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Anthropometric Somatotype of Kshatriya and Kurmi of Uttar Pradesh: population and gender differences

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Abstract: *The aim of this cross-sectional study was to describe the population and gender related variations of the somatotype, employing Heath and Carter's method, in Kshatriya and Kurmi population residing in a rural region of Uttar Pradesh. The sample included 1008 adult Kshatriya (252 males and 252 females) and Kurmi (252 males and 252 females), belonging to the age group of 18-40 yrs. The population and gender differences were evaluated by one –way ANOVA. The results suggest that average body physique of Kshatriya males is Ectomorphic-Mesomorph (2.2 – 4.6 – 3.9) while that of Kshatriya females is Balanced mesomorph (2.5- 4.7- 2.1). Kurmi males are also Ectomorphic- Mesomorph (2.3 – 6.5 – 3.4) and Kurmi females are Balanced mesomorph (2.3 – 4.7- 2.9). It means that, in general, both Kshatriya and Kurmi males have linear and muscular body physique whereas females are muscular in their body physique. The overall high mesomorphic ratings in both the populations can be attributed to the occupation of agriculture and factory work involving high physical activity.*

Key words: *anthropometric somatotype, Kshatriya, Kurmi, population difference, gender difference, one-way ANOVA, Uttar Pradesh*

INTRODUCTION

Worldwide variation in body size, body proportion and body physique exists between the genders (Hall, 1982; Antoszewska et al., 1992; Ghosh, 2004) and among different populations (Eveleth and Tanner, 1976; Ruff, 2002). Studying this variation in body size and physique has long been the interest of Anthropologists as it helps in understanding the health, nutritional status and degree of environmental adaptation of a population. The term 'Somatotype' was coined by Sheldon and his co-workers (Sheldon et al., 1940). Anthropometric somatotyping is basically the modified and developed version of Sheldon's technique but it gained impetus in the last two decades following the introduction of a simplified method for somatotyping by Heath and Carter, who forwarded a method of assessing anthropometric somatotype on the basis of ten anthropometric measurements (Heath and Carter, 1967). Because of its uniqueness it has been used for studying, among others population variation, age changes and sex differences.

Anthropometric somatotyping method has since been applied in its original and modified forms in a variety of ways from measuring the effects of nutrition on physique to the description

of many different groups and individuals including children, athletes and adults (Heath and Carter, 1967; Malousaris et al., 2008). The method of somatotyping is used as a means of assessing body shape and composition, independent of size (Bailey et al., 1982). Previous investigators suggested that adults' physique and body dimension were influenced by various factors, such as genetic factors, diet and environmental factors, occupation and physical activity (Sheldon, 1954; Heath and Carter, 1967; Walker and Tanner, 1980). Numerous factors that affect somatotype of an individual are age (Carter and Parizkova, 1978; Gakhar and Malik, 2002; Bhasin and Jain, 2007; Kaur, 2009), sex (De Garay et al., 1974; Heath et al., 1961; Prakash and Malik, 1989; Kalichman and Kobliansky, 2006), high altitude (Malik, 1987); nutrition (Sheldon, 1954; Malik et al., 1986; Chakrabarty et al., 2008), physical activity (Carter and Rahe, 1975; Ozener, 2008), occupation (Singh and Singh, 2006), socio-economic differences (Rahmawati et al., 2004; Dibamani Singh, 2011), etc.

Somatotype changes on different Indian populations of both sexes in different environment covering tribal and non-tribal groups have been carried out by researchers (Singh and Sidhu, 1980; Singh and Bhasin, 1990; Singh and Singh, 1991; Handa et al., 1995; Ghosh and Malik, 2007; Bhasin and Jain, 2007; Kaur, 2009; Singh, 2011). Besides, somatotype studies were also conducted on Bods of the Western Himalayas (Malik and Singh, 1978; Malik, 1987; Pandey and Malik, 1990); Garhwali males (Gaur and Singh, 1997); Brahmins Dogras (Singh and Bhasin, 1990); Rajputs and Brahmins of Chamba, Himanchal Pradesh (Singh and Singh, 1991); Jat girls (Gakhar and Malik, 2002); Brahmin and Rajput females of Himachal Pradesh (Dabral and Malik, 2003); Santhal males and females (Ghosh and Malik, 2010).

Considering the importance of understanding variation in body physique, the present study aims to study the population and gender differences in anthropometric somatotype among Kshatriya and Kurmi of Uttar Pradesh. As occupation of both the population groups require high level of physical activity and knowing that there is a strong relationship between activity and mesomorphy, the present study also aims to examine particularly the mesomorphic component in these groups.

MATERIALS AND METHODS

A cross sectional sample of 1008 adult Kshatriya (252 males and 252 females) and Kurmi (252 males and 252 females) belonging to the age group of 18-40 yrs was collected using multi-

stage sampling.The data for the Kshatriya population was collected from the Akbarpur subdivision of Ramabai Nagar, while that of Kurmi population was collected from the Fatehpur subdivision of Fatehpur district of Uttar Pradesh. Uttar Pradesh is the most populous state of our country with 71 districts (Census of India, 2011) where the major occupation is farming. Kshatriya or Kashtriya, meaning warrior, is one of the four castes (social orders) in Hinduism. It traditionally constituted the military and ruling elite of the Vedic-Hindu social system outlined by the Vedas and the Laws of Manu. In modern times, the Kshatriya caste includes a broad class of caste groups, differing considerably in status and function but united by their claims to ruler-ship, the pursuit of war, or the possession of land. Kshatriya marriages show caste endogamy and subcaste exogamy.

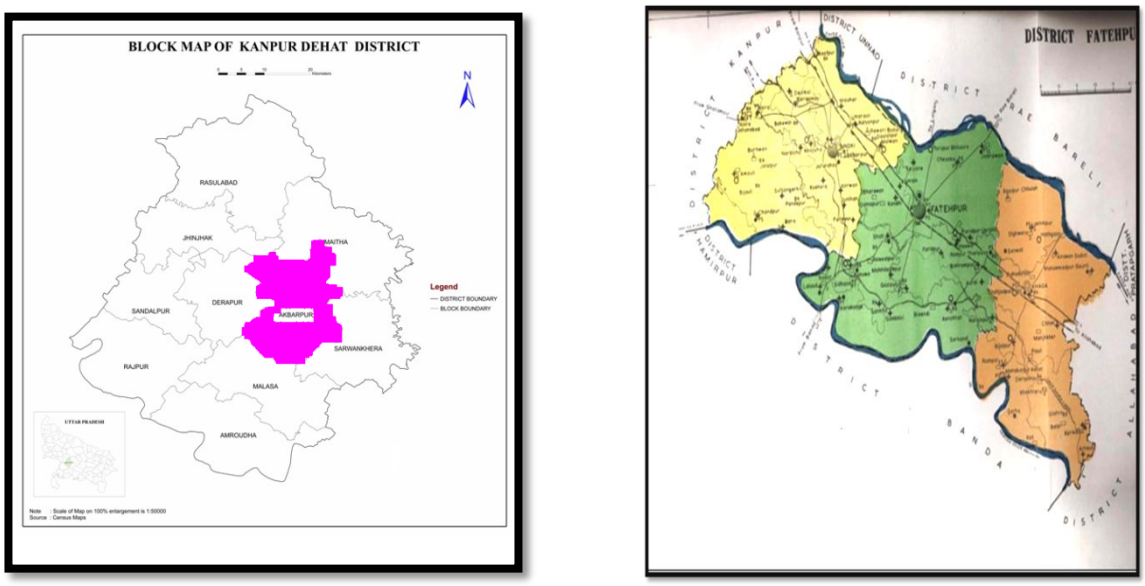

Figure 1: Maps of the districts of Kanpur dehat (http://kanpurdehat.nic.in) and Fatehpur (http://fatehpur.nic.in) showing the area of present study in Uttar Pradesh.

Kurmi is a large peasant community of farmers widely distributed in the states of Uttar Pradesh, Bihar, Madhya Pradesh, Punjab and Assam. They have eleven main divisions that follow caste endogamy and subcaste endogamy. Kurmi are often identified on the basis of the region they hail. For example, those from Uttar Pradesh are known as Purabia Kurmi, those from Bihar, Bihari Kurmi, and those from Madhya Pradesh as Manwa Kurmi and so on. They are listed among the Other Backward Class (OBC) and receive benefits from the government accordingly.

Anthropometric measurements namely stature, weight, skinfolds at triceps, suscapular, suprailiac and calf, bicondylar humerus, bicondylar femur, upper arm circumference and calf

circumference were taken following standard techniques (Tanner et al., 1969). Using above measurements, subjects were somatotyped following Heath-Carter method (Heath and Carter, 1967; Carter, 1980). Furthermore, Somatotype dispersion distances, Mean somatotype dispersion, Standard deviation of somatotype dispersion distance have been calculated using Ross and Wilson's (1973) method. In statistical analysis, mean, standard error and coefficient of variation for three somatotype components were computed using computerized statistical analysis software (SPSS 16 and MS Excel). Population and gender differences in all these variables were assessed using analysis of variance (ANOVA). Distribution and concentration of the somatotype were plotted in somatochart. Somatochart, which was first devised by Sheldon (Sheldon et al., 1940) is a graphical method to display somatotype data and is a basis of determining the pattern of component dominance.

RESULTS AND DISCUSSION

The distribution of all the three somatotype components among Kshatriya and Kurmi of Uttar Pradesh are presented in Table 1 and illustrated in Figure 2. Mean mesomorphic component is the highest in all the four groups, followed by ectomorphic and endomorphic components respectively. Both the populations are, thus, muscular and lean in their body physique.

Kshatriya females are slightly more endomorphic than their male counterparts (Table 1; Figure 2). Coefficient of variation is quite high in Kshatriya males showing their heterogeneous nature. Kurmi males are as endomorphic as Kurmi females. Kurmi males are significantly more endomorphic than Kshatriya males (Table 2). A reverse trend is observed in females where Kshatriya females are significantly more endomorphic than Kurmi females. As expected, both Kshatriya and Kurmi females are significantly more endomorphic than their male counterparts (Table 2). Earlier investigators have also found that females are generally more endomorphic than the males (Stepnika, 1976; Malik, et al., 1986; Gakhar and Malik, 2002; Buffa et al., 2005; Kalichman and Kobyliansky, 2006).

Table 1: Descriptive Statistics: anthropometric somatotype of Kshatriya and Kurmi of Uttar Pradesh

Somatotype components	Gender	Kshatriya			Kurmi		
		Mean	S.E	C.V	Mean	S.E	C.V
Endomorphy	Males	2.22	0.02	16.15	2.29	0.01	10.19
	Females	2.50	0.01	8.69	2.35	0.01	9.54
Mesomorphy	Males	4.55	0.06	19.76	6.46	0.07	16.66
	Females	4.69	0.05	16.66	4.68	0.06	21.41
Ectomorphy	Males	3.85	0.05	20.71	3.44	0.04	17.65
	Females	2.16	0.05	35.97	2.91	0.06	30.61

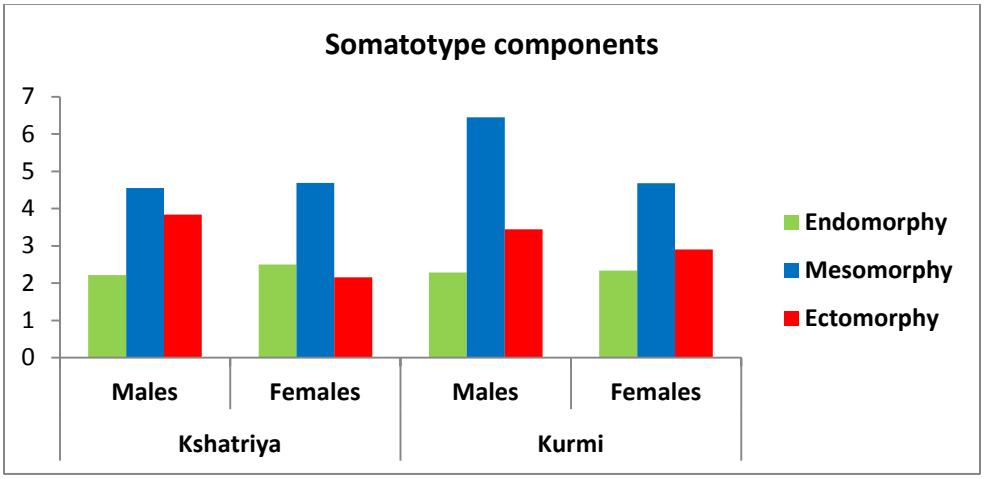

Figure 2: Somatotype components, by population and gender

Table 2: Somatotype components, by population and gender

Somatotype components	Population differences		Gender differences	
	Males	Females	Kshatriya	Kurmi
	F^{**} value	F^{**} value	F^{**} value	F^{**} value
Endomorphy	6.424*	59.105*	110.01*	8.032*
Mesomorphy	465.66*	0.012	3.493	367.00*
Ectomorphy	41.22*	100.68*	577.71*	61.63*

*Significant at 5% probability level; d.f= 1/502; ** One way ANOVA

A higher mesomorphic rating in Kurmi males than in Kshatriya males suggests that the former are more muscular than the later (Table 1; Figure 2). Females have more or less similar mean mesomorphic ratings suggesting alike musculo-skeletal development. Variability in mesomorphy is much more pronounced in Kshatriya males than in Kshatriya females and it is vice-versa in Kurmi. Kurmi males are significantly more mesomorphic than Kshatriya males whereas females show non-significant population difference in mesomorphy (Table 2). Range of variation is more in the case of Kshatriya males than in Kurmi males whereas a reverse trend is observed in the case of females. Kshatriya males are as mesomorphic as Kshatriya females showing non-significant difference. But non-statistically significant sex differences in this component need to be carefully interpreted as this component is adjusted for height. Males being taller, may be are stronger and muscular than females even if they have equal mesomorphic component (Gakhar and Malik, 2002). Kurmi males have significantly higher mesomorphic component than Kurmi females. Kshatriya males are more heterogeneous than Kshatriya females and Kurmi females are more heterogeneous in this component than Kurmi males. High mesomorphic ratings in both the populations can be attributed to the occupation of agriculture and factory work, as there is positive association between mesomorphic component and physical activity (De Gary et al., 1974; Stepnicka et al., 1976; Malik et al., 1986; Ozener, 2008).

Mean ectomorphic ratings in both Kshatriya and Kurmi males are higher than Kshatriya and Kurmi females (Table 1 and Figure 2). Both male and female Kshatriya are significantly more ectomorphic than male and female Kurmi respectively (Table 2). This purports that Kshatriya adults are more linear in physique than Kurmi adults. Both male and female Kshatriya show much higher variability than male and female Kurmi in this component. Males of both the populations are significantly more ectomorphic than their female counterparts delineating that male have much more linear physique than female (Table 2). This observation is in consonance with the results of other studies (Heath and Carter, 1971; Khongsdier, 2001; Herrera et al., 2004).

Somatotype values were plotted on somatocharts, which is a schematic, triangular shaped, two dimensional representation of the theoretical range of known somatotypes (Figures

3, 4, 5 and 6). General body physique of both Kshatriya and Kurmi males is Ecto-Mesomorph (2.2 – 4.6 – 3.9 and 2.3 – 6.5 – 3.4), which means they are predominantly linear and muscular. Females of both the populations are Balanced Mesomorph (2.5 – 4.7 – 2.1 and 2.3 – 4.7 -2.9), revealing a muscular body physique and a balance of linear and fatty components.

Table 3: Frequency distribution of Kshatriya and Kurmi in various Somatotype categories

Somatotype Categories*	Kshatriya				Kurmi			
	Males		Females		Males		Females	
	No.	%	No.	%	No.	%	No.	%
Mesomorph – Ectomorph	64	25.4	11	4.4	8	3.1	42	16.7
Ectomorphic – Mesomorph	108	42.6	32	12.7	203	80.6	78	30.9
Mesomorphic – Ectomorph	40	15.9	5	1.9	0	0	7	2.8
Balanced Mesomorph	23	9.1	110	43.7	39	15.5	92	36.5
Endomorphic – Mesomorph	10	3.9	94	37.3	10	3.9	30	11.9
Mesomorph – Endomorph	0	0	0	0	0	0	0	0
Endomorphic – Ectomorph	0	0	0	0	0	0	0	0
Balanced Ectomorph	7	2.8	0	0	0	0	3	1.1
Ectomorphic – Endomorph	0	0	0	0	0	0	0	0
Mesomorphic – Endomorph	0	0	0	0	0	0	0	0
Balanced Endomorph	0	0	0	0	0	0	0	0
Endomorph – Ectomorph	0	0	0	0	0	0	0	0
Central	0	0	0	0	0	0	0	0
Total	**252**	**100**	**252**	**100**	**252**	**100**	**252**	**100**

*Carter (1980)

Somatotypes of adult Kshatriya and Kurmi are classified into thirteen categories following Carter's classification (Carter, 1980) and presented in Table 3. Distribution of Somatotype categories among Kshatriya and Kurmi reveals that a sizeable amount of Kshatriya males are Ectomorphic-Mesomorph (42.6%). Every fourth of Kshatriya male is Mesomorph-Ectomorph. Also, Mesomorphic-Ectomorph (15.9%) and Balanced Mesomorph (9.1%) type of physique is observed.

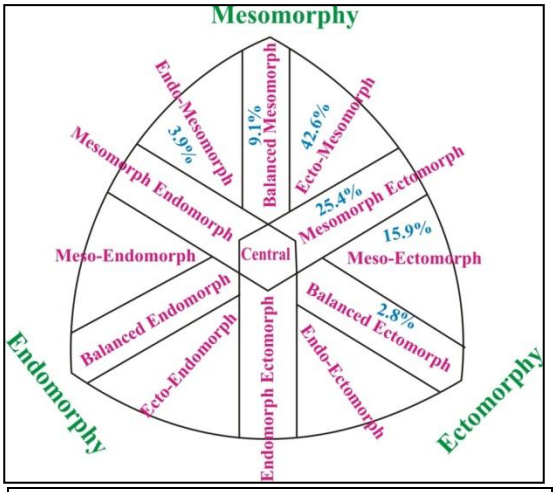

Figure 3: Somatochart displaying frequency of Kshatriya males in various categories

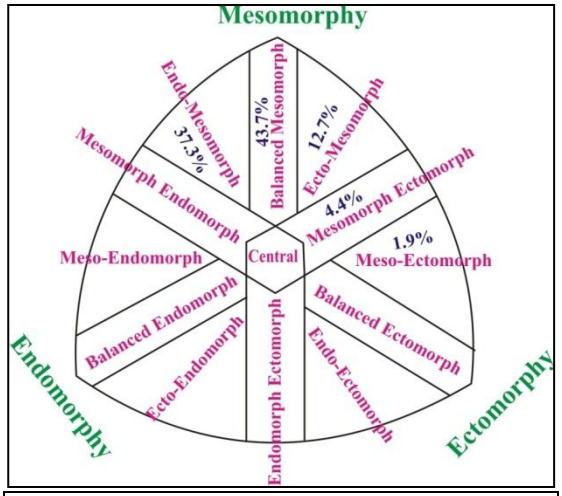

Figure 4: Somatochart displaying frequency of Kshatriya females in various categories

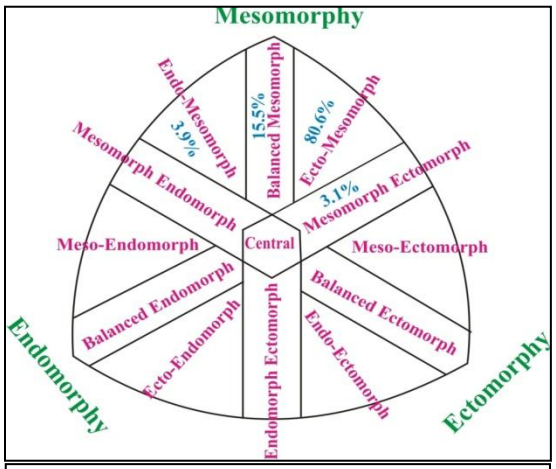

Figure 5: Somatochart displaying frequency of Kurmi males in various categories

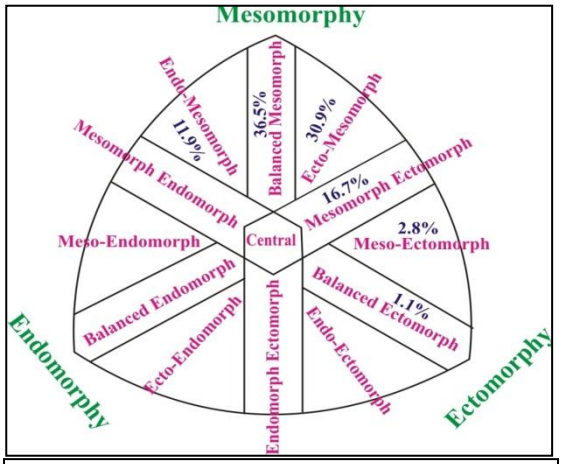

Figure 6: Somatochart displaying frequency of Kurmi females in various categories

Kshatriya females are predominantly Balanced-Mesomorph (43.7%), followed closely by, Endomorphic-Mesomorph (37.3%) and Ectomorphic-Mesomorph (12.7%). A very small section of females belongs to Mesomorph-Ectomorph (4.4%) and Mesomorphic-Ectomorph (1.9%). Kurmi males are predominantly Ectomorphic-Mesomorph (80.6%) in their body physique, followed by Balanced Mesomorph (15.5%). Rests of the males are either Endomorphic-Mesomorph (3.9%) or Mesomorph-Ectomorph (3.1%). Kurmi females are either Balanced Mesomorph (36.5%) or Ectomorphic-Mesomorph (30.9%). A sizeable number of Kurmi females

are also Mesomorph-Ectomorph (16.7%) or Endomorphic-Mesomorph (11.9%). Rests of them are either Mesomorphic-Ectomorph (2.8%) or Balanced Ectomorph (1.1%). The analysis of the entire three component in Kshatriya and Kurmi suggests that the general body physique of Kshatriya males is Ectomorphic-Mesomorph (2.2 – 4.6 – 3.9) while that of Kshatriya females is Balanced mesomorph (2.5- 4.7- 2.1). Kurmi males are Ectomorphic- Mesomorph (2.3 – 6.5 – 3.4) while Kurmi females are Balanced mesomorph (2.3 – 4.7 -2.9). It means that in general both Kshatriya and Kurmi males have linear and muscular body physique whereas females are muscular in their body physique.

Kshatriya males have significantly higher mean somatotype dispersion distance (SDM) than Kurmi males (Tables 4 and 5; Figure 7). In contrast, Kurmi females have significantly higher mean somatotype dispersion distance than Kshatriya females. Standard deviations of the somatotype dispersion distance (DSD) are greater in Kshatriya males than in Kurmi males, whereas in Kurmi females DSD is slightly higher than in Kshatriya females. Thus the physique of Kshatriya males is much more diverse than that of Kurmi males.

Table 4: Descriptive Statistics: somatotype dispersion distance among Kshatriya and Kurmi of Uttar Pradesh

Somatotype Dispersion Distance	Gender	Kshatriya		Kurmi	
		S.D.M	D.S.D	S.D.M	D.S.D
S.D.D	Males	4.54	2.02	2.30	1.26
	Females	2.08	1.22	2.54	1.25

Table 5: Somatotype Dispersion Distance, by population and gender

Somatotype Dispersion Distance	Population differences		Gender differences	
	Males	Females	Kshatriya	Kurmi
	F^{**} value	F^{**} value	F^{**} value	F^{**} value
S.D.D	222.85^{*}	17.63^{*}	275.29^{*}	4.37^{*}

*Significant at 5% probability level; d.f= 1/502; ** One way ANOVA

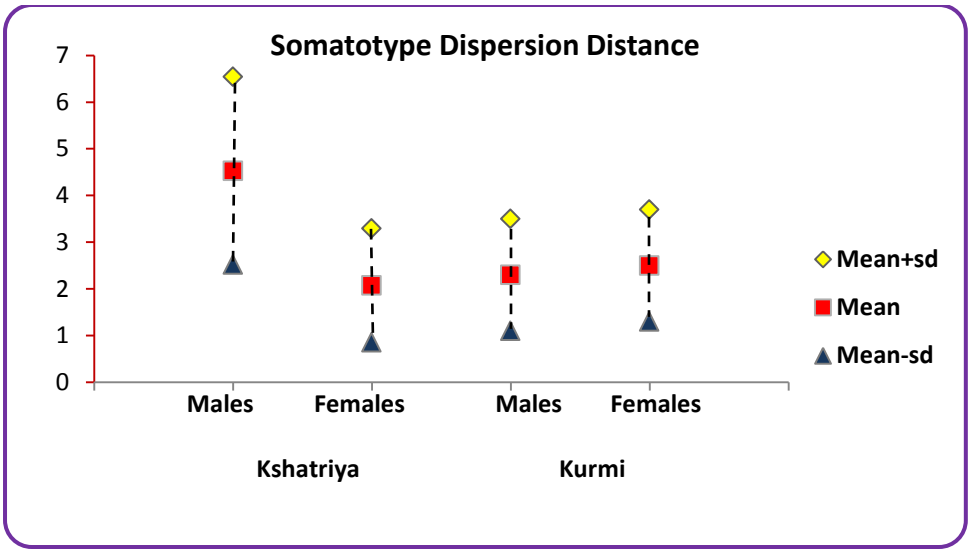

Figure 7: Somatotype Dispersion Distance in Kshatriya and Kurmi

Kshatriya males have significantly higher mean somatotype dispersion distance (SDM) than Kshatriya females (Table 5). A reverse trend is observed in Kurmi where females have significantly higher mean somatotype dispersion distance (S.D.M) than males. Standard deviation of the somatotype dispersion distance (DSD) is higher in Kshatriya males than their female counterparts revealing their much more diverse body physique. Kurmi females, on the other hand have higher DSD than Kurmi males. In general, Kurmi are more homogeneous in physique than Kshatriya.

The analysis of the three components of somatotype suggests that the general body physique of both Kshatriya and Kurmi males is Ectomorphic-Mesomorph while that of their females is Balanced mesomorph. Succinctly, all the Kurmi males, all the Kshatriya females, over 98% Kurmi females and over 97% of Kshatriya males, fall in the categories having the 'taxonomy' of mesomorphy demonstrating the dominance of this component in the physique of both the populations. Strong muscular-skeletal development, as evident from the predominant mesomorphic component in Kshatriya, supports the historical viewpoint that they are the 'marshal' group. Similarly muscular development is a prerequisite in peasant communities requiring intensive labour. Thus, this kind of physique can develop, in addition to their genetic predisposition, by having high level of physical activity as required in their occupations of military service, agriculture and industrial labour.

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