

Age Changes and Sex Differences in Somatotypes Among Jats of Delhi

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INTRODUCTION

A somatotype is a convenient shorthand descriptor of overall physique in terms of body shape and composition independent of body size (Carter, 1996). It combines an appraisal of relative adiposity, musculo-skeletal robustness and linearity into a three number rating. The three numbers represent endomorphic, mesomorphic and ectomorphic components of physique respectively. Because of its uniqueness it has been used for studying population variation and/or age and sex variations. Information available through the study of somatotypes has also been applied in the field of exercise, sports, growth, etc. Handa et al. (1995) emphasized that the differences in physique between populations in different regions were of importance, especially to underlie the cultural differences between populations. Somatotypes vary between population groups as well as during growth in the same population (Singh and Sidhu, 1980; Malik et al., 1986a, Kaul et al., 1996). Numerous somatotype studies yielding information about human physique and characteristics associated with it were conducted in India mostly in the northern region. Most of these studies have made use of Heath-Carter method of Anthropometric Somatotyping. Somatotype studies were conducted on Bods of the Western Himalayas (Malik and Singh, 1978; Malik et al., 1986a; Malik, 1987; Pandey and Malik, 1990), Gaddi Rajputs (Singh and Sindhu, 1980; Singh, 1981), Garhiwali males (Gaur and Singh, 1997), Brahmin Dogras (Singh and Bhasin, 1990), Jat Sikhs and Banias of Punjab (Sidhu and Kansal, 1974; Sidhu et al., 1982; Singal and Sidhu, 1984), Jat Sikhs of Punjab (Singal and Kaur, 1993), Punjabis (Kahlan, 1994), Rajput and Brahmins of Chamba, Himachal Pradesh (Singh and Singh, 1991), Santhals of Midnapur (Malik et al., 1986b; Prakash and Malik, 1989a, b).

In India the relationship between physique, sports and body composition were examined in a variety of sport events (Sidhu et al., 1982; Sidhu and Singh, 1996; Sidhu and Wadhan, 1975; Singh and Sidhu, 1982; Sodhi, 1980a, b; Sodhi and

Sidhu, 1984; Verma et al., 1982). Somatotype of sports person and impact of training on somatotypes were studied from different parts of the world to provide competitive edge (Withers et al., 1986; Casagrande and Viviani, 1993; Carter et al. 1982; Claessens et al., 1986; Carter and Phillips, 1969; Carter and Rahe, 1975). Information related to somatotypes has been summarized in a series of earlier studies (Carter, 1970, 1971, 1978; De Garay et al., 1974; Stepnicka, 1974, 1986; Ross et al., 1977).

The present study aims to delineate age changes and sex differences in anthropometric somatotype and its three components, viz., endomorphy, mesomorphy and ectomorphy among Jats of Delhi in the age range of 10 to 18 years.

MATERIALS AND METHODS

Field Area: Delhi at a Glance

The present study was conducted in Delhi, the National capital of India. Since time immemorial, Delhi has been absorbing a variety of cultures and customs into her social fold. Diversity in caste, class, religion and consequently in life-styles, eating habits, dress patterns, marriage rituals and other customs, is the hallmark of Delhi and its inhabitants. Despite a preponderance of the Punjabi speaking people, Delhi can boast of having an admixture of several cultures or ethnic groups. The influxes of post-Partition refugees and migrations caused by years of terrorism in Punjab and Kashmir have had their impact on the demographic composition of the city. However, Delhi has still fairly large chunks of communities from other states that have made this place their home for generations. Such a myriad array of traditions communicates a vibrant cosmopolitan culture of Delhi. It truly portrays the country's axiom of 'Unity in Diversity'. For Delhi and its inhabitants, it is not a matter of mere pride, but the tallest sign of its maturity, confidence, trust, respect for one-another and triumph of the secular sentiment of our country.

Situated between 28° 24' 17" to 28° 53' 00" North latitude and 76° 50' 24" to 77° 20' 37" East longitude, Delhi comprises a total area of 1483 km², out of which 685.34 km² is urban and 797.66 km² is rural. The total population of Delhi is over 9.42 million, of which nearly 5.15 million are males and 4.27 million are females (Delhi Statistical Handbook, 1997). Since independence, the population of Delhi has grown by 487 per cent (compared with Mumbai at 227 per cent, Chennai at 49 and Calcutta at 39 per cent).

According to 1991 Census, Delhi has 29 census towns and 209 villages (Census of India, 1991). Delhi is the most densely populated city in India. The density of population per km² is 12361 per km² in the urban sector of the National Capital Territory of Delhi, whereas it is 1190 per km² in the rural sector. The sex ratios for the urban and rural sector are 830 and 807 females per thousand males, respectively.

Population: The Jats

General Features of the Jats: The study has been conducted among the Jats of Delhi. According to Ibbetson (1883), Delhi has a Jat population of 107,075 that constitutes over 16 per cent of its total population. Thus, Jats constitute a sizeable proportion of this Capital region, particularly along its boundaries with other northern states of India. Table 1 describes the distribution of some of the sub castes of Jats in Delhi. Besides Delhi, the major concentration of Jats is in the states of Haryana, Punjab, Rajasthan and Uttar Pradesh. They also occupy the upper valleys of the Ganges and Jamna from Bareilly, Farrukabad, and Gwalior upwards. They form a mass of the population in Bikaner, Jaisalmer, and Marwar. They are especially numerous in the northern and northwestern states.

Ibbetson (1883) mentioned that the Jats were of Aryan stock and made the northern plain of India their home. He referred that General Cunningham and Major Tod agreed in considering the Jats to be of Indo-scything stock. The former identified them with the Zanthii of Strabo and the Jatu of Pliny and Ptolemy, and opined that they probably entered Punjab from their home on the Oxus shortly after the Meds or Mands, who were also Indo-scythians, and had moved into Punjab about a century before Christ. The Jats seem to have first occupied the Indus valley as far down as Sindh, where the Meds followed them about the beginning of the present

era. But before the earliest Mohammedan invasion the Jats had spread into the Punjab proper, where they were firmly established in the beginning of the 11th century.

They brought with them some institutions, the most important being the *Panchayat* and the custom of marrying the widow of the elder brother. The brunt of most foreign invasions into India was borne by the 'marshal races' of Punjab, Haryana, Rajasthan, and western Uttar Pradesh, including the Jats of these regions, who not only tilled their fields but also defended the country. The first Hindus known to the Arabs were the Jats. Jats of Sindh and western Rajasthan harassed Mahmud of Ghazni considerably and his seventeenth expedition was made to chastise them. Taimur dealt severely with the Jats during his invasion in 1398 and called them "a robust race, demon like in appearance and as numerous as ants and locusts, a veritable plague to the merchants and wayfarers" (Ibbetson, 1883). Organized Jat resistance took shape during the latter half of the reign of Aurangzeb when his severity aroused their wrath and that of the Marathas and the Sikhs. The Jats controlled the routes to and from Delhi and Agra, Mathura and Ajmer and when Aurangzeb was away in the Deccan, they made their presence felt. It was during the last two decades of the reign of Aurangzeb that the Sinsinwar Jats of Bharatpur under individual village headmen became powerful enough to carve out the little kingdom of Bharatpur for themselves by 1720. After the invasion of Nadir Shah, the Jat dominions expanded further. They fortified their villages and built the famous forts of Deeg, Kumher, Bharatpur and Weir that soon came to be known as the most impregnable forts of India. The head of these Jats at that time, Badan Singh enhanced his political strength by matrimonial alliances and

Table 1: Distribution of major subcastes of Jats in Delhi

Subcastes	Number of Persons
Ahlawat	1746
Dagar	8558
Dalal	1850
Dehia	14334
Deswal	720
Ghatwal	4434
Jakhar	122
Khatri	11098
Phogat	196
Sahrawat	4202
Sangwan	288

Source: Ibbetson, 1883

is said to have had a harem of 150 women (some secured by consent, others by force) of different castes and tribes. After his death, his son Suraj Mal became the greatest warrior and statesman that the Jats have produced. His son, Jawahar Singh, who, as a young prince in 1757, had stood against Ahmad Shah Abdali's armies at Chaumuha when about 10,000 Jats laid down their lives to save Mathura, succeeded Suraj Mal. Although the 1857 revolt began in Meerut, the Jats did not play a leading role in it. They tilled their fields and some fortunes were made.

After the First World War, their leader Chaudhari (Sir) Chhotu Ram (1885-1946), a man of vision, foresight, openness of character and subtlety of mind, was largely responsible for their awakening. He channeled their energies into fields other than farming and military service, he opened schools and colleges and it was under his inspiration that the Jats took to law, teaching, business and politics.

Jats are pre-eminent in agricultural skills. They are honest, industrious and sturdy of all the various groups of the northern region. None of the rival caste groups can equal Jats as landowners and yeoman cultivators. Jats are considered to be the most independent, possessing patient vigorous labour and skill. They have strong communal ties and take pride in helping their neighbours. Jats are independent and self-willed. They are reasonable in their attitude and peaceably inclined. They are usually content to cultivate their fields and pay the revenues in peace and quietness if others let him do so. Though occasionally when they go wrong, they take to anything from gambling to murder, with perhaps a preference for stealing other people's wives and cattle. The proverbial wisdom of the villages describes them fairly well, though perhaps somewhat too severely: "The soil, fodder, clothes, hemp, grass fiber, and silk, these six are best beaten; and the seventh is the Jat" (Ibbetson, 1883).

In the caste hierarchy, Jats occupy a position that is shared by the Ror, the Gujjars, and the Ahir, all the four eating and smoking together (Ibbetson, 1883). In their own opinion, out of the castes of pure Hindu origin, Jats consider them to be next to the Brahmans, the Khatris and the Rajputs, Jats occupy this position due to the practice of widow-remarriage. Other groups, however, do not agree with this position of Jats in the caste hierarchy.

The language most commonly spoken by the Jats in the areas covered under the present study

includes *Haryanvi*, a dialect of Hindi. Besides, Hindi and English is also known to the Jats and used whenever required, particularly in educational or other institutions. Among the young generation, both boys and girls are treated equally. Formal education is provided to both the sexes. This practice applies well to the urban residents. Contrarily, in the rural settings, since more hands are required for agricultural lands that almost every Jat household acquires of its own, most of the Jats do not go for higher studies. Few of them, especially boys pursue higher studies. Literacy rate among Jats is, therefore, higher in males than in females.

Before eighties, the main occupation of the Jats was agriculture. Also, mostly at least one male member of the family was preordained to serve the nation by joining the armed forces. It was so because their traditional skills made them the greatest warrior of all times. Females, on the other hand, usually stayed back to take care of their children and fields. Gradually, with the realization of acquiring affluence as that owned by members of other groups, Jats also pervaded various spheres of activities and gained numerous job opportunities in other occupations. Besides owning lands in their native villages, the Jats shifted closer to the cities and flourished in their respective skills. Trading in diversified fields, some of the Jats have established themselves extremely well in the cities. Those with an academic bend of mind have acquired higher positions at various public or private sector undertakings through their scholastic excellence. Consequently, keeping pace with changing times, both male and female Jats have carved a niche for themselves in various professions, viz., Govt. services, Defence services, Medicine, Engineering, Computers, Industries, Business or other lucrative professions.

Jats practice their daily religious services with devotion. Being staunch believers of Hindu tradition, they worship all the Hindu Gods and Goddesses, and are mostly vegetarians. *Lohri*, *Holi*, *Dussehra*, *Diwali*, *Teej*, *Sankrant* and *Raksha Bandhan* are the major festivals celebrated by Jats. The traditional dress of Jats constitutes a *Dhoti-kurta*, and a *Pagri* for males and *Salwar-kurta*, and *Dupatta* for females.

Jat, as a caste group, is the combination or cluster of various patrilineal and patriarchal clans, and interests of caste at village or wider level, are taken care by the males only. Women are considered inferior in terms of their status. Most

women even today continue to subscribe to the idea that decision-making is the male prerogative alone. The women are thoroughly discouraged, prevented and suppressed from going against the wish of their elder males. The headship of the clan and family lies in the eldest male member. Next to the family social group is 'Kutumb' (comparable to lineage), membership in which is determined by birth. The male head of this group behaves as the spokesman at the time of crises. The descents of Jat clans are traced through male ancestors. A cluster of families belonging to one or more clans constitutes a village community. In case of multi-caste villages, which are the pattern in Jat settlements, there are numerous clans representing different castes. In a predominant Jat village, one clan, representing a single Jat subcaste is usually reported.

Mating Pattern Among the Jats: Mating pattern among the Jats was derived, on the basis of the information provided by the subjects on their paternal and maternal subcastes. Jat is an endogamous group and there is no Jat and non-Jat marriage observed in our sample. Out of a total of 580 marriages, 577 were inter-subcaste marriages. Only 3 intra-subcaste marriages were and all of them were in the subcaste Yadav. The areas from where the data were collected had in majority people belonging to Dabas, Sahrawat, Dagar, and Singh subcastes. Due to restriction in intra-subcaste marriages, the females were not chosen from these subcastes. Females were largely taken from Rana, Dalal, Dehia and Gulia subcastes. The mating pattern thus establishes endogamy in Jats and exogamy within the subcastes of Jats.

Communities, tribes or social classes, membership in which is bound together by a network of marriages, where mates are selected from a common descent, are known as 'Mendelian populations'. Members of such a population share a common gene pool, where there is no or limited gene flow from or into the group. On the basis of nature of mating pattern, it is evident that in anthropological terms, Jat is a 'Mendelian population'.

The Sample

In order to assess somatotypes of Jats, a cross sectional sample of five hundred eighty (580) Jat school children (Boys=308, Girls=272) in the age range of 10 to 18 years was selected for the present study. Data were collected from six government-run schools in the Jat predominant

areas of Delhi during April - October 1997 (Table 2).

Age and sex wise distribution of the sample is depicted in Table 3. Date of births of subjects were taken from the school registers, and confirmed from the subjects. In case of an anomaly, subject was requested to get the date confirmed from his/her parents. Decimal age of each subject was calculated by subtracting the date of birth of the subject from the date of data collection, using decimal age calendar (Tanner et al., 1969). All the subjects between 9.500 and 10.500 years were classified in the age group of 10 years, whereas those falling between 10.500 and 11.500 were included in the age group of 11 years. The same principle was applied throughout to classify subjects in various age groups. As per the International Convention, when such a method of age classification is used, age groups are represented as $10 \pm$, $11 \pm$, $12 \pm$, and so on (Eveleth and Tanner, 1976). Accordingly, all the subjects were classified into nine age groups ranging from $10 \pm$ to $18 \pm$ years.

Methods: Anthropometric Somatotyping

In accordance with internationally accepted standards following ten body measurements were taken (Martin and Saller, 1957; Tanner et al., 1969; Heath and Carter, 1967):

1. Height vertex, 2. Body weight, 3. Bicondylar humerus, 4. Bicondylar femur, 5. Upper arm circumference, 6. Calf circumference, 7. Skinfold at triceps, 8. Skinfold at Subscapula, 9. Skinfold at suprailiac and 10. Skinfold at calf.

Anthropometric Somatotyping was done incorporating the above ten anthropometric measurements using Heath and Carter's method (Carter, 1980; Heath and Carter, 1967). A somatotype is expressed in a three digit sequential numerals, representing endomorphy,

Table 2: Distribution of sample, by School

Name of the school	Sample drawn
Rajkiya Saha Shiksha Varisht Vidyalaya, Chandzpur Majra, Delhi.	190
Govt. Girls Senior Sec. School, No. 1, Palam, New Delhi.	120
Sarvodaya Vidyalaya (Bal) No. 1, Delhi Cantt.	84
Sarvodaya Balika Vidyalaya, Delhi Cantt.	75
Govt. Co-Ed. Senior Sec. School, Surhera, New Delhi.	63
Govt. Co-Ed. Senior Sec. School, Jaffarpur Kalan, New Delhi.	48
Total Sample	580

Table 3: Distribution of sample, by age and sex.

Age range	Age group	Boys	Girl	Total
9.500-10.500	10 ±	27	27	54
10.500-11.500	11 ±	26	40	66
11.500-12.500	12 ±	37	33	70
12.500-13.500	13 ±	36	35	71
13.500-14.500	14 ±	35	25	60
14.500-15.500	15 ±	46	33	79
15.500-16.500	16 ±	40	27	67
16.500-17.500	17 ±	34	26	60
17.500-18.500	18 ±	27	26	53
Total		308	272	580

mesomorphy and ectomorphy respectively.

Endomorphy: As the first component of physique, endomorphy represents the relative fatness in an individual's physique. It was calculated using the following equation:

$$\text{Endomorphy} = -0.7182 + 0.1415 (X) - 0.00068 (X)^2 + 0.0000014 (X)^3$$

Where, X is the sum of skinfolds at triceps, subscapular and suprailiac.

Mesomorphy: The second component of physique, mesomorphy represents the relative musculo-skeletal development per unit of length. It was calculated using the following formula given by Carter (1980):

$$\text{Mesomorphy} = (0.858 \times \text{Bicondylar humerus} + 0.601 \times \text{Bicondylar femur} + 0.188 \times \text{Corrected arm girth} + 0.161 \times \text{Corrected calf girth}) - (\text{Height} \times 0.131) + 4.50$$

Where,

Corrected upper arm girth = upper arm

Circumference (in cm) - Triceps skinfold (in mm)/10; and

Corrected Calf girth = Calf circumference - Calf skinfold/10

Ectomorphy: The third component of physique, ectomorphy refers to the relative linearity of individual physique. It is a measure of the form and degree of longitudinal distribution of the first and second component of physique, i.e., endomorphy and mesomorphy respectively. It was calculated using the following equations given by Carter (1980). Before calculating ectomorphy, Height-weight ratio (HWR) was calculated using the following equation:

$$\text{HWR} = \text{Height} / \sqrt{\text{weight}}$$

When $\text{HWR} \geq 40.75$, then

$$\text{Ectomorphy} = \text{HWR} \times 0.732 - 28.58$$

When $\text{HWR} < 40.75$ > 38.25, then

$$\text{Ectomorphy} = \text{HWR} \times 0.463 - 17.63$$

When $\text{HWR} \leq 38.25$, then

$$\text{Ectomorphy} = 0.1$$

Using the formula given by Carter (1980), Individual somatotypes were plotted on a somatochart by calculating values of X and Y-axis.

$$X = \text{Ectomorphy} - \text{Endomorphy}$$

$$Y = 2 \times \text{Mesomorphy} - (\text{Endomorphy} + \text{Ectomorphy})$$

The values thus obtained were plotted on a somatochart. A somatochart is a schematic, triangular

shaped, two-dimensional representation of the theoretical range of known somatotypes. It shows the distribution of the somatotypes plotted as points, and their concentration on the chart. Three corners of the somatoplot represent the extreme endomorphs, mesomorphs and ectomorphs with numerical values of 711, 171 and 117 respectively. Since, the human body is made up of not only one of the three components, but on the contrary is the sum of three primary components, which collectively define the body shape (i.e., somatotype) of an individual. The central region of the somatoplot is called 'central', where all the three components are more or less equally represented. The individuals who deviate from the central region towards the endomorphic, mesomorphic and ectomorphic region are classified accordingly into different somatotype categories. For example, when the somatotype values lie between the ectomorphic and endomorphic or mesomorphic area, but more towards the ectomorphic side then it is classified as ecto-endomorphic and ecto-mesomorphic respectively. Individual Somatotypes of Jat boys and girls were classified into thirteen categories following Carter's classification (Carter, 1980). Also age group wise mean somatotypes were identified in different categories. These categories are as follows:

Balanced endomorph - In this case, the first component, i.e. endomorphy, dominates over second and third, i.e. mesomorphy and ectomorphy respectively, which are either equal or differ no more than 0.5 units, for example 5-3-3, 5-3-2.5, 5-2.5-3.

Balanced mesomorph - Second component dominates, the first and third components are either equal or differ no more than 0.5 units, e.g., 3-5-3, 2.5-5-3, 3-5-2.5.

Balanced ectomorph - Third component dominates, first and second components are either equal or differ no more than 0.5 units, e.g., 3-3-5, 3-2.5-5, 2.5-3-5.

Mesomorph endomorph - First and second components are either equal or differ no more than 0.5 units and dominate over third component, e.g., 5-5-3, 4.5-5-3, 5-4.5-3.

Mesomorph ectomorph - Second and third component are either equal or differ no more than 0.5 units and dominates over the first component, e.g., 3-5-5, 3-5-4.5, 3-4.5-5.

Endomorph ectomorph - First and third components are either equal or differ no more than 0.5 units and dominate over second component, e.g., 5-3-5, 4.5-3-5, 5-3, 4.5.

Mesomorphic endomorph - First component is greater than second and the third is the smallest, e.g., 5-3-2, 5-4-2.

Ectomorphic endomorph - First component is greater than the third and the second is the smallest, e.g., 5-2-3, 5-2-4.

Endomorphic mesomorph - Second component is greater than the first whereas the third is the smallest, e.g., 3-5-2, 4-5-2.

Ectomorphic mesomorph - Second component is greater than the third whereas the first is the smallest, e.g., 2-5-3, 3-5-4.

Endomorphic ectomorph - Third component dominates over first and the second is the smallest, e.g., 3-2-5, 4-2-5.

Mesomorphic ectomorph - Third component is greater than second and the first is the smallest, e.g., 2-3-5, 2-4-5.

Central - All three components are either equal or differ no more than one unit from the other two,

the ratings of all the components should be within and consist of ratings of 2,3 or 4, e.g., 3-3-3, 4-4-4, 3.5-4-3.5.

Somatotype Dispersion Distance (S.D.D)

The distance between mean somatoplot and each individual somatotype is referred to as somatotype dispersion distance. It was calculated by using the formulae given by Ross and Wilson (1973). It is given as follows:

$$\text{S.D.D.} = [3 * (X_1 - X_2)^2 + (Y_1 - Y_2)^2]^{1/2}$$

Where, X_1 and Y_1 are the scalar coordinates of mean somatoplot and X_2 and Y_2 are the co-ordinates of individual somatoplot. The S.D.D. is represented in Y distance units, i.e., in terms of distances at Y - axis of a somatoplot.

Mean Somatotype Dispersion (S.D.M.)

It was calculated as the average of all the Somatotype dispersion distances.

$$\text{S.D.M.} = \sum \text{S.D.D.} / N$$

The S.D.D. is ideal in comparing two mean somatotypes whereas S.D.M. is useful in knowing about the distribution of somatotypes in a group from its mean somatotypes.

RESULTS AND DISCUSSION

The somatotype is a convenient shorthand descriptor of overall physique in terms of body shape and composition independent of body size (Carter, 1996). It combines an appraisal of relative adiposity, musculo-skeletal robustness and linearity into a three number rating. The three numbers represent endomorphic, mesomorphic and ectomorphic components of physique respectively. Somatotype identifies a person as belonging to a biological family which appears to be world wide in distribution and cuts across boundaries through which men have attempted to divide themselves according to ethnicity, colour, blood type, geographic origin and so on (Prakash and Malik, 1989a). Therefore, by providing a universal frame of reference, it attempts to serve the function of general human taxonomy (Sheldon et al., 1954). Because of its uniqueness, somatotyping has been used to study many aspects of exercise, sports sciences and human biology.

Somatotype has been applied, in its original and modified forms, in a variety of ways to demonstrate similarities and differences between diverse groups or populations. Differences in physique between populations in different regions also accrue because of cultural differences between populations (Handa et al., 1995). Somatotypes also vary with age and sex in the same population. Studies conducted on somatotype of different groups including

children, athletes and adults provide useful information regarding association between physique and other factors, viz., human growth, exercise, performance, nutrition, etc. Based on the finding of these studies, possessions of certain somatotypes are considered superior in skills requiring stamina. For example, athletes are generally found to possess limited (or less variable) somatotypes. Also, changes have been demonstrated to occur in somatotypes of men as a result of physical training (Carter and Phillips, 1969; Carter and Rahe, 1975).

Endomorphy

Age group wise distribution of endomorphic component of somatotype physique in Jat boys and girls is shown in figure 1. Endomorphy or the 'component of relative fatness' in physique demonstrates a steady increase with age till 14 years of age in boys. Age changes in Jat boys are less marked. Endomorphy tends to increase in Jat girls between 10 to 18 years of age. Higher age group girls (14 to 18 yrs) are more endomorphic than the younger ones (10 to 13 yrs). Higher endomorphy in individuals requires them to utilise more energy to perform a task (Stepnicka, 1976), due to a negative relationship between

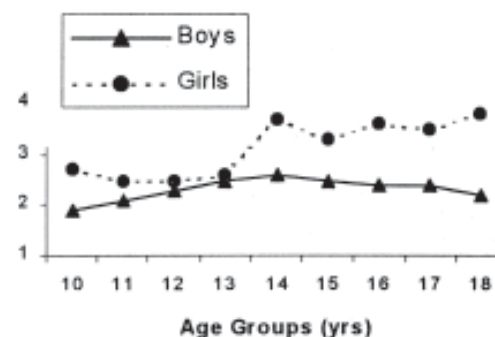


Fig. 1. Endomorphy in Jats, by age and sex.

endomorphy and physical activity involving strength and stamina. The girls are more endomorphic than the boys. Sex differences in endomorphy are statistically significant after 13 years of age (Table 4).

Mesomorphy

Age group wise distribution of mesomorphic component of body physique of Jat boys and girls are set out in figure 2. Mesomorphy, the

second component of physique is an indicator of relative musculo-skeletal development per unit of length. A marginal decline in the mean values with age is visible in the boys between 10 to 18 years of age. There is no age specific trend in mesomorphic component of somatotype in Jat girls (Fig. 2). Mesomorphic component does not display any sex difference with age, except at 11 yrs. (Table 4). However, this has to be interpreted cautiously. As mesomorphy is assessed in relation to stature, therefore, it is possible that boys are absolutely stronger in

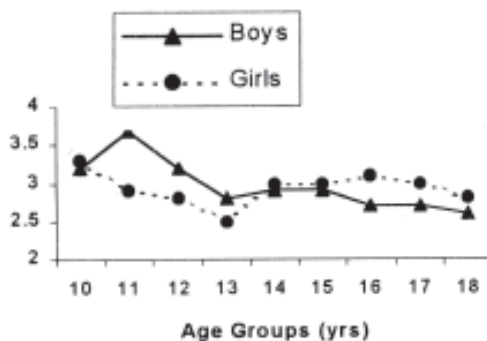


Fig. 2. Mesomorphy in Jats, by age and sex.

muscle mass than the girls but not related to stature. The younger boys and girls have greater mesomorphic component than the older boys and girls. This however, does not mean that younger ones are more muscular than the older ones, partly because of the fact that mesomorphy is adjusted for height. Also, non-statistically significant sex differences in this component should not be interpreted as that boys and girls are having equal muscle mass. As this component is adjusted for height, male being taller especially after 14 years of age are stronger, and muscular than the girls.

Proportionately there is no difference but absolutely there is difference in boys and girls. Higher muscularity in Jat boys as compared to Jat girls is also evident from results of various physical fitness tests associated with muscularity. For example, in the tests of strength (static, explosive and functional) and endurance, boys scored better than girls (Gakhar and Malik, 1999).

Ectomorphy

Fig. 3 delineates the age group wise distribution of ectomorphic component of somatotype physique in Jat boys and girls ranging in age from 10 to 18 years. Ectomorphy

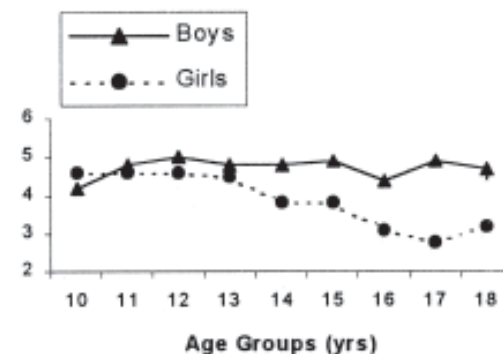


Fig. 3. Ectomorphy in Jats, by age and sex

or the 'relative linearity of individual physique' remains almost leveled off in boys after an initial gain between 10-11 years. The girls between 10-12 years are much linear than the girls of higher age groups. Jat girls are comparatively less ectomorphic than boys at all ages, except at 10 years of age (Fig. 3). In the lower age groups, between 10-13 years, differences in linearity of

Table 4: Sex differences in somatotype components: results of ANOVA

Age Groups (yrs.)	Endomorphy		Mesomorphy		Ectomorphy	
	F values	Significance	F values	Significance	F values	Significance
10 ±	7.58	Significant	0.55	Non-sign.	1.59	Non-sign.
11 ±	3.56	Non-Sign.	9.48	Significant	0.02	Non-sign.
12 ±	1.70	Non-Sign.	2.59	Non-sign.	1.77	Non-sign.
13 ±	0.58	Non-Sign.	1.34	Non-sign.	0.56	Non-sign.
14 ±	15.60	Significant	0.14	Non-sign.	7.19	Significant
15 ±	15.56	Significant	0.02	Non-sign.	13.62	Significant
16 ±	23.33	Significant	1.49	Non-sign.	18.89	Significant
17 ±	27.08	Significant	1.70	Non-sign.	42.33	Significant
18 ±	35.77	Significant	0.58	Non-sign.	21.33	Significant

Significant at 5 % probability level.

the two sexes are not significant. However, after 13 years boys are significantly more ectomorphic than coeval girls in rest of the age groups (Table 4).

Anthropometric Somatotyping

Age group wise distributions of mean somatotypes in Jat boys and girls belonging to different age groups are presented in table 5 and elucidated in Figure 4 and Figure 5. Mean somatotypes in 10–18 yrs age group of Jat boys are either Meso-ectomorph or balanced ectomorph closed to the central types. In fact the younger boys (10–11 yrs.) are Meso-

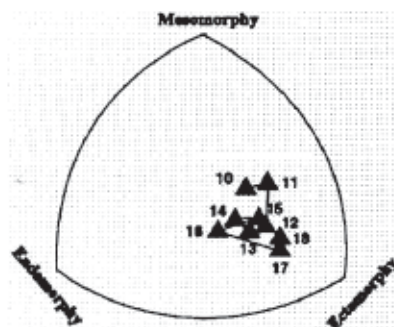


Fig. 4. Mean somatotype in Jat boys, by age

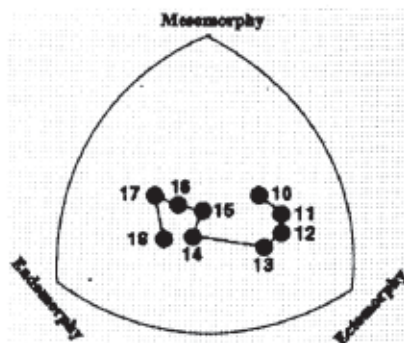


Fig. 5. Mean somatotype in Jat girls, by age.

ectomorphs, whereas the older boys (12 years and above) are Balanced ectomorphs. Jat girls begin as Balanced ectomorph (10–13 yrs.) to become Central type (14–18 yrs.) as they advance in age. It is important to note that the age changes in physique from 10 to 18 years are greater in girls than in boys (Fig. 6). Also the average somatotype dispersion distance in this age range is higher in girls (1.11) than boys (0.71).

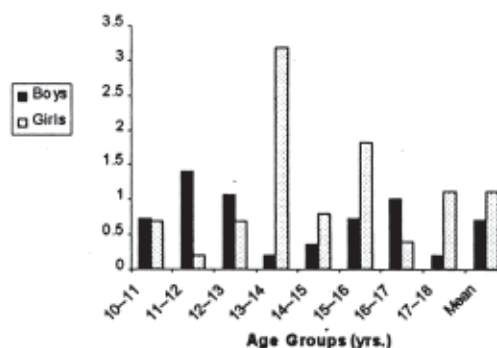


Fig. 6. Age changes in somatotype dispersion distance in Jat boys and girls.

Somatotype dispersion distances calculated between coeval boys and girls show increase with age (Fig. 7). This indicates that the sex differences in body physique increase with age.

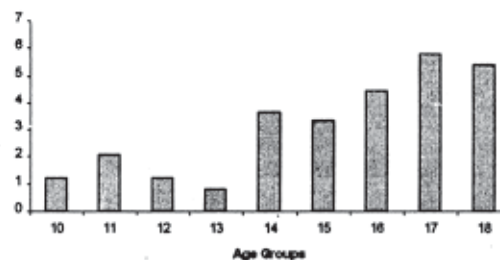


Fig. 7. Age group wise sex differences in Somatotype dispersion distance.

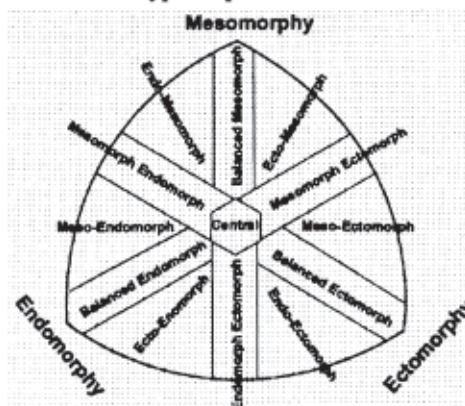


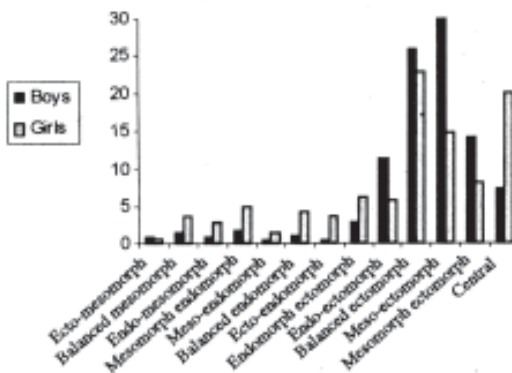
Fig. 8. Somatochart displaying somatotype categories

Somatochart categories have been displayed in figure 8 and age group wise distribution of Jat boys and girls into different somatotype categories is provided in figure 9. Jat boys, in the

Table 5: Mean somatotype and somatotype categories, by age and sex

Age Groups (yrs.)	Boys		Girls	
	Mean Somatotype	Somatotype Category	Mean Somatotype	Somatotype Category
10 ±	1.9 – 3.2 – 4.2	Meso-Ectomorph	2.7 – 3.3 – 4.6	Balanced Ectomorph
11 ±	2.1 – 3.7 – 4.8	Meso-Ectomorph	2.5 – 2.9 – 4.6	Balanced Ectomorph
12 ±	2.3 – 3.2 – 5.0	Balanced Ectomorph	2.5 – 2.8 – 4.6	Balanced Ectomorph
13 ±	2.5 – 2.8 – 4.8	Balanced Ectomorph	2.6 – 2.5 – 4.5	Balanced Ectomorph
14 ±	2.6 – 2.9 – 4.8	Balanced Ectomorph	3.7 – 3.0 – 3.8	Central
15 ±	2.5 – 2.9 – 4.9	Balanced Ectomorph	3.3 – 3.0 – 3.8	Central
16 ±	2.4 – 2.7 – 4.4	Balanced Ectomorph	3.6 – 3.1 – 3.1	Central
17 ±	2.4 – 2.7 – 4.9	Balanced Ectomorph	3.5 – 3.0 – 2.8	Central
18 ±	2.2 – 2.6 – 4.7	Balanced Ectomorph	3.8 – 2.8 – 3.2	Central

Significant at 5 % probability level.

**Fig. 9. Sex differences in distribution of Jats in various somatotype categories.**

age range of 10 to 18 years have a dominant ectomorphic component and only marginally higher mesomorphic component than the endomorphic component. A sizeable number of Jat boys are either Meso-ectomorph (29.8%) or Balanced ectomorph (25.8%). Also Mesomorph-ectomorph (14.2%), endo-ectomorph (11.3%) and Central (7.4%) type of physique is common. Rest of the boys belongs to Endomorph-ectomorph (2.9%), Mesomorph-endomorph (1.9%), Balanced mesomorph (1.6%), Balanced endomorph (1.2%), Ecto-mesomorph (0.9%), Endo-mesomorph (0.9%), Meso-endomorph (0.6%) and Ecto-endomorph (0.6%) category.

The commonest somatotype of Jat girls is Balanced ectomorph (22.8%), followed by Central (20.2%), Meso-ectomorph (14.7%) and Mesomorph-ectomorph (8.1%) as illustrated in fig. 9. It is followed by Endomorph-ectomorph, (6.3%), Endo-ectomorph (5.9%) and Mesomorph-endomorph (5.1%). Rests of the girls are Ecto-endomorph (4.4%), Balanced mesomorph (3.7%), Ecto-endomorph (3.7%), Endo-mesomorph

(2.9%), Meso-endomorph (1.5%), or Ecto-mesomorph (0.7%). Generally Jat girls have the three components well distributed with slight ectomorphic dominance.

Succinctly, only minor changes with age are evident in endomorphic, mesomorphic and ectomorphic components among Jat boys and girls. Girls have higher endomorphic and lower ectomorphic components than the boys. The differences in these two components are statistically significant in the older age groups than in the younger age groups. Presence of higher body fat in them basically influences the performance of physically active tasks. Rowland (1996) explained the gender-related differences in physiological responses to physical fitness exercises through sex differences in body composition. Lesser physical exercise in girls in higher age groups may be responsible for lower linearity levels in them as compared to younger ones. Parizkova (1973) reported that undertaking systematic physical activity improved body composition in a characteristic way in children and even in adults. Mesomorphic component is not displaying any sex difference, partially because this component is height adjusted. Jat boys and girls have predominantly meso-ectomorphic, balanced ectomorphic and central type of physique. Thus, differences in physical activity patterns, among other factors, help explain age and sex related variations in body physique of Jats (Gakhar and Malik, 1999).

KEY WORDS Body Physique, Growth, Jat Children, Somatotype, Delhi.

ABSTRACT Somatotype studies have both pedagogic and pragmatic merits. With a view to delineate age changes and sex differences in anthropometric somatotype and its three components, viz., endomorphy, mesomorphy and ectomorphy among Jats of Delhi in the age range of 10 to 18 years, data were collected on Jat

boys (308) and Girls (272). Jat boys and girls have primarily meso-ectomorphic, balanced ectomorphic and central type of physique. Generally Jat girls are more endomorphic and less ectomorphic than Jat boys. With advancement in age, Jat boys tend to become balanced ectomorphic from meso-ectomorphic, whereas Jat girls have a tendency to become central type from balanced ectomorphic type of physique.

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