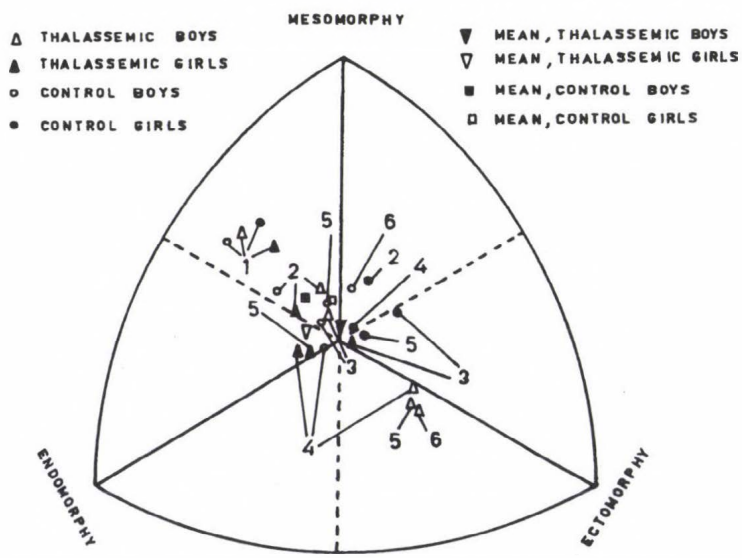

Fig. 2: Somatotype means by age and sex of thalassemia patients and normal healthy children (1 = 4-5 years; 2 = 6-7 years; 3 = 8-9 years; 4 = 10-11 years; 5 = 12-13 years; 6 = 14-15 years)

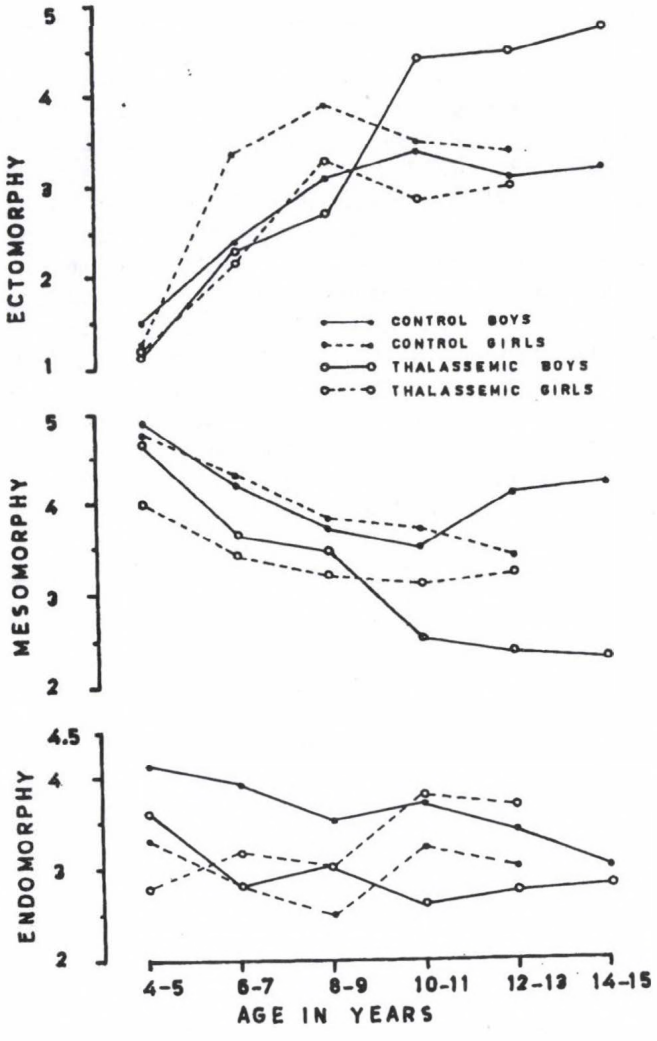

Fig. 3: Somatotype component means of children with thalassmia, as compared with that of normal healthy controls

Figure 3 shows a comparison of means of somatotype components of different age groups of thalassemic children with control children. As can be seen in the figure, control boys are more endomorphic and mesomorphic than thalassemic boys at all ages. In ectomorphy, however, boys with thalassemia major were much ahead of control boys after 8–9 years. Thalassemic girls showed greater mean values of endomorphy than control girls, except at 4–5 years. The control girls showed superior mean values of ectomorphy and mesomorphy at all ages than girls with thalassemia major. On the

whole, the control children were distinctly more mesomorphic than children with thalassemia major.

In order to find out the overall possible differences between mean somatotypes of thalassemic and control samples (Table 2), one-way ANOVAs were employed, using SADs as suggested by Carter et al. (1983). The F-ratios for boys (25.67) as well as girls (24.40) were significant $P<0.01$), indicating significant differences between mean somatotypes of thalassemia patients and normal healthy controls of both sexes. To check for possible differences between control and thalassemic children with respect to the three somatotype components, one-way ANOVAs were used for each component. The results are presented in Table 3. It is evident from the table that F-ratios were significant ($P<0.05$) for mesomorphy in both sexes and endomorphy in boys. No significant differences were found with respect to ectomorphy in boys as well as girls. Thus, thalassemic children were significantly less mesomorphic than controls and the thalassemic boys had significantly less fat reserves than control boys. Tukey test was applied to mesomorphy in both sexes and endomorphy in boys, to find out means of which age groups differed significantly. In mesomorphy, the differences were significant ($P<0.05$, 5 J, and 120df) in girls at all ages, except the oldest age group; in boys the differences were generally significant ($P<0.05$, 6 J, and 120df), except in 4–5 and 8–9 age groups. In endomorphy, means of all age groups showed significant differences ($P<0.05$, 6 J, 120df) between thalassemic and control boys.

Table 2: Somatotype characteristics (± SD) of control children

Age group (years)	N	Mean ± S.D. Endomorphy	Mesomorphy	Ectomorhy	SAM
		B O Y S			
4–5	25	4.1 ± 0.54	4.9 ± 0.51	1.5 ± 0.45	1.56
6–7	34	3.9 ± 0.40	4.2 ± 0.62	2.4 ± 0.43	0.54
8–9	29	3.5 ± 0.57	3.7 ± 0.55	3.1 ± 0.56	0.59
10–11	30	3.7 ± 0.42	3.5 ± 0.35	3.4 ± 0.39	0.93
12–13	28	3.4 ± 0.34	4.1 ± 0.43	3.1 ± 0.46	0.37
14–15	21	3.0 ± 0.72	4.2 ± 0.59	3.2 ± 0.49	0.51
Ages combined	177	3.6 ± 0.58	4.1 ± 0.39	2.8 ± 0.63	–
		G I R L S			
4–5	32	3.3 ± 0.41	4.8 ± 0.43	1.3 ± 0.47	2.07
6–7	34	2.8 ± 0.37	4.3 ± 0.53	3.4 ± 0.49	0.47
8–9	31	2.5 ± 0.58	3.8 ± 0.64	3.9 ± 0.57	1.18
10–11	28	3.2 ± 0.49	3.7 ± 0.39	3.5 ± 0.43	0.36
12–13	33	3.0 ± 0.58	3.4 ± 0.65	3.4 ± 0.61	0.64
Ages combined	158	3.1 ± 0.64	4.0 ± 0.51	3.0 ± 0.68	–

Sexual dimorphism regarding differences between thalassemic and control children was evident in endomorphy with affected boys registering significantly lesser mean endomorphy values than control boys. Does it indicate the better buffering of the female with respect to fat metabolism under stressful conditions (in this case severe hemolytic anaemia due to a hemoglobin defect)? The present investigation may point in this direction. However, the relatively smaller sample size of female thalassemics must be

kept in mind while interpreting these results. More studies based on larger samples are, thus, indicated.

Table3: Summary of ANOVAs between different components of thalassemics and controls

Component	Sex	Sources of variation	SS	df	MS	F-ratio
Endomorhy	M	Between	1.56	1	1.56	14.18*
		Within	1.12	10	0.11	
	F	Between	0.23	1	0.23	1.53
		Within	1.23	8	0.15	
Mesomorphy	M	Between	2.88	1	2.88	5.76*
		Within	4.98	10	0.50	
	F	Between	0.90	1	0.90	6.92*
		Within	1.07	8	0.13	
Ectomorphy	M	Between	0.83	1	0.83	0.56
		Within	14.80	10	1.48	
	F	Between	0.90	1	0.90	1.04
		Within	6.96	8	0.87	

* Significant difference between thalassemics and controls (P<0.05)

The results of this cross-sectional study indicate that, in spite of receiving regular blood transfusions, children with thalassemia major had significantly lesser mesomorphy ratings than normal children. The condition may, thus, adversely affect the musculo-skeletal development of thalassemia patients. Occurrence of developmental stress on the skeletal system of thalassemia patients is also supported by some previous reports which indicated that the condition leads to retardation in bone age (Erlandson 1964, Johnston et al. 1966, Weatherall and Clegg 1972) and changes in bones (Kattamis et al 1990).

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