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Magnitude of Sex difference in Body Physique of Sainis of Punjab

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ABSTRACT:

The aim of the present study was to evaluate the magnitude of sex difference in body physique of 678 Sainis of Punjab (260 males and 418 females), aged 18-45 years. Anthropometric somatotyping was done following the method of Heath and Carter (Heath and Carter, 1967; Carter, 1980). Descriptive statistics and One way analysis of variance depicted significant higher endomorphy and lower ectomorphy among Saini females than Saini males, whereas non-significant differences were observed in mesomorphy. Further, the distribution of mean somatotypes and somatotype categories showed that in general Saini males have endomorphic mesomorph body physique and females have endomorph mesomorph body physique.

Key words: Body Physique, Somatotyping, Endomorphy, Mesomorphy, Ectomorphy, Sainis.

INTRODUCTION

The body physique of an individual can be aptly represented using anthropometric somatotyping. Somatotyping attempts to lay a foundation in describing human physical variations. The term

'Somatotype' was coined by Sheldon and his co-workers (Sheldon *et al*., 1940). A modification was suggested for extension and readjustment of this universal rating scale, applicable to both the sex at all ages and constructed tables to obtain reliable anthropometric somatotype rating (Heath and Carter, 1967). The three somatotype components-Endomorphy, Mesomorphy and Ectomorphy together act as a three-component rating system to describe the morphological characteristics of an individual. Somatotype does not change with age but it represents the rater's estimate of that element of body shape which remains unchanged during growth, at least under reasonably favourable conditions (Sheldon *et al*., 1954). Significant variations considering anthropometric somatotyping among and within the populations have been illustrated in prior studies (Singh and Sidhu, 1980; Malik *et al. 1986*, Gaur and Singh, 1997). Pertaining to sexual dimorphism studies across the world, statistically significant sex differences were reported in the body composition and somatotypes (Buffa *et al*., 2005). Earlier studies (Heath, 1961; De Garay *et al*., 1974; Prakash and Malik, 1989) have also demonstrated that the difference in body physique between the two sexes is the combined effect of genetics (Heath *et al*., 1961; Eiben, 1972; De Garay *et al*., 1974; Stepnicka *et al*., 1976), age (Carter and Parizkova, 1978), physical activity (Parizkova, 1977; Carter and Parzkova, 1978), maturation (Borms, 1971; Beunen, 1973-74), body composition (Willmore, 1970; Slaughter and Lohman, 1976;), physical performance (Carter, 1970; De Garay *et al*., 1974; Eiben *et al*., 1986), nutrition (Stini, 1979; Malik *et al*., 1986) and environment (Eiben *et al*., 1986; Malik *et al*., 1986).

The present study aims to evaluate magnitude of sex difference in body physique of Sainis of Punjab.

MATERIAL AND METHODS

The State of Punjab is located in North West part of India with Chandigarh as its capital. The total area of the state is 50,362 km^2 and it extends from 29˚30' to 29˚30' North latitude, and 73˚55' to 76˚50' East longitude. Punjab is divided into three regions namely Majha, Doaba and Malwa including twenty two districts.

Sainis are the agriculturist and landowning caste of Punjab settled mainly in districts of Roopnagar, Jalandhar, Hoshiarpur, Shahid Bhagat Singh Nagar, and Gurdaspur with less presence in other districts. Major clans (*gotra*) of Sainis include Boli, Badwal, Chere, Pable,

Masute, Longia, Nanua, Banwait, Dhamrait, Mundre Chandel, Daurke, Gahuniye, Gidde, Tumbar, Girn and Panghlia.

Land is the main source of economy for the rural section of the Sainis in Punjab. Lately, Saini people have gradually diversified into trade, small-scale industries, government and private sector services or self- employment and are employed in jobs such as teachers, administrators, lawyers, doctors and defense. High literacy rate is prevalent amongst this population with most of the Saini children achieving tertiary level of education. Most of the marriages are monogamous and are arranged through negotiations. They are endogamous at community level, and exogamous at village and gotra level. Both men and women are chiefly vegetarian with moderate consumption of non-vegetarian food and occasional intake of fruit though milk is essential part of their diet.

A cross-sectional sample of six hundred and seventy eight adult Sainis was collected from various villages and cities of district Roopnagar, Shahid Bhagat Singh Nagar, Hoshiarpur, Jalandhar, Chandigarh, Sahibzada Ajit Singh Nagar, Patiala, and Ludhiana in Punjab and involved two hundred sixty males and four hundred eighteen females in the age group of 18-45 years.

To evaluate anthropometric somatotyping following measurements were taken as per internationally accepted standards (Carter and Heath 1980; Singh and Sidhu, 1980; Gakhar and Malik, 2002).

Body weight, stature, bicondylar humerus, bicondylar femur, mid upper arm and calf circumference, skin folds (triceps/sub-scapular/supra-iliac/calf medial). Furthermore, statistical analysis included mean, standard error of mean, coefficient of variation, analysis of variance.

Endomorphy: The first component of the somatotype, it describes the relative fatness in an individual's physique. It was calculated using formula (Carter 1980),

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

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

Height corrected: It is described as the relative fatness of a physique adjusted to universal height (170.18 cm) (Hebbelinck *et al.*, 1973). The sum of three skinfolds, viz., triceps, subscapular and suprailiac is corrected using the height of the subject.

The formula is as below (Carter, 1980):

Height Corrected Endomorphy = -0.7182 + 0.1415(X) – 0.00068$(X)^2$ + 0.0000014$(X)^3$

Where X = (sum of triceps, subscapular and suprailiac skinfolds) multiplied by (170.18/height in cms.).This is called height corrected endomorphy and is preferred method for calculating endomorphy.

Mesomorphy: The second numeral component of the somatotype and it defines the relative musculoskeletal development of a body. This was obtained using following equation proposed by Carter (Carter, 1980):

Mesomorphy = (0.858 x Bicondylar humerus) + (0.601 x Bicondylar femur) + (0.188 x corrected arm girth) + (0.161 x corrected calf girth) – (height x 0.131) + 4.50.

Where,

Corrected upper arm girth = Mid Upper arm circumference (cm) – Triceps skinfold (mm)/10;

Corrected calf girth = Calf circumference (cm) – Calf skinfold (mm)/10.

Ectomorphy: It is the third component of physique and it refers to the relative linearity of the individual's physique. It was calculated using Carter's equation (Carter, 1980). Before calculating the ectomorphy, Height – Weight Ratio (HWR) is calculated using the following formula:

HWR = Height / $\sqrt[3]{\text{weight}}$, where height is in cm and body weight is in kg.

Based on the obtained value of HWR, three equations were used to calculate ectomorphy:

When HWR $\geq$ 40.75, then Ectomorphy = (HWR x 0.732) – 28.48

When 40.75 > HWR > 38.25, then Ectomorphy = (HWR x 0.463) – 17.63

When HWR $\leq$ 38.25, then Ectomorphy = 0.1

The three digit somatotype was plotted on a two dimensional somatochart using the X, Y coordinates derived from Carter's equations (Carter, 1980) as follows:

X coordinate = Ectomorphy – Endomorphy

Y coordinate = 2 (Mesomorphy) – (Endomorphy + Ectomorphy)

The values, thus obtained were plotted on X and Y axis of somatochart.

Somatotype Dispersion Distance (S.D.D.): It was calculated by the formula given by Ross and Wilson (Ross and Wilson, 1973).

S.D.D. = $\sqrt{[3 * (x1 - x2)^2 + (y1 - y2)^2]}$

Where, x_1 and y_1 are scalar coordinates of mean somatoplot. The S.D.D. is represented in y distance units, i.e. in terms of distance at y axis of a somatoplot.

Mean Somatotype Dispersion (S.D.M.): It was calculated as the average of all Somatotype Dispersion Distances.

S.D.M. = $\sum$ S.D.D. / N

Standard deviation of Somatotype dispersion distance (D.S.D.): It was calculated as the standard deviation of S.D.D.

Somatotype Attitudinal Distance (S.A.D.): It was calculated using the following formula:

$$SAD_{(A, B)} = \sqrt{(endoA - endoB)^2 + (mesoA - mesoB)^2 + (ectoA - ectoB)^2}$$

Where, endo =endomorphy rating, meso =mesomorphy rating, ecto =ectomorphy rating, A= an individual or a group and B= an individual or a group.

Somatotype Attitudinal Mean (S.A.M.): It was calculated as the average of the SADs of each somatopoint from the mean somatopoint (S) of the sample.

SAM = $\sum SAD_i / n_x$

RESULTS AND DISCUSSION

As evident from the somatotyping results, the endomorphic component is significantly higher in females than in males (Tables 1 and 2; Figure 1). Prior investigations have found to be having similar trends (Malik *et al.*, 1986; Gakhar and Malik, 2002; Herrera *et al.*, 2004; Buffa *et al.*, 2005; Kalichman and Kobyliansky, 2006). In mesomorphic component, sex differences in the population group are non-significant. As this component involves height measurement, males being taller are stronger and muscular than females which show absolute difference between both the sex (Gakhar and Malik, 2002). So, non-significant differences in this component should not be interpreted as that males and females of the population group have equal muscle mass. Males have significantly higher ectomorphic component than their female counterparts in the population suggests that males are much more linear in physique than females. This is in agreement with other studies (Heath and Carter, 1971; Khongsdier, 2001 and Herrera *et al.*, 2004 Ghosh and Malik, 2007; Ghosh and Malik, 2010). Sex differences in body physique may be due to the compounded effect of genetics, physical growth, maturation, body composition, nutrition and environment (Heath *et al.*, 1961; De Garay *et al.*, 1974; Stini, 1979; Malik *et al.*, 1986).

Table 1: Descriptive statistics of Somatotype components, SDD and SAD in male and female Sainis of Punjab

Anthropometric Somatotypes	Sex	Mean	S. E.	C.V.
Endomorphy	Males	4.27	0.09	35.15
	Females	5.77	0.08	27.47
Mesomorphy	Males	5.61	0.11	32.49
	Females	5.63	0.11	38.23
Ectomorphy	Males	2.49	0.11	69.44
	Females	1.85	0.08	91.23
SDD	Males	5.88	0.21	56.97
	Females	6.27	0.17	53.86
SAD	Males	2.55	0.09	55.89
	Females	2.79	0.07	52.68

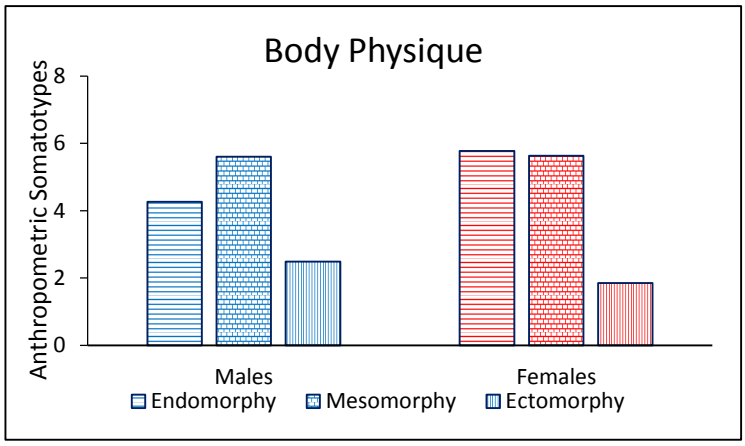


Figure 1: Body Physique, by Sex

Table 2: Comparison of Body Physique, by Sex

Anthropometric Somatotypes	F-value	d/f	P-value	Significance
Endomorphy	150.58	1/677	P <0.001	S
Mesomorphy	0.01	1/677	1.0> P >0.9	NS
Ectomorphy	22.91	1/677	P <0.001	S
SDD	2.05	1/677	0.5> P> 0.1	NS
SAD	4.42	1/677	0.05>P >0.01	S

S-Significant and NS-non significant at 5% probability level,

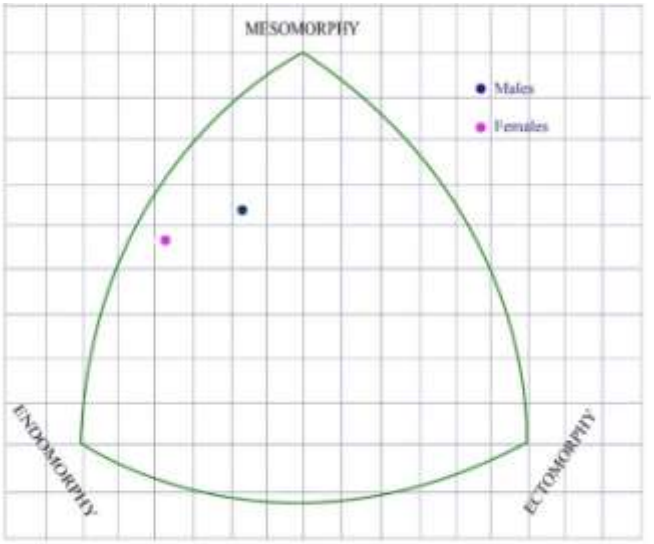


Figure 2: Somatochart displaying distribution of mean somatotype, by Sex

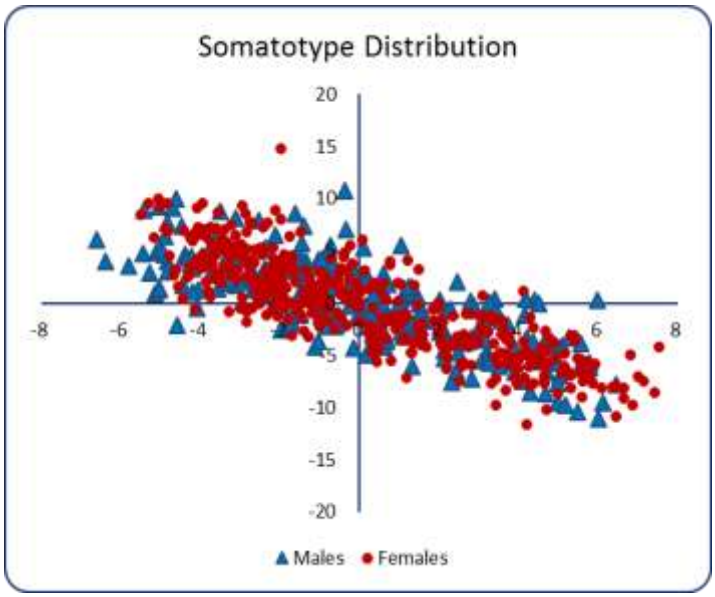


Figure 3: Somatotype distribution, by Sex

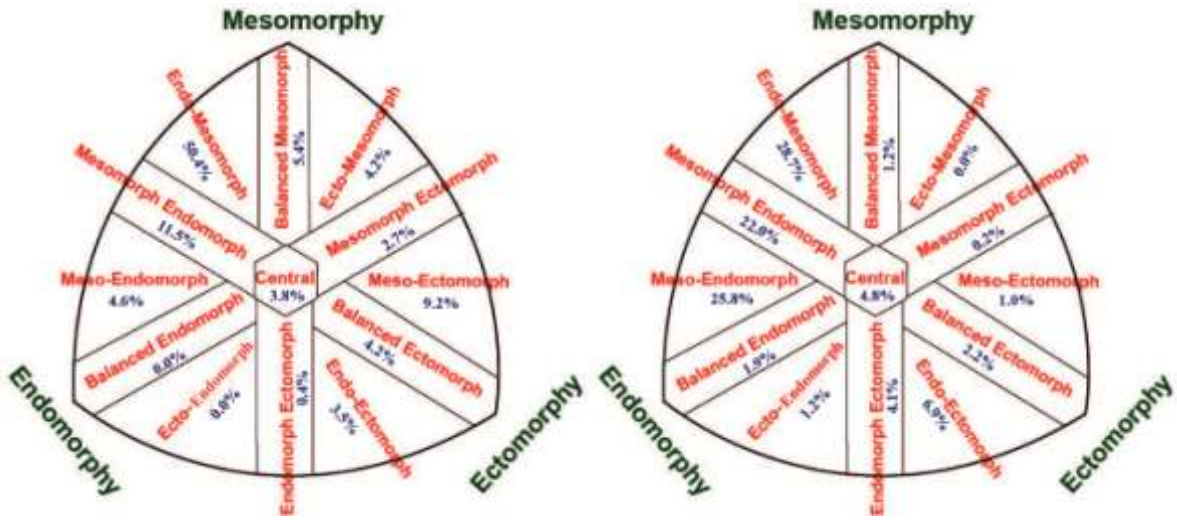
The distribution of somatotype values in the Somatochart (Figures 2 and 3) reveals that in general males of Sainis are Endomorphic-Mesomorphs (4.3-5.6-2.5). The study also reveals that Saini females are Endo-Mesomorphs (5.7-5.6-1.8) with slight differences in respect of males, which suggests that the population group is fattier as well as muscular in its body physique.

Individual somatotypes of the adult Saini population were classified as per the categories given by Carter (Carter, 1980). As per the distribution of somatotype categories among Saini males and females (Table 3 and Figure 4 (A) and (B)), Saini males are mostly endomorphic-mesomorph,

followed by mesomorph-endomorph and mesomorphic ectomorph. Saini males show a similar prevalence of balanced mesomorph and mesomorphic-endomorph. Also, balanced ectomorph, ectomorphic-mesomorph, endomorphic ectomorph, mesomorph-ectomorph and central type of physique is observed, followed by rare presence of endomorph-ectomorph and mesomorph-ectomorph. Ectomorphic endomorph and balanced endomorph somatotypes are not observed among Saini males. Generally, Saini females belonged to endomorphic-mesomorph followed by mesomorphic-endomorph, mesomorph-endomorph, endomorphic-ectomorph, occasionally central, endomorph-ectomorph, balanced mesomorph, balanced ectomorph, balanced endomorph but seldom mesomorphic-ectomorph and mesomorph-ectomorph. Ectomorphic mesomorph somatotype was not seen in case of females.

Table 3: Sex differences in Somatotype Categories of Male and Female Sainis of Punjab

Somatotype Categories	Sex	Frequency	Percent
Central	Male	10	3.8
	Female	20	4.8
Balanced Endomorph	Male	0	0
	Female	8	1.9
Mesomorphic Endomorph	Male	12	4.6
	Female	108	25.8
Mesomorph endomorph	Male	30	11.5
	Female	92	22.0
Endomorphic Mesomorph	Male	131	50.4
	Female	120	28.7
Balanced mesomorph	Male	14	5.4
	Female	5	1.2
Ectomorphic Mesomorph	Male	11	4.2
	Female	0	0
Mesomorph Ectomorph	Male	7	2.7
	Female	1	0.2
Mesomorphic Ectomorph	Male	24	9.2
	Female	4	1
Balanced Ectomorph	Male	11	4.2
	Female	9	2.2
Endomorphic Ectomorph	Male	9	3.5
	Female	29	6.9
Endomorph Ectomorph	Male	1	0.4
	Female	17	4.1
Ectomorphic Endomorph	Male	0	0
	Female	5	1.2



Males(Fig. 4A) *Females (Fig. 4B)*

Figure 4A and 4B: Somatocharts displaying somatotype categories in Saini males and females respectively

Somatotype Dispersion Distance (S.D.D): In Sainis, dispersion pattern in body physique shows sex differences, (Tables 1 and 2; Figure 5). Dispersion of somatotype distance (D.S.D.) reveals that Saini females exhibit a marked variability in physique distribution than Saini males.

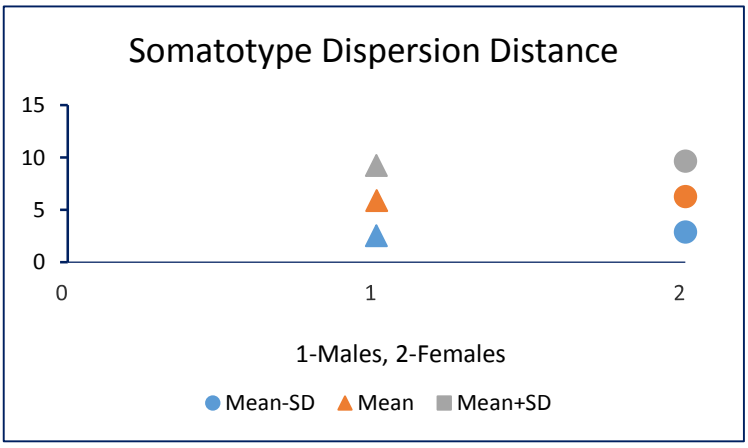


Figure 5: Somatotype Dispersion distance

Somatotype Attitudinal Distance (SAD): Somatotype attitudinal mean was determined using SAD values of adult Saini population for both males and females (Table 1 and 2; Figure 6) and

the magnitude of somatotype deviation of each individual somatotype with respect to mean group somatotype separately for both sexes is presented in a box and whiskers graph. It is noteworthy that SAM values for Saini females are more than males of the population group. Wider dispersion was found in case of females whereas range of variation i.e. between maximum and minimum is found to be greater in case of Saini males.

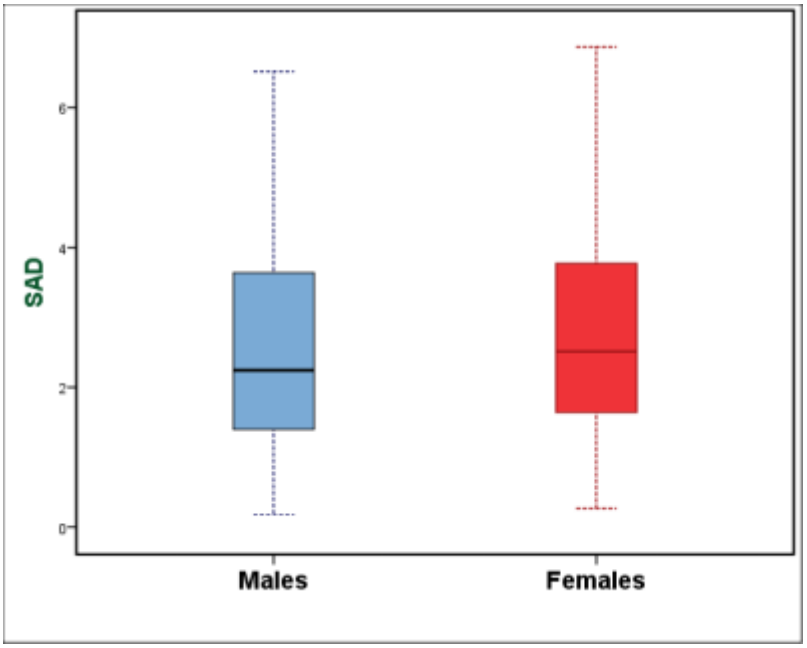


Figure 6: Somatotype Attitudinal Distance

Among Sainis, sex differences are evident in Dispersion pattern in body physique. Thus, the distribution of mean somatotypes and somatotype categories delineate that in general males of the population group are Endomorphic-Mesomorphs (4.3-5.6-2.5) and females are Endo-Mesomorphs (5.7-5.6-1.8) with slight differences in respect to males, which suggests that the population group is fattier as well as muscular in its body physique. High mesomorphic ratings in the population may be characterised by the occupational differences, as there is positive association between mesomorphic component and physical activity as both body mass and its distribution also affect the mechanical strength of weight-bearing skeletal elements, i.e. long bones of the extremities (De Garay *et al.*, 1974; Stepnicka *et al.*, 1976; Malik *et al.*, 1986; Ozener 2008).

Table 4: Sex Difference Index in Body Physique

Anthropometric Somatotypes	Males	Females	Sex Difference Index
Endomorphy	4.27	5.77	-29.96
Mesomorphy	5.61	5.63	-0.27
Ectomorphy	2.49	1.85	29.59
SDD	5.88	6.27	-6.35
SAD	2.55	2.79	-9.10

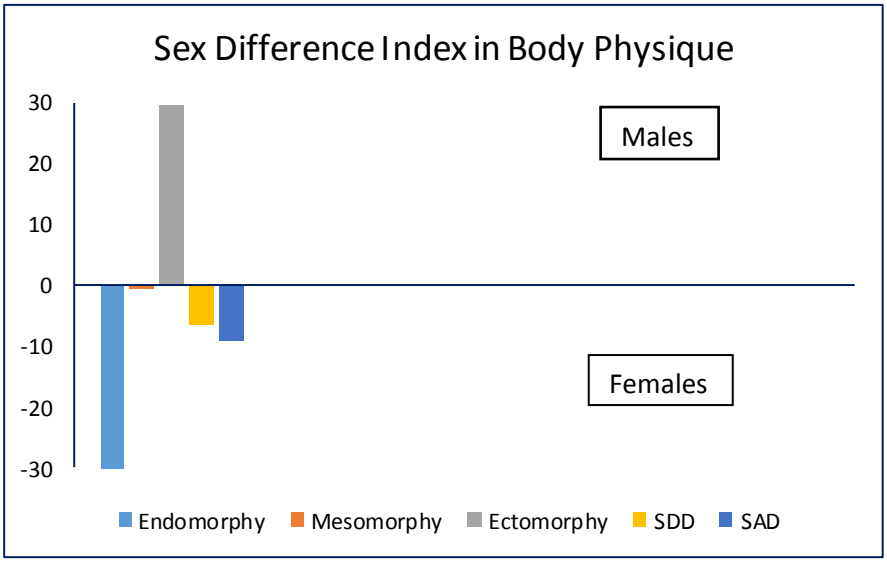


Figure 7: Sex Difference Index in Body Physique

Sex differences in body physique (Table 4 and Figure 7) reveal that endomorphic component is higher in females (Malik *et al.*, 1986; Gakhar and Malik, 2002; Herrera *et al.*, 2004; Buffa *et al.*, 2005; Kalichman and Kobyliansky, 2006) as evident from negative sex difference index whereas ectomorphic component is higher in males (Heath and Carter, 1971; Khongsdier, 2001 and Herrera *et al.*, 2004 Ghosh and Malik, 2007; Ghosh and Malik, 2010). This could be because of more subcutaneous adipose tissue level in females as compared to males whereas greater lean tissue as well as tall stature in males results in higher ectomorphy values. Mesomorphy shows least sex differences. Dispersion of somatotype is more in case of females than males.

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