

Variations of Body Physique in Santhals: An Indian Tribe

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ABSTRACT

In order to assess sex differences in body physique in Santhals, a cross sectional sample of 800 adult Santhals (400 males and 400 females) was collected from West Bengal (India) using multistage cluster random sampling. The present study aims to explore the body physique of Santhals of West Bengal, where both males and females do backbreaking labor work. This type of research is rare in tribal communities, especially in India. Anthropometric Somatotyping, the method forwarded by Heath and Carter, is followed in the present study, which is a technique of rating human body physique and composition through anthropometric measurements. The results suggest that the Santhal males and females are predominantly Mesomorphic in their body physique. Mean somatotype of Santhal males and females are 1.98–4.81–3.98 and 3.16–5.43–3.17 respectively. Variation among Santhal females is more than males in terms of their body physique. Males in general are linear and muscular, whereas females are lean to fatty, but muscular.

Key words: body physique, santhals, sex differences, anthropometrics, one-way ANOVA, West Bengal, India

Introduction

In a developing country like India, where the incidence of protein-calorie malnutrition is high and mechanization is at a minimum, human labour provides most of the power for work outputs¹. This occurrence is far more common among rural communities, especially among tribal populations. Santhals, a tribal population from West Bengal, is no exception to this. The requirements of strenuous and laborious physical activity to sustain daily livelihood affects body composition and physique of these tribal people, as also suggested by previous investigators². Further, reduction in gender inequality in physique, particularly masculinity, may accrue from the fact that tribal females are as laborious as tribal males, as they participate equally in almost all the activities of subsistence^{3,4}. However, among the mainstream urban societies, where majority of males are involved in white-collar jobs, females are either engaged in the same kinds of occupation or act as house-wives that requires low physical labour. Therefore, both the males and the females sustain their livelihood without doing much of painstaking laborious activities in their day-to-day life. This is apparent in their body composition^{5,6-7}.

In human populations, sex difference in body physique is a common phenomenon. In some populations

this incidence is apparent^{5,8-9,10-11}, whereas in others, especially those under extreme ecological stresses, sex difference in body physique is evident in a lesser degree^{3,12}. In addition, other factors that influence somatotype of an individual includes age^{13,14}, nutrition^{15,16}, smoking habit¹⁷, physical performance^{18,19-20}, high altitude^{12,15}, occupation²¹ and genetic factors²².

In India, studies on body physique, which are informative about population variation as well as age and sex variation, were mostly conducted in the northern region^{3,5,6,12}. However, such studies in other parts of India, especially in tribal populations, are few and far in-between. Keeping these observations in mind, the present investigation aims to study the variations in body physique of Santhals of West Bengal, India, focusing on gender differences, if any.

Materials and Methods

A cross-sectional sample of 800 Santhals (400 males and 400 females), was collected from eighteen villages of Ranibandh block of Bankura district, West Bengal, using multistage random cluster sampling method. West Ben-

gal is one of the few states of India, having a considerable percentage of tribal population. First of all, out of eighteen districts of West Bengal, Bankura was selected by cluster random sampling. In the next stage, out of twenty-two community blocks of Bankura district, Rani-bandh block was selected through cluster random sampling. Similarly, out of two hundred and eight villages, eighteen villages were selected using the same sampling method. Finally, random sampling was used to select eight hundred Santhals from these eighteen villages. Males ranged in age from 40 years to 87 years with a mean age of 57.5 years, whereas females ranged in age from 35 years to 83 years with a mean age of 48.6 years. Data for both Santhal males and females were classified according to the age categories. Analyses were done for each category separately as well as Santhal males or females as a whole. Date of birth of each subject was asked and recorded. Decimal age of each subject was calculated using Decimal Age Calendar²³.

In accordance with internationally accepted standards ten body measurements were taken on each subject^{23,24–25}. These are: 1) Height vertex; 2) Body weight, 3) Bicondylar humerus, 4) Bicondylar femur, 5) Mid upper arm circumference, 6) Calf circumference, 7) Skinfold at triceps, 8) Skinfold at subscapula, 9) Skinfold at suprailliac and 10) Skinfold at calf. Anthropometric measurements were taken following standardised protocols and all the measurements were taken by the authors, themselves. All the anthropometric measurements were taken on the right side of the subject, using Anthropometric Rod and Sliding Caliper. Circumferences were measured with the help of Steel Tape. All the skinfold measurements were taken on the left side of the subject, following Tanner²³. Skinfold measures in the present study were taken with the Holtain skinfold caliper in mm, with the dial marked in division of 0.2 mm.

Anthropometric somatotyping was done using Heath and Carter’s method^{24,26}. Three somatotype components, i.e. Endomorphy, Mesomorphy and Ectomorphy were plotted on somatocharts, after calculating 'X' and 'Y'. Individual somatotypes of Santhals were classified into thirteen categories following Carter’s classification²⁶. Somatotype dispersion distance (S.D.D.) and mean somatotype dispersion distance (S.D.M.) were computed using the formula given by Ross and Wilson²⁷. Mean Sex Difference Index (MSDI) was calculated using the following formula, which is $MSDI = \frac{M_1 - M_2}{(M_1 + M_2)/2}$, Where, M_1 and M_2 are means of a variable for males and females respectively. A One-way Analysis of Variance (ANOVA) was used to examine sex differences in somatotype components. Statistical analyses were carried out using either SPSS or MS Excel software programs.

Results and Discussion

Descriptive statistics of height and weight of Santhals suggest a slight decline with age in both males and females, especially after the age of 50 years (Table 1). Similar trend is observed for other anthropometric measure-

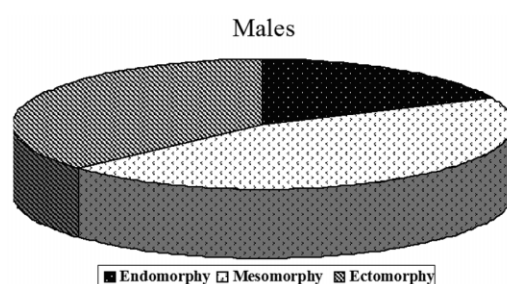


Fig. 1. A Somatotype components among Santhals, by sex.

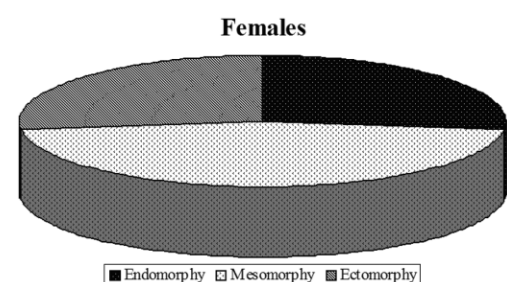


Fig. 1. B Somatotype components among Santhals, by sex.

ments, including soft tissue related measurements. In somatotype characteristics, both Santhal males and females are found to be predominately Mesomorphic in their body physique (Figure 1). Dominance of Mesomorphic component among Santhals is also apparent from the somatocharts (Figures 2 and 3). Moreover, this trend is noticed across the age, among both the males and the females (Table 2). One of the important factors behind this could be hard work, necessary for survival in harsh conditions. Santhals use primitive technology for cultivation in a low-fertile land that has poor water retention ability. Moreover, for irrigation, majority of them solely depend on rain water. As a consequence, yield is too low and they can not rely on cultivation alone. Thus, they substantiate their livelihood by hunting, gathering and animal husbandry. All these compel them to do a lot of hard work to sustain their livelihood, resulting into

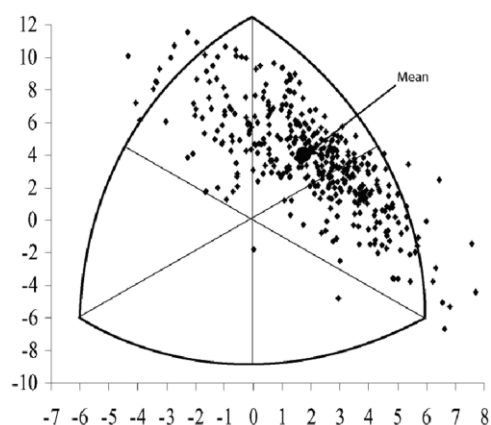


Fig. 2. Somatochart of Santhal males.

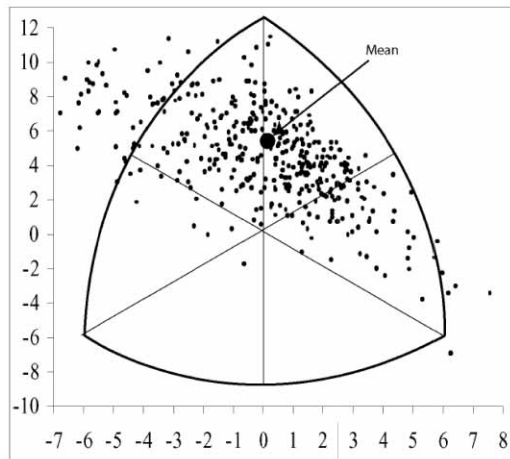


Fig. 3. Somatochart of Santhal females.

muscular body physique. These harsh environmental conditions play a dominant role in building up their muscular body physique even when more than half of them are 'underweight', as evident from their Body mass index (BMI)²⁸.

Of the other two components of somatotype, Ectomorphy dominates Endomorphy among the males, whereas, they are co-dominant among the females. This trend is observed across the age groups among both the

males and the females, with an exception among older females, i.e. 60 and above (Table 2). Amongst older Santhal females Ectomorphic component marginally dominates Endomorphic component. Mean sex difference indices suggest, in general, relatively greater Endomorphy and Mesomorphy among the females and higher Ectomorphy among the males (Table 3). These differences are more pronounced for Endomorphic and Ectomorphic components. This suggests that although Santhal males and females are muscular, but males are more linear type and females are lean to fatty type in their body physique. This observation is in agreement with earlier investigations^{21,29,30}. One-way ANOVA revealed that sex differences are statistically significant ($p < 0.05$) for all the three components of somatotype, i.e. Endomorphy, Mesomorphy and Ectomorphy, among Santhals (Table 4). Besides biological factors, sex difference among the Santhals might have accrued from differences in their activity patterns, nutrition, body composition, and environment^{24,13-34}.

Variation, as evident from the coefficient of variation, is the lowest for Mesomorphy, amongst both the males and the females. Considering that Santhals have high Mesomorphy but small range of variation in this component, it seems reasonable to infer that most of them are muscular, which seems to be a prerequisite for surviving in harsh environmental conditions. The range of variation in endomorphic component is of similar magnitude among the males and the females. Females are more

TABLE 1
DESCRIPTIVE STATISTICS OF ANTHROPOMETRIC MEASUREMENTS IN SANTHALS

Measurements	Males Age Category ($\bar{X} \pm SD$)					Females Age Category ($\bar{X} \pm SD$)				
	40-49	50-59	60-69	70 up	All ages	35-39	40-49	50-59	60 up	All ages
Height vertex	160.55±5.35	160.48±6.24	159.05±6.56	157.58±6.96	159.84±6.30	148.93±4.99	149.36±5.81	148.88±5.75	147.05±5.38	148.94±5.69
Body Weight	48.43±6.55	47.95±6.96	46.22±6.72	43.56±4.43	47.15±6.74	41.07±6.52	42.58±6.91	40.28±6.14	38.40±5.17	41.37±6.64
Bicondylar humerus	8.04±0.43	7.95±0.47	7.83±0.52	7.64±0.47	7.90±0.49	7.49±0.51	7.53±0.47	7.44±0.52	7.25±0.36	7.47±0.48
Bicondylar femur	9.10±0.45	9.12±0.42	9.15±0.46	9.09±0.38	9.12±0.43	8.70±0.69	8.77±0.61	8.84±0.66	8.69±0.48	8.77±0.62
Mid upper arm circumference	24.29±2.05	24.09±2.22	23.31±2.28	22.09±1.85	23.72±2.26	23.36±2.26	23.78±2.36	23.24±2.29	21.91±2.65	23.39±2.42
Mid calf circumference	29.73±2.45	29.60±2.38	29.07±2.48	27.34±1.90	29.25±2.47	29.00±2.35	29.32±2.16	28.53±2.72	27.14±2.03	28.84±2.41
Skinfold at triceps	5.20±1.90	5.49±2.24	5.67±2.52	5.25±1.92	5.45±2.22	7.77±3.81	8.86±4.28	8.70±4.28	7.17±3.00	8.52±4.14
Skinfold at subscapula	9.01±2.85	9.52±4.55	9.02±4.80	7.74±2.92	9.11±4.21	10.58±4.22	12.18±5.81	11.99±5.42	10.14±5.18	11.74±5.53
Skinfold at suprailliac	5.55±2.19	5.94±2.87	6.09±2.91	5.70±2.17	5.88±2.69	7.63±3.86	9.50±5.36	8.98±5.14	6.93±3.97	8.89±5.09
Skinfold at calf	4.21±1.56	4.64±2.53	4.61±2.72	4.30±2.81	4.52±2.46	6.98±2.40	7.72±3.13	7.89±3.34	5.48±2.31	7.44±3.12

TABLE 2
SOMATOTYPE CHARACTERISTICS OF SANTHALS

Males					Females				
Age Category	N	Endomorphy $\bar{X}\pm SD$	Mesomorphy $\bar{X}\pm SD$	Ectomorphy $\bar{X}\pm SD$	Age Category	N	Endomorphy $\bar{X}\pm SD$	Mesomorphy $\bar{X}\pm SD$	Ectomorphy $\bar{X}\pm SD$
40–49	74	1.91±0.71	5.00±1.13	3.83±1.28	35–39	41	2.80±1.27	5.44±1.23	3.23±1.50
50–59	188	2.03±1.05	4.90±1.26	3.94±1.59	40–49	212	3.30±1.58	5.56±1.32	2.97±1.50
60–69	93	2.02±1.08	4.76±1.26	4.04±1.62	50–59	103	3.22±1.56	5.36±1.34	3.43±1.67
70 up	45	1.81±0.81	4.26±1.25	4.30±1.44	60 up	44	2.62±1.38	4.95±1.24	3.48±1.64
All ages	400	1.98±0.97	4.81±1.24	3.98±1.53	All ages	400	3.16±1.54	5.43±1.32	3.17±1.57

endomorphous than males, as stated earlier, also Santhal females seem to vary a lot in terms of linearity, as compared to their male counterparts (Table 3).

Distribution of Santhals in various somatotype categories indicates a substantial concentration of Santhals around mesomorphic and ectomorphic components (Table 5). A good percentage of Santhals are Ectomorphic-Mesomorph (30.0%), followed by Endomorphic-Mesomorph (23.3%) and Mesomorphic-Ectomorph (19.0%), suggesting Santhals to have linear-muscular, fatty-muscular or linear physique. A sizable number of them are either Mesomorph-Ectomorph (12.4%) or Balanced Mesomorph (11.1%). Comparison of males and females in different somatotype categories reveals that nearly equal

percentage of males and females of this tribal population are Ectomorphic-Mesomorph (30.5% and 29.5% respectively), indicating a linear-muscular body physique. This gives Santhals an appearance that is linear but well built, irrespective of sex. A considerable number of Santhal males are Mesomorphic-Ectomorph (26.3%), followed by Mesomorph-Ectomorph (18.3%). On the other side, females are Endomorphic-Mesomorph (28.5%) and Balanced Mesomorph (17.0%). Thus, Santhal males are generally linear-muscular with a tendency towards linear physique, whereas, Santhal females are muscular with a little inclination towards fatty muscular physique. A small segment of this society has low Mesomorphy and fall under Balanced Ectomorph or Endomorphic Ecto-

TABLE 3
DESCRIPTIVE STATISTICS OF SOMATOTYPE COMPONENTS IN SANTHALS, BY SEX

Somatotype Components	Males (400)			Females (400)			Total (800)			MSDI
	\bar{X}	S.E.	C.V.	\bar{X}	S.E.	C.V.	\bar{X}	S.E.	C.V.	
Endomorphy	1.98	0.05	49.22	3.16	0.08	48.73	2.57	0.05	55.08	-0.46
Mesomorphy	4.81	0.06	25.86	5.43	0.07	24.26	5.12	0.05	25.72	-0.12
Ectomorphy	3.98	0.08	34.42	3.17	0.08	49.50	3.58	0.06	44.76	0.23

S.E. – standard error, C.V. – coefficient of variation, MSDI – mean sex difference index

TABLE 4
SEX DIFFERENCES IN SOMATOTYPE COMPONENTS (ONE-WAY ANALYSIS OF VARIANCE)

Somatotype Components	Analysis of Variance (ANOVA)					
		Sum of Squares	Df	Mean Square	F	Significance
Endomorphy	Between groups	276.066	1	276.066	166.589	0.000*
	Within Groups	1322.419	798	1.657		
	Total	1598.485	799			
Mesomorphy	Between groups	76.101	1	76.101	46.315	0.000*
	Within Groups	1311.194	798	1.643		
	Total	1387.295	799			
Ectomorphy	Between groups	131.123	1	131.123	54.559	0.000*
	Within Groups	1917.852	798	2.403		
	Total	2048.975	799			

* p<0.05

TABLE 5
INCIDENCE OF OCCURRENCE OF SANTHALS IN 13 SOMATOTYPE CATEGORIES, BY SEX

Somatotype Category	Males (400)		Females (400)		Total (800)	
	No.	%	No.	%	No.	%
Mesomorph – Ectomorph	73	18.3	26	6.5	99	12.4
Ectomorphic – Mesomorph	122	30.5	118	29.5	240	30.0
Mesomorphic – Ectomorph	105	26.3	47	11.8	152	19.0
Balanced Mesomorph	39	9.8	68	17.0	107	13.4
Endomorphic – Mesomorph	54	13.5	114	28.5	168	21.0
Mesomorph – Endomorph	4	1.0	19	4.8	23	2.9
Endomorphic – Ectomorph	1	0.3	1	0.3	2	0.3
Balanced Ectomorph	2	0.5	2	0.5	4	0.5
Ectomorphic – Endomorph	0	0.0	1	0.3	1	0.1
Mesomorphic – Endomorph	0	0.0	4	1.0	4	0.5
Balanced Endomorph	0	0.0	0	0.0	0	0.0
Endomorph – Ectomorph	0	0.0	0	0.0	0	0.0
Central	0	0.0	0	0.0	0	0.0
Total	400	100.0	400	100.0	800	100.0

No. – number of occurrence, % – percentage of occurrence

morph. It seems reasonable to associate this kind of physique with undernourishment or malnourishment. This argument derives strength from the fact that over half of the population is classed as 'underweight' on the basis of BMI classification²⁸. Further, only females are found in categories like, Mesomorphic-Endomorph and Ectomorphic-Endomorph, though their percentage is low. This indicates that among the Santhals, females are sometimes little fatty in their built, while males do not seem to be having such an appearance. Thus, body physique in general, and its components in particular, vary more among the Santhal females than among the males. Somatotype Dispersion Distance further confirms this observation, as higher mean somatotype dispersion distance is observed among the females (females=4.74) than the males (males=4.17).

Thus, muscular and strong built seems to be an important characteristic of Santhal physique. Even inter-individual variation is low for this particular component of physique. Other than biological factors, marriage system or mating pattern of Santhals could be one of the decisive factors. Analysis of marriage/mating pattern reveals that Santhals of West Bengal are generally monogamous and only occasionally polygynous. They have the preference of bringing their brides from the same village or from the neighboring villages with a marital distance of not more than 15 km. Further, Santhals strictly follow the rule of tribal endogamy and clan exogamy. The nature of mating pattern suggests that Santhals marry within their own community, having low marital distance, indicating homogeneity of this population.

Besides, back breaking and pain staking physical labor could be one of the crucial factors behind the occurrence of this kind of physique. The subsistence pattern of

Santhals demands a lot of muscular activity in their day-to-day life, irrespective of sex. As a consequence they have developed strong muscle mass, as evident from the predominance of Mesomorphic component in somatotype. It is a well known fact that individuals with high mesomorphic and low endomorphic components can perform work more efficiently than those with high endomorphic and low mesomorphic components. Thus, Santhals' body physique is more suitable to hard work under tropical conditions and low nutritional situations.

Low endomorphy with high ectomorphic component results into large amount of body surface area. It helps to dissipate greater amount of heat through evaporation, especially in tropical environmental conditions which is humid and hot, where this tribe inhabit. Santhals have been living in southern and western part of West Bengal for at least five hundred years and some of them claim to be living at the same place over several generations³⁵. The area where they live is characterized by lateritic reddish soil with low water retention ability. Primarily, Santhals are agriculturists. However, the yield from this activity is low because of low fertility of the soil, dependence on the rain water for irrigation and primitive technology. Thus, they supplement their requirements by food gathering and animal husbandry. Hence, the subsistence pattern and adaptation to such ecological condition over generations might have helped Santhals to attain this kind of body physique. Though, one could be certain only after getting information from an extensive longitudinal study among this population.

Comparatively higher Mesomorphic component among the females than among the males is perhaps because of the extra-strenuous works performed by the females. Santhal males basically carry out the agricultural activi-

ties and animal husbandry. Females on the other hand, in addition to assisting men in the above mentioned activities, perform household work that includes collecting fodder and fuel, for which they often travel 10–15 km to and fro. Succinctly, Santhals of West Bengal are linear but strong built mesomorphic people having efficient adaptive mechanisms and noticeable sex differences.

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VARIJACIJE U TJELESNOJ FIGURI SANTALA – INDIJSKOG PLEMENA

SAŽETAK

Kako bi se proučile spolne razlike tjelesne figure Santala, sakupljen je uzorak 800 odraslih Santala (400 muškaraca i 400 žena) u Zapadnom Bengalu (Indija) slučajnim odabirom. Cilj ove studije bio je istražiti tjelesnu figuru Santala iz Zapadnog Bengala, gdje oba spola obavljaju težačke poslove. Ovaj tip istraživanja rijedak je u plemenskim zajednicama, pogotovo u Indiji. Antropometrijsko somatotipiziranje, metoda predstavljena od Heatha i Cartera, a korišteno i ovdje, je tehnika ocjenjivanja ljudske tjelesne figure i kompozicije pomoću antropometrijskih mjera. Rezultati sugeriraju da su santalski muškarci i žene predominantno mezomorfnе tjelesne figure. Srednja vrijednost somatotipa santalskih muškaraca je 1,98–4,81–3,98 i 3,16–5,43–3,17, značajno. Varijacija tjelesne figure među santalskim ženama je veća nego među muškarcima. Općenito, muškarci su mršavi i muskulozni, dok su žene sklone debljanju ali ipak muskulozne.