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Biology of the Tribal Groups of Rajasthan, India: 4. Age Changes in Somatotype

M. K. Bhasin and Sweta Jain

Department of Anthropology, University of Delhi, Delhi 110 007, India

KEYWORDS Tribals. Rajasthan. Anthropometry. Somatotype

ABSTRACT The present study is based on a cross-sectional investigation on 2928 samples consisting of 1503 males and 1425 females belonging to both adolescent (8^+ to 18^+) and adult age groups (19 & above). The study was carried out on the Scheduled Tribes, namely Mina, Bhil, Sahariya, Garasia, Damor and Kathodi of Rajasthan. Samples are collected from the place of residence and schools. The data for somatotype were collected following the internationally accepted standards. The calculated somatotypes are plotted on somatochart triangle to determine their physique. Study of body physique reveals that in all the tribal groups ectomorphic component is dominant, which indicates their linear physique. This is also reflective of their overall poor conditions and undernutrition prevailing in the area. Both males and females of Bhils show least endomorphy rating i.e. lowest relative fatness and highest ectomorphy rating indicating linear physique than the other tribal groups. Distribution of somatotypes on somatochart indicates that values plotted, in all the age groups, lie in mesomorphic ectomorph or endomorphic ectomorph region, thus showing a greater linearity among the tribal groups.

INTRODUCTION

Full appreciation of the utility of anthropometry requires an understanding of the human body composition. The somatotype provides a general summary of body shape, from which estimates of body composition can be inferred. Somatotyping is a quantitative overall appraisal of body shape and composition. Somatotypes are useful for description and comparison of populations and for monitoring growth and ageing changes and changes due to exercise and physical training. A large variety of somatotype studies have yielded much useful information about human physique and characteristics associated with somatotypes. In the past thirty years increasing numbers of these have used the Heath- Carter method (Singh and Sidhu, 1980; Singal and Sidhu, 1984; Malik, 1987; Singh and Bhasin, 1990; Bhasin and Singh, 1991; Singh and Singh, 1991; Bhasin and Singh, 1992b; Singal and Kaur, 1993; Kahlon, 1994; Sidhu and Singh, 1996; Gaur and Singh, 1997).

Heath and Carter have dealt with somatotype distributions of different populations, with heritability of somatotypes, with changes of somatotype in growth and aging, with somatotypes in sports and physical performance and with medical, behavioral, occupational and other variables associated with somatotype. It can be used to record changes in physique and to estimate gross biological differences and similarities among human beings. From the beginning of somatotype research, investigators in anthropology, biology, medicine, physical education and sports sciences have shown great interest. Primarily their research has concerned methodology, population studies, growth-studies and the effects of exercise and sports on somatotype.

W.H. Sheldon introduced the concept and the word 'somatotype' in 'The Varieties of Human physique' (1940). Sheldon recognized that every individual instead of being particular type was a mixture of three basic components of physique, which he called as endomorphy, mesomorphy and ectomorphy. Sheldon stated that somatotype is a trajectory along which an individual under average nutritional conditions and absence of major illness is destined to travel. He stressed on the permanence of the physique throughout life.

The Heath-Carter method, derived from modifications and simplifications of Sheldon's system, is designed to provide an objective phenotype method. It has become the most used somatotype method. Heath and Carter gave the method of somatotyping the human physique by giving different ratings according to anthropometric measurements. They defined somatotype as 'present morphological confirmation', expressed in a three numeral rating of primary components of physique that identify individual features of morphology and body composition. Their method of somatotyping is sensitive to

changes in physique over time and is used in rating both the sexes at all ages. They recognized three basic components of physique viz., endomorphy, mesomorphy and ectomorphy. Each individual has varying degrees of development of these three components. The somatotype is always written in three numerals, first indicating the development of endomorphy, the second mesomorphy and the third ectomorphy. Endomorphy is an estimate of relative fatness and mesomorphy is an estimate of musculo-skeletal robustness per unit of height. Ectomorphy refers to the relative linearity of individual physiques. Whether the shortage of food is imposed by the harshness of the external environment, increase demands of disease or an inner compulsion towards exercise thinness, the consequences for body composition is the same-a loss of both fat and lean tissue (Keys et al., 1950).

Data on physique characteristics of Indian population is limited and only a handful of reports (Berry and Deshmukh, 1964; Singh and Sidhu, 1980; Singh, 1981; Singal and Sidhu, 1984; Singh et al., 1988; Singh and Bhasin, 1990; Bhasin and Singh, 1991; Singh and Singh, 1991; Bhasin and Singh, 1992a; Gaur and Singh, 1997; Gaur and Sarkar, 1998; Gaur et al., 1999; Gaur and Kaur, 2001) consider somatotypes. Somatotype studies were conducted on Bods of the Western Himalayas (Malik and Singh, 1978a; Malik et al., 1986a; Malik, 1987;), Gaddi Rajputs (Singh and Sidhu, 1980; Singh, 1981), Garhwali males (Gaur and Singh, 1997), Brahmin Dogras (Singh and Bhasin, 1990), Jat Sikh and Banias of Punjab (Sidhu et al., 1982; Singal and Sidhu, 1984), Jat Sikhs of Punjab (Singal and Kaur, 1993), Jats of Delhi (Gakhar and Malik, 2002), Punjabis (Kahlan, 1994), Rajput and Brahmins of Chamba, Himachal Pradesh (Singh and Singh, 1991), Santhals of Midnapore (Malik et al., 1986b).

Various factors are responsible for the ultimate body shape and size. Somatotype studies from around the world reflect extensive variations suggesting differences due to genetics (Singh and Singh, 2000), sex (Tanner, 1962; Parizkova and Carter, 1976; Carter and Parizkova, 1978), nutrition (Malik et al., 1986), physical activity (Carter, 1970; Parizkova, 1970; Withers et al., 1987) and ageing (Zuk, 1958; Heath and Carter, 1971; Walker, 1978). Handa et al. (1995) emphasized that the differences in physique between populations in different regions are of importance, especially to underlie the cultural differences between populations. Somatotypes vary between population groups and also during growth in the same population (Singh and Sidhu, 1980; Malik et al., 1986; Kaul et al., 1996). Thus these studies provide useful information regarding association between physique and other factors, viz., human growth, exercise, performance, nutrition etc.

Somatotypes can also be assessed as a useful tool for description and comparison of populations and for monitoring growth and aging changes and changes due to exercise and physical training. The present study, thus, attempts to study the body composition of different Scheduled Tribes of Rajasthan and to assess the physique/ somatotype changes with age among them and also to assess their physique in relation to each other and to determine their status in relation to other populations studied elsewhere.

MATERIALS AND METHODS

Human beings differ in many ways in their external form and physique. The body composition also changes during growth. In the evaluation of body composition, anthropometric measurements have included various circumferences, widths, depths and lengths. Heath and Carter method of anthropometric somatotyping was used to describe the body physique of the Scheduled Tribes selected for the study. The data required for Heath-Carter ratings are height, weight, four skinfolds (triceps, subscapular, suprailiac and calf), two bone diameters (humerus, femur), two muscle girths (calf, flexed arm), age and a revised height- weight ratio table. In this method the physique of subjects is expressed in a three digit sequential numerals, which are always recorded in the same manner. These numerals represent three basic components of physique viz., endomorphy, mesomorphy and ectomorphy.

The present study is based on a cross-sectional investigation on 2925 samples consisting of 1501 males and 1424 females belonging to both adolescent (8^+ to 18^+) and adult age groups (19 & above) (Table 1). The study was carried out on the Scheduled Tribes, namely Mina, Bhil, Sahariya, Garasia, Damor and Kathodi residing in the districts Sawai Madhopur, Udaipur, Baran, Sirohi, Dungarpur, respectively of Rajasthan (For more detail about area and people see Bhasin and Jain, 2007). Samples are collected from the place of residence and schools. For the purpose of analysis, the subjects were classified into yearly

intervals. Those subjects who had completed 8 years of age but were less than 9 years even by one day were grouped under 8+ age group. Similar pattern was followed for other age groups as well. The data were collected following the Internationally accepted standards of Martin and Saller (1957), Tanner et al. (1969), Weiner and Lourie (1969), Singh and Bhasin (1989).

The calculated somatotypes are plotted on somatochart triangle, where the two corners of the triangle base represent extreme endomorphy and extreme ectomorphy and the top represents extreme in mesomorphy. The three components of physique were plotted on a somatochart by calculating X and Y-axis values, according to Carter (1980).

RESULTS AND DISCUSSION

The anthropometric somatotypes of the six tribal groups studies are shown in Table 2. In all the population groups, ectomorphic component is dominant in younger age groups and continues to be so till 18^{+} years of age; with few changes from ectomorphic to mesomorphic component. No regular spurt could be recognized in somatotypes component during adolescence. High prevalence of ectomorphic component in the present study indicates their linear physiques. The tribal groups show lower height-weight ratios than the reference values, therefore, exhibit a more linear or ectomorphic physique than others. This can be attributed to their lower socio-economic status (SES) as Clements and Pickett (1957), reported linear physique of populations belonging to lower SES on the basis of lower height-weight ratio.

Sahariya males and females showed highest endomorphy ratings thereby indicating greater relative fatness than the other five populations. Mina males at young age group showed minimum endomorphy values, whereas among females, Kathodis exhibited the same. Mina males and Garasia females showed greater musculo-skeletal development than the others, which is indicated by higher mesomorphy ratings in them. Maximum mean value of ectomorphy is exhibited by Damor males and females followed by Garasias among males and Kathodis among females, thus revealing their higher linearity as compared to the other populations. Negative associations between percentage fat and lean body weight on the one hand and ectomorphy on the other (Carter and Phillips, 1969; Slaughter and Lohman, 1976; Wilmore, 1970). This can be perceived in the present study also, such that the population having the maximum endomorphic development has showed the least linearity. Adults also show higher ectomorphy value with its greater development among Garasia males and Kathodi females followed by Garasia females. Sahariya males and females followed by Mina males and females exhibit maximum endomorphy values among adults.

Males in general show higher ectomorphic values as compared to their female counterparts, which suggests a more linear physique of men. Szmodis (1977) also reported higher ectomorphy in males than females. Similar studies reported are that of Zuk (1958), Heath and Carter (1971), Shoup (1987).

It is also evident that females are more endomorphic than the males. This is consistent with other studies reported by Zuk (1958), Heath and Carter (1971), Shoup (1987). Duquet (1980) reported higher endomorphy in girls than boys at all ages. In general males are seen to have higher mesomorphic component than the females, which shows a greater musculo-skeletal development of males. Gakhar and Malik (2001) reported higher mesomorphic component in males as compared to females, which was a measure of strength in boys. Females, in higher age groups show lower linearity levels as compared to younger age groups. This could be attributed to lesser physical exercise in girls in higher age groups. Parizkova (1973) reported that undertaking systematic physical activity improved body composition in a characteristic way in children and even in adults.

Distribution of somatotypes on somatochart in Mina, Bhil, Sahariya, Garasia, Damor and Kathodi tribal groups of Rajasthan in both males and females for various age groups is shown from figure 1 to figure 12. All the values plotted show that in all the age groups in six population groups, the value of somatotypes lies in mesomorphic ectomorph or endomorphic ectomorph region. From the studies of Singh and Sidhu (1980), Singh and Bhasin (1990), Bhasin and Singh (1991), Singh and Singh (1991) and Bhasin and Singh (1992 b), it has been reported that Indian population groups are ectomorph, endo-ectomorph, meso-ectomorph and balanced ectomorph and their ratings are considerably lower than their western counterparts (Heath and Carter, 1971;

Table 3: Anthropometric somatotypes of the tribal groups of Rajasthan

Age (yrs)	*Mina*				*Bhil*				*Sahariya*				*Garasia*				*Damor*				*Kathodi*			
	Male		*Female*		*Male*		*Female*		*Male*		*Female*		*Male*		*Female*		*Male*		*Female*		*Male*		*Female*	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Endomorphy Ratings																								
8+	1.11	0.28	1.36	0.42	1.30	0.31	1.35	0.34	1.76	0.75	1.56	0.42	1.45	0.26	1.69	0.44	1.14	0.28	1.45	0.38	1.40	0.15	1.37	0.33
9+	1.10	0.31	1.44	0.38	1.28	0.28	1.70	0.49	1.70	0.55	1.72	0.52	1.62	0.32	1.91	0.49	1.28	0.19	1.59	0.31	1.41	0.34	1.59	0.27
10+	1.62	0.93	1.65	0.61	1.33	0.35	1.48	0.35	2.01	0.68	2.00	0.72	1.79	0.40	1.77	0.33	1.30	0.30	1.86	0.49	1.47	0.27	1.51	0.29
11+	1.39	0.50	1.75	0.47	1.42	0.33	1.42	0.33	2.32	0.86	2.32	0.68	1.64	0.41	2.28	0.55	1.54	0.51	1.69	0.38	1.51	0.34	1.82	0.43
12+	1.35	0.38	1.88	0.62	1.42	0.20	1.99	0.41	2.36	0.59	2.39	0.78	1.71	0.37	2.05	0.41	1.58	0.31	1.79	0.45	1.51	0.30	1.54	0.22
13+	1.43	0.37	1.93	0.56	1.63	0.29	2.17	0.56	2.14	0.56	2.52	0.90	1.80	0.31	2.55	0.38	1.74	0.32	1.99	0.73	1.62	0.42	1.83	0.37
14+	1.50	0.42	2.27	0.76	1.57	0.24	2.18	0.57	2.49	0.95	2.58	0.81	1.82	0.49	2.34	0.75	1.51	0.38	2.55	0.68	1.70	0.47	1.59	0.25
15+	1.67	0.43	2.33	0.77	1.61	0.35	2.45	0.74	2.43	0.96	3.45	0.81	1.76	0.30	2.48	0.65	1.92	0.34	2.62	0.79	1.67	0.41	1.87	0.42
16+	1.68	0.39	2.41	0.71	1.74	0.30	2.53	0.56	2.80	1.13	3.20	0.69	1.90	0.40	2.41	0.86	1.76	0.34	2.63	0.89	1.56	0.40	1.76	0.39
17+	1.87	0.62	1.97	0.60	1.66	0.21	2.30	0.74	2.77	0.89	3.23	0.85	1.90	0.52	2.10	0.39	1.87	0.37	2.23	0.71	1.81	0.49	1.60	0.35
18+	1.83	0.47	2.66	0.50	1.76	0.44	2.07	0.65	3.45	0.87	2.74	0.97	1.95	0.21	2.34	0.56	1.85	0.39	2.08	0.52	1.72	0.43	1.60	0.33
>19+	2.09	0.56	2.28	0.65	1.68	0.34	2.12	0.91	2.25	0.78	2.54	0.91	1.78	0.34	1.80	0.57	1.81	0.50	2.15	0.84	1.61	0.39	1.66	0.44
Mesommorphy Ratings																								
8+	2.20	1.03	1.82	0.59	1.88	0.48	1.44	0.99	2.24	0.99	1.86	0.74	1.81	0.81	1.81	0.68	1.67	0.60	1.43	0.72	2.26	0.46	1.84	0.46
9+	1.53	0.65	1.79	0.62	1.94	0.53	1.32	0.65	1.91	0.88	1.80	0.67	1.95	0.81	1.47	0.48	2.03	0.81	1.16	0.68	2.01	0.56	1.62	0.70
10+	1.85	0.58	1.10	0.97	1.68	0.60	1.47	0.67	1.77	0.78	1.79	0.75	1.75	0.47	2.07	0.64	1.77	0.65	1.31	0.61	2.13	0.69	1.24	0.69
11+	1.59	0.73	1.04	0.96	1.66	0.45	1.12	0.61	1.79	0.79	1.45	0.85	1.45	0.63	1.95	0.74	1.34	0.69	1.73	0.68	2.13	0.90	1.46	0.67
12+	1.28	0.79	1.45	0.66	1.50	0.57	1.61	0.78	2.22	0.54	1.31	0.86	1.86	0.53	1.55	0.90	1.59	0.67	1.89	0.71	2.32	0.92	1.80	0.79
13+	1.72	0.76	1.09	1.36	2.22	0.91	1.39	1.08	1.49	0.61	1.80	0.95	1.66	0.66	2.01	0.82	1.52	0.82	1.62	1.27	2.37	0.94	2.59	0.72
14+	2.44	0.54	1.55	0.92	1.71	0.71	1.56	0.87	1.68	0.74	1.29	0.85	1.25	0.72	1.92	0.97	1.57	0.73	2.01	0.59	2.14	0.89	2.21	0.62
15+	1.64	0.71	1.66	1.28	2.22	0.76	1.59	0.78	1.81	0.96	1.97	0.99	1.19	0.36	2.05	0.67	2.41	0.63	2.28	0.79	2.10	1.05	2.59	0.80
16+	1.38	0.79	1.57	0.72	1.76	1.10	1.36	0.81	1.67	1.12	1.88	0.83	1.50	0.93	2.65	0.62	1.89	0.87	1.61	1.02	2.75	0.88	1.95	1.33
17+	1.87	0.66	1.43	0.88	2.21	0.78	1.87	0.78	1.94	1.35	1.94	1.03	1.72	0.83	2.55	0.64	1.32	0.61	2.37	0.81	2.65	0.73	2.31	1.17
18+	1.88	0.69	2.19	1.05	1.98	0.62	1.89	0.71	2.28	1.06	1.66	0.61	1.06	0.94	2.11	0.74	1.89	0.79	2.54	1.06	2.34	1.48	2.56	1.27
>19+	2.12	0.27	1.73	0.88	2.24	0.86	1.83	1.12	2.28	1.16	1.65	1.04	2.37	0.82	2.90	0.75	2.21	0.95	2.55	0.91	2.10	0.90	2.00	0.76
Ectomorphy Ratings																								
8+	5.39	1.49	5.21	1.37	5.37	1.55	5.81	1.81	4.76	1.61	5.15	1.19	5.25	1.12	5.27	0.89	6.14	1.72	6.70	1.52	4.81	1.33	5.86	1.08
9+	6.20	1.65	5.12	1.03	6.32	1.09	6.27	1.39	5.39	0.93	6.02	2.45	5.14	0.76	4.98	1.85	5.73	0.74	5.90	1.76	5.51	1.31	6.02	1.47
10+	5.23	0.85	6.19	1.17	6.42	1.37	6.43	1.21	5.54	1.18	5.43	1.18	5.23	0.81	5.22	1.21	6.72	1.07	5.61	1.05	5.46	1.41	6.36	0.92
11+	5.68	1.15	6.12	1.53	6.47	0.89	6.21	0.96	5.42	0.92	5.29	1.10	5.84	0.83	5.14	1.44	6.69	1.03	5.45	1.18	6.34	1.92	6.30	1.28
12+	6.04	0.87	5.96	1.33	6.23	1.17	5.64	1.34	5.47	1.06	5.47	1.28	5.86	0.92	5.29	0.73	6.37	1.33	5.53	0.80	4.77	0.95	6.53	1.31
13+	6.05	1.20	5.92	2.44	5.38	0.94	5.82	1.28	5.56	0.91	4.25	1.38	6.17	0.92	5.02	1.38	5.72	1.29	5.85	1.83	5.42	1.02	5.23	1.20
14+	6.03	0.83	5.55	1.04	6.23	1.15	5.40	1.09	5.96	1.14	4.20	1.19	5.20	0.50	5.68	1.19	6.51	1.09	4.46	0.98	5.69	0.97	5.33	1.11
15+	6.08	1.14	4.77	1.36	6.20	1.19	4.84	1.04	6.11	1.22	4.08	1.34	5.31	0.61	5.42	1.13	5.91	0.70	4.71	0.93	5.63	1.56	4.91	1.48
16+	6.22	1.19	4.46	1.23	6.25	1.48	5.21	1.10	5.55	1.32	4.41	1.04	5.51	0.74	4.79	1.10	6.29	1.45	4.41	1.02	5.77	1.18	5.92	1.52
17+	5.52	0.86	4.42	1.07	5.73	0.88	5.28	1.00	5.58	1.19	4.40	1.19	6.63	0.82	5.50	1.07	6.41	0.77	4.79	1.12	5.17	0.73	5.88	1.06
18+	5.53	1.19	3.98	1.04	5.91	0.72	4.88	1.17	5.10	1.31	4.10	1.47	6.61	0.87	4.56	0.78	6.02	0.84	4.79	0.79	5.32	0.83	5.27	1.49
>19+	5.14	1.15	3.55	0.99	5.67	0.83	4.99	1.43	5.20	1.58	4.28	1.59	6.29	0.94	5.23	1.04	6.14	1.08	4.51	1.25	6.10	1.24	5.35	1.10

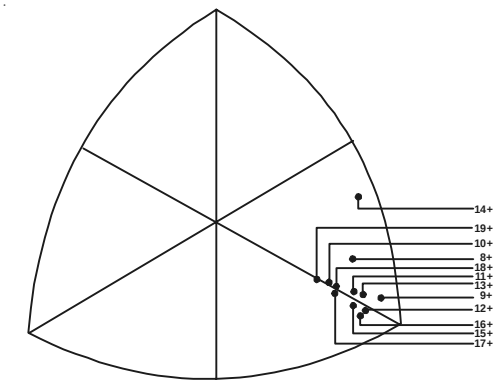

Fig. 1. Minas

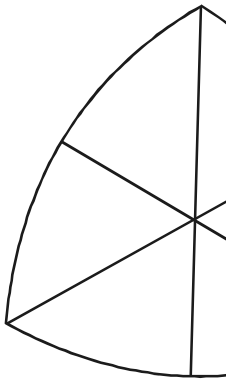

Fig. 2. Bhils

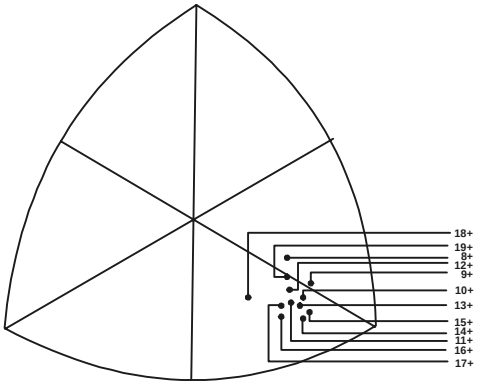

Fig. 3. Sahariyns

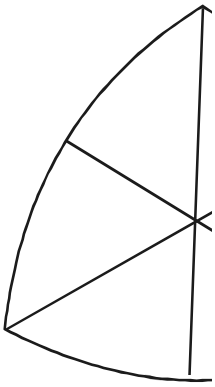

Fig. 4. Garasias

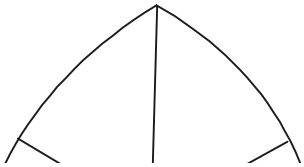

Fig. 5. Damors

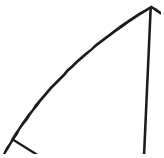

Fig. 6. Kathodis

Fig. 1-6. Samatochart showing somatotype distribution in males tribal groups of Rajasthan

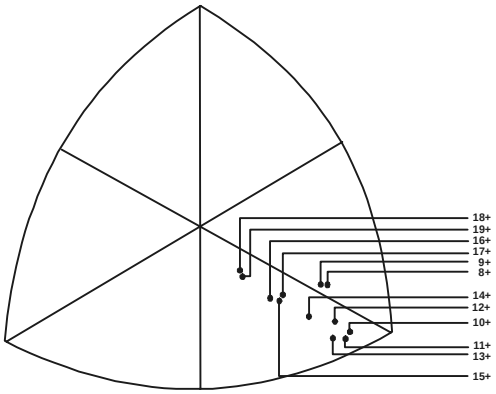

Fig. 7. Minas

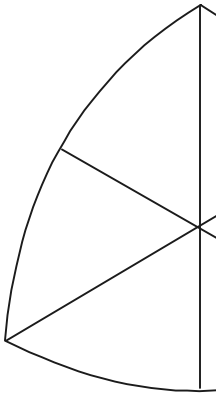

Fig. 8. Bhils

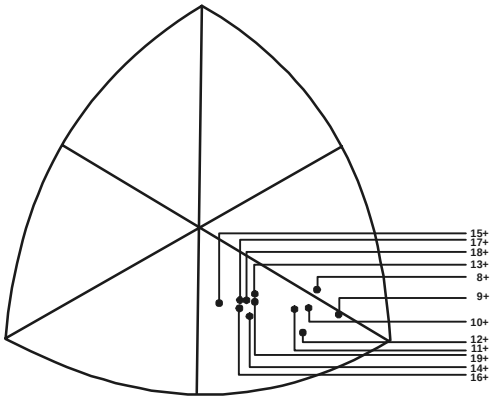

Fig. 9. Sahariyns

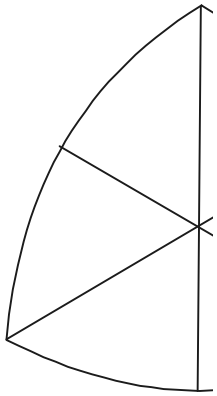

Fig. 10. Garasias

Fig.11. Damors

Fig. 12. Kathodis

Fig. 1-6. Samatochart showing somatotype distribution in females tribal groups of Rajasthan

Parizkova and Carter, 1976; Singh and Sidhu, 1980; Singh, 1987). The data of the present population also show a similar trend.

Males in general, showed a more concentrated trend in all age groups in the Scheduled tribe populations, whereas, girls showed a greater dispersion with increased endomorphy as also reported by Duquet (1980), Stepnick (1976 a). Rangan (1982) reported a more linear or ectomorphic build among lower socio-economic class than the upper class. The Scheduled Tribes of Rajasthan studied, exhibit higher ectomorphy mean values at all the age groups, which may be attributed to their genetic and environmental factors, as the adverse socio-economic, dietary and sanitary conditions exert a strong negative pressure on the genetic potential for growth. Apart from genetical factors, inadequate nutrition, unfavorable sanitary conditions, high tobacco and alcohol consumption, lack of awareness and low literacy rate also contribute to their linear physique.

The data of males when compared with Gaddi Rajputs (Singh and Sidhu, 1980), Brahmins of Himachal Pradesh (Singh and Singh, 1991), Dogra Scheduled Caste (Singh and Bhasin, 1990), high altitude population of male Bods from Leh, Ladakh, and low altitude Bods settled in Kullu Valley (Malik et al., 1986a) and Jats of Delhi (Gakhar and Malik, 2002) showed that the tribal groups show lower endomorphy than the Gaddi Rajputs, Brahmins of Himachal Pradesh and Dogra Scheduled Caste in the pre-adolescent age groups.

While comparing endomorphy ratings with Bods of high altitude, it is found that tribal values show lower values in the adolescent ages after which they gain and have a somewhat higher value till 18 years, whereas Sahariya males at all age groups show higher values. Bods of low altitude and Jats of Delhi show higher values for endomorphy than others. Inspite of the fact that greater body fat is an adaptation to high altitude, it is seen that the present tribal groups show greater endomorphy ratings than the high altitude male Bods. Stepnicka (1976) observed a negative relationship between endomorphy and physical acitvity requiring strength and stamina. Conditions of undernutrition and low oxygen pressure limit the release of energy and also the difficult terrain at high altitude enhances the workload. Thus all the stresses outweigh the stress of cold and results in lower endomorphy in highlanders as compared to other low altitude populations (Malik et al., 1986a).

The general trends of mesomorphy among males show that the tribal groups of Rajasthan at all age groups are less mesomorphic than the Gaddi Rajputs, Brahmins, Dogras, Bods of high and low altitude and Jats. Bods of high altitude are seen to be most mesomorphic. This could be attributed to the increased workload and the difficult terrain in view of the positive association between mesomorphic component and physical activity (De Garay et al., 1974; Stepnicka et al., 1976; Malik et al., 1986a). Males show distinct higher ectomorphic values than the Brahmins, Gaddi Rajputs, Jats and Bods of high and low altitude at all age groups.

Due to lack of similar studies reported on males and females the female population of Scheduled Tribes of Rajasthan has been compared with other studies reported from different regions. The data on females have been compared with available data from north-west India; study reported by Singal et al. (1990) on Rajput girls of Himachal Pradesh, Talwar and Kaur (1997) on Punjabi Bania girls, Gaur and Kaur (2002) on Jat girls of Haryana. It has also been compared with the similar study, as reported in males also, on Jats of Delhi (Gakhar and Malik, 2002). The tribal groups of the present sample had distinctly lower mean endomorphy ratings than the Rajput girls and Jat girls of Delhi over the entire age range considered here. In comparison to Punjabi Bania girls, Bhils, Minas, Damors and Kathodis show lower mean values at all age groups; whereas, Sahariya females show lower values at younger age group i.e. till the age of 14 years (except at 11 years). At higher age groups, at 15 and 16 years, Sahariya females tend to have higher mean endomorphy values. It may be evaluated that Sahariyas are seen to be more endomorphic as compared to Punjabi Bania girls and Jat girls of Haryana and Delhi, but overall the Rajput girls of Chamba (H.P.), show the highest endomorphy ratings.

The present study female population shows distinct mean lower mesomorphy values and high ectomorphy ratings in comparison to Rajputs and Jat girls of Haryana and Delhi at all age groups. Overall the present tribal groups show a lesser musculo-skeletal development and higher linearity than the populations of other regions.

Both males and females of the present study tribal groups show a relatively more linear build

than the other national and international data, which can be attributed to their low socio-economic status, poor nutrition and occupational factors (Kansal, 1981; Rangan, 1982). Majority of the population are agriculturists and work as labourers and are thus engaged in strenuous physical work, thus highlighting their more ectomorphic body build than the other populations. The intake of foods like pulses, green and leafy vegetables, fruits, milk and fats and oils are grossly inadequate to meet the needs of the individuals, resulting in growth impairment and poor nutritional status and reduced body size.

Greater linearity may also be attributed to the difference in their gene pools or the environment. This could also be due to the undernutrition and other environmental pressures prevalent in the community as they vastly influence the physique and body composition (Kansal, 1981; Rangan, 1982; Tanner and Whitehouse, 1982; Eiben, 1985). Lower socio-economic classes have less height-weight ratio (HWR) than the upper socio-economic class and are therefore, more linear or ectomorphic as reported by Clements and Pickett (1957), Hammond (1953). Study by Prakash and Malik (1988) reported more ectomorphy in smokers than nonsmokers as smoking reduces lung functions, increases disorders in digestive tract and impairs human body functions in many other ways. The present study tribal groups show a high rate of smoking which also affects the overall anthropometric somatotypes, giving them a more linear build. The causes of socio-economic differential may be due to nutrition where, in the present study population inadequate diet with no regular meals, high intake of liquor and tobacco, unfavorable living conditions like *kuchcha* houses with no separate lavatory facility, unhygienic surroundings, and lack of medical facilities are rampant.

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