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Sex Differences in Body Size and Shape among Santhals of West Bengal

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ABSTRACT With an objective of assessing intra population variation with a special reference to sex differences in a number of body size and shape measurements, a cross sectional sample of 800 adult Santhals (400 males and 400 females) were collected from the Bankura district of West Bengal. The study reveals that Santhals are short statured, dolihocephalic, mesorrhinae, and euryprosopic people. They are well adapted to their physical as well as climatic conditions. Sex difference is clearly evident in their body measurements, as Santhal males are significantly taller, heavier, possess greater bone breadths (except biiliocristal breadth) and circumferences than Santhal females.

INTRODUCTION

Sex difference in body size and shape is a common phenomenon in human populations. But the degree of sex difference varies from population to population. It is evident that population living in extreme climatic conditions, tend to show lesser degree of sexual dimorphism in their body shape and size as compared to the population living in moderate climatic conditions. In societies where survival is based on physical labor, sex difference is less. This may be because each member of the society has to perform similar laborious work irrespective of gender. However, even in these societies sex difference are evident in body size and shape particularly the ones that have genetical basis.

Almost all the studies examining the gender differences in body size show that males are significantly heavier and taller than the females (Hiernaux and Hartono, 1980; Sidhu et al., 1985; Bhatnagar, 1990; Mittal et al., 1992). They possess broader shoulders (Antoszewska et al., 1992; Smith et al., 1995; Oguntona et al., 2000) and have bigger bone widths (Chiu et al., 2000; Ghosh et al., 2001; Santos et al., 2004; Ghosh, 2004 and Verma, 2005) and circumferences (Mitra et al., 2002; Reddy and Rao, 2000, Prothro and Rosenbloom, 1995) than the females.

Studying intra and inter population variations in different morphological characters have long been an interest of Anthropologists. Human diversity in body size and shape is a hallmark of Indian population. Intra- and inter-populational morphological variations are influenced by micro and macro environmental factors like socio-economic condition (Tanner, 1969; Kaul, 1975), nutritional status (Stini, 1969; Wolanski et al., 1994), climatic condition (Khongsdier and Mukherjee, 2003), physical setting of the habitat (Roua, 2000) and level of physical work (Silventoinen, 2003). As a consequence, human populations possess characteristics that stamp them as residents of particular areas of the world (Stini, 1979).

In India, studies on morphological variations are limited to mostly on caste and communities and rarely in tribal population. Keeping these objectives in mind the present study has been conducted on the Santhals, a tribal population from Bankura district of West Bengal.

This study has the following aims:

To investigate the intra population diversity in different body measurements of the Santhals,

To estimate the sex differences in these body measurements.

MATERIALS AND METHODS

Sample: A cross-sectional sample of 800 individuals was collected from an endogamous tribal population of West Bengal, the Santhal. It comprises of 400 males (age ranges from 40 to 87 with a mean age 57.5) and 400 females (age ranges from 35 to 83 with a mean age 48.6). The study was carried out at the Ranibandh block of the Bankura district, West Bengal, by using multistage random cluster sampling method. Out of 208 villages of Ranibandh block, data were collected from 18 villages, using the above mentioned

method. In each village, measurements were taken on more than eighty percent males and females of the above mentioned age ranges. Date of birth of each subject was recorded by asking them. In case of doubt it was verified by other sources. Decimal age of each subject was calculated by subtracting the date of birth of the subject from the date of data collection, using the decimal age calendar (Tanner et al., 1969).

The Place: Bankura district is one of the 18 districts of the state of West Bengal. The total land area of the district is 6,882 km^2. Bankura district is situated at the latitude of $23^o12'$ and the longitude of $87^o6'$ Situated in the western part of the state it situated on a densely populated alluvial plain, on the northern bank of the river Dhaleshwari (Dhalkisor). It is surrounded by Bardhaman in its north, Puruliya in its west, Hugli in its east and Midnapur in its south. Bankura is a district with high percentage of tribal population. Cultivation is the main source of income.

District Bankura has 22 Community Development Blocks, of which Ranibandh Block is one of the blocks. The total land area of the block is 428 km^2 with a population density of 244 per km^2, which is the lowest among all the other blocks of this district. The total population of the block is 1, 08,591. The area is undulating and covered with the forest and the hills. These are intercepted by numerous streams and springs. In some parts, there are ranges of low hills, while in others, the conical shaped hills rise abruptly from the undulating plains. Most part of the countryside is covered with the Sal forest that contributes to the well being of the dwellers. The area in the plain is characterized with the lateritic reddish soil having scanty water supply. Ranibandh is predominantly a Santhal region and some of the villages are exclusively occupied by them.

The Santhals: The Santhals is the third largest tribal community in India after the Gonds and the Bhils. It is the largest tribe in India to retain an aboriginal language, locally known as 'Santali' that belongs to Austro-Asiatic, a sub-family of the Austric family. The primary occupation of the Santhals is agriculture, though food gathering and hunting are their important subsidiary economic pursuits. They are familiar with the animal husbandry also but that plays a minor role in their livelihood. Both men and women take part in agricultural activities, with a division of labor on the basis of gender. Women are tabooed from ploughing the field.

Their houses are built on either side of the village street, which is wide enough to cross at least two bullock carts at a time. This pattern of settlement is known as 'linear type settlement pattern'. The staple food of the Santhals is boiled rice, locally known as 'daka'. They usually take meals thrice a day. In the morning they take breakfast, known as 'basiam'. It consists of a small quantity of cold rice or rice gruel, prepared with the evening meal of the previous day and is kept for the morning. For lunch and dinner they have hot boiled rice with vegetable curry ('utu'). When available their vegetable diet is supplemented with fish and meat. The women prepare the rice beer, locally known as 'Handi', which is brewed in all the homes. Santhals live in patrilineal society. Therefore, only male Santhal has to undergo an initiation rite through the 'Cacho chhatiar' ceremony by which he becomes an effective member of the society and enjoys the rights, duties and privileges of a full-fledged member. Monogamy is the rule of marriage among the Santhals, though polygyny is also found in some cases. A man may marry the sister of his elder brother's wife but not the sister of his younger brother's wife. Among Santhals village is the most important socio-economic and political unit. Every village has a 'Panchayat' to maintain law and order, which governs by a number of officials. The village headman or 'Manjhi' is the man of greatest consequence in the community.

The Santhals are divided into 12 exogamous totemic clans, locally known as 'Paris'. These are: 1) 'Hansda', 2) 'Marndi', 3) 'Soren', 4) 'Hembrom', 5) 'Tudu', 6) 'Kisku', 7) 'Murmu', 8) 'Baske', 9) 'Besra', 10) 'Pauria', 11) 'Chore' and 12) 'Bedea'. 'Pauria', 'Chore' and 'Bedea' clans are on the verge of extinction and not even a single member of these three clans was found during the present study. The clans are strictly exogamous in nature and there are no intra-clan marriages. The supreme deity in Santhal religion is termed as 'Maran Buru', who is believed to be the giver of life, rain, crops and all other necessaries.

Measurements: Fifteen anthropometric measurements were taken on each subject following standard methods (Martin and Saller 1857, Tanner et al., 1969). These measurements are; 1) Height vertex, 2) Sitting height vertex, 3) Weight, 4) Biacromial breadth, 5) Bicristal breadth, 6) Head circumference, 7) Mid upper arm circumference, 8) Mid calf circumference, 9) Head length, 10) Head breadth, 11) Nasal height, 12)

Nasal breadth, 13) Bizygomatic breadth, 14) Bigonial breadth and 15) Total facial height.

On the basis of the above mentioned measurements, six indirect measurements were calculated. These are; 1) Total upper extremity length, 2) Total upper arm length, 3) Total fore arm length, 4) Hand length, 5) Total lower extremity length and 6) Head cum neck segment.

Following indices were calculated as described by Martin and Saller (1957) and Brugsch (1917): 1) Cephalic index, 2) Nasal index, 3) Total facial index, 4) Body mass index, 5) Upper extremity-stature index, 6) Lower extremity-stature index, 7) Biacromial breadth-stature index and 8) Bicristal breadth-stature index.

Statistical Analysis: Mean, standard error and coefficient of variation were calculated for each anthropometric measurement by using computerized statistical analysis software (SPSS and MS Excel). Mean sex difference index was calculated for all the above mentioned direct and indirect anthropometric measurements. In addition, the significance of the sex differences in all these variables was examined by using analysis of variance (ANOVA). Further, chi-square was used to test the significance of sex differences in body shape and size indices.

RESULTS AND DISCUSSION

Santhal males are significantly taller than Santhal females (Table 1). Males have greater sitting height and longer extremities than the females. Males, on an average are heavier than females. Coefficient of variation is relatively lower in height, as compared to other body size measurements in both males and females. However, across gender the maximum variation is observed in case of weight. Males have broader shoulder and broader bone widths in arms and legs than females. Santhal males have larger head circumferences, as well as greater calf and upper arm circumferences, as compared to Santhal females. Females have smaller head, nose and face as compared to that of the males. Mean sex difference indices confirm higher and greater values in males than that in the females for all body measurements. Statistically significant sex differences is observed at 5% probability level in all body measurements, except for the difference in bicristal breadth (Table 2).

The frequency distribution of the head shape among the Santhals shows that a little over fifty percent of them are Dolichocephalic, followed by Mesocephaly and Hyperdolichocephaly. Besides Dolichocephaly, Mesocephalic head shape is relatively more common among Santhal females. On the other hand, among the males the frequency of Mesocephaly and Hyperdolichocephaly is nearly the same. Sex difference in their cephalic index is statistically significant at 5% probability level (Table 3). The frequency distribution of nasal

Table 1: Descriptive statistics of different body measurements, by sex

Body measurements	*Males (400)*			*Females (400)*		
	Mean	*S.E.*	*C.V.*	*Mean*	*S.E.*	*C.V.*
Height vertex, cm	159.84	0.32	3.94	148.94	0.29	3.82
Sitting height vertex, cm	79.29	0.19	4.86	73.71	0.18	4.82
Total upper extremity length, cm	74.39	0.01	5.12	67.17	0.16	4.88
Total upper arm length, cm	30.20	0.12	7.95	26.76	0.10	7.44
Total fore arm length, cm	26.16	0.08	6.28	23.92	0.08	6.66
Hand length, cm	18.03	0.09	9.77	16.49	0.07	9.02
Total lower extremity length, cm	91.70	0.22	4.69	88.16	0.18	4.16
Head cum neck segment, cm	28.72	0.13	9.04	27.67	0.12	8.72
Weight. Kg	47.15	0.34	14.29	41.38	0.33	16.05
Biacromial breadth, cm	37.96	0.12	6.42	35.14	0.12	6.69
Bicristal breadth, cm	27.09	0.09	6.96	26.97	0.10	7.25
Head circumference, cm	54.87	0.09	3.20	54.20	0.08	2.95
Mid upper arm circumference, cm	23.72	0.11	9.55	23.39	0.12	10.36
Mid calf circumference, cm	29.25	0.12	8.43	28.84	0.12	8.36
Head length, cm	19.26	0.04	4.44	18.46	0.04	3.77
Head breadth, cm	14.13	0.03	4.05	14.01	0.03	3.99
Nasal height, cm	4.79	0.02	9.20	4.38	0.02	9.87
Nasal breadth, cm	3.82	0.02	10.29	3.48	0.02	8.87
Bizygomatic breadth, cm	13.73	0.03	4.34	13.25	0.03	4.34
Bigonial breadth, cm	10.82	0.03	5.80	10.15	0.03	6.51
Total facial height, cm	11.30	0.03	5.82	10.39	0.04	6.74

Table 2: Mean Sex Difference Index and ANOVA of different body measurements

Body measurements	*MSDI@*	*Sex Differences*		
		ANOVA Value ofF	*Proba-bility*	*Signi-ficance**
Height vertex, cm	0.07	658.79	0.00	S
Sitting height vertex, cm	0.07	454.53	0.00	S
Total upper extremity length, cm	0.10	825.65	0.00	S
Total upper arm length, cm	0.12	486.35	0.00	S
Total fore arm length, cm	0.09	383.42	0.00	S
Hand length, cm	0.09	178.54	0.00	S
Total lower extremity length, cm	0.04	156.97	0.00	S
Head cum neck segment, cm	0.04	34.70	0.00	S
Weight. Kg	0.13	148.92	0.00	S
Biacromial breadth, cm	0.01	276.52	0.00	S
Bicristal breadth, cm	0.07	0.88	0.35	NS
Head circumference, cm	0.08	31.92	0.00	S
Mid upper arm circumference, cm	0.04	3.86	0.05	S
Mid calf circumference, cm	0.06	5.47	0.02	S
Head length, cm	0.04	212.70	0.00	S
Head breadth, cm	0.01	8.68	0.00	S
Nasal height, cm	0.09	177.08	0.00	S
Nasal breadth, cm	0.09	178.42	0.00	S
Bizygomatic breadth, cm	0.04	133.75	0.00	S
Bigonial breadth, cm	0.06	219.80	0.00	S
Total facial height, cm	0.08	354.35	0.00	S

* Significant at 5% probability level @MSDI = Mean Sex Difference Index

Table 3: Cephalic Index, by sex

Cephalic Index	*Males*		*Females*		*Total*	
	No.	*%*	*No.*	*%*	*No.*	*%*
Hyperdolichocephalic	93	23.3	45	11.3	138	17.3
Dolichocephalic	210	52.4	206	51.5	416	52.0
Mesocephalic	85	21.3	127	31.7	212	26.4
Brachycephalic	8	2.0	22	5.5	30	3.7
Hyperbrachycephalic	2	0.5	-	-	2	0.3
Ultrabrachycephalic	2	0.5	-	-	2	0.3
Total	400	100.0	400	100.0	800	100.0

d.f. = 3 Chi-square = 27.996 (Significant at 5% probability level)

index of Santhals suggests that nearly sixty percent of them are Mesorrhinic, followed by Chamaerrhinae. Leptorrhinae is rare in this population. Statistically non-significant sex difference is observed in the nose shape of the Santhals (Table 4). In general Hypereuryprosopic and Euryprosopic type of facial form are present in highest and equivalent percentages in Santhals. However, females are generally Hypereuryprosopic, while males are Euryprosopic in their total facial index. It reflects that Santhal females have relatively broader face than the males. Hyperleptoprosopic is the rarest type of facial form in both the sexes. Sex difference is statistically significant in their total facial index (Table 5). Around fifty-five percents of the Santhals are 'underweight',

Table 4: Nasal index, by sex

Nasal Index	*Males*		*Females*		*Total*	
	No.	*%*	*No.*	*%*	*No.*	*%*
Hyperleptorrhinae	2	0.5	5	1.3	7	0.9
Leptorrhinae	48	12.0	46	11.4	94	11.7
Mesorrhinae	227	56.7	229	57.3	456	57.0
Chamaerrhinae	112	28.0	113	28.3	225	28.1
Hyperchamaerrhinae	11	2.8	7	1.7	18	2.3
Total	400	100.0	400	100.0	800	100.0

d.f. = 2 Chi-square = 0.056 (Significant at 5% probability level)

closely followed by 'normal weight' in their body mass index. 'Underweight' is more common among males, while the frequency of 'normal weight' and 'overweight' are comparatively higher in females. Only a negligible percentage of Santhals have 'obesity'. Sex difference is statistically non-significant in the body mass index of Santhals (Table 6). Frequency distribution of upper extremity-stature index suggests that eighty percent of the Santhals have 'long arm'. Percentage of males having 'long arm' is higher than the percentage of females having 'long arm'. On the other hand, 'short arm' and 'medium arm' are more frequent in females than in males. Sex difference is statistically significant in the upper extremity-stature index of Santhals (Table 7). Almost all the Santhals are 'long legged' in their lower extremity-stature index. The percentage of females with 'long leg' is slightly higher, as compared to the percentage of males. 'Short leg' and 'medium leg' are rare among them. Sex difference in lower extremity-stature index is statistically non-significant at 5% probability level (Table 8). The frequency distribution of biacromial breadth-stature index shows that nearly eighty percent of the Santhals have 'broad shoulders' followed by 'medium shoulders' and 'narrow shoulders'. A noticeable percentage of males have 'narrow shoulders', whereas, it is comparatively less frequent in females. Statistically non-significant sex difference is observed in their shoulder shape (Table 9). Almost forty percent of the Santhals have 'medium pelvic', closely followed by 'broad pelvic' and 'narrow pelvic' in their bicristal breadth-stature index. A high percentage of Santhal males have 'medium pelvic', whereas, nearly equivalent percentage of females have 'broad pelvic' and 'medium pelvic'. Sex difference in bicristal breadth-stature index is statistically non-significant at 5% probability level (Table 10).

A typical Santhal is thus, short statured, dolichocephalic, mesorrhinae, and euryprosopic. Almost all the Santhals of West Bengal have long legs and long arms with broad shoulders. Such a kind of physique allows greater heat dissipation and lesser heat gain; as a consequence, it is advantageous for population living in hot and

Table 5: Total Facial Index, by sex

Total Facial Index	*Males*		*Females*		*Total*	
	No.	*%*	*No.*	*%*	*No.*	*%*
Hypereuryprosopic	109	27.3	161	40.3	270	33.7
Euryprosopic	144	36.0	126	31.5	270	33.7
Mesoprosopic	94	23.5	72	18.0	166	20.8
Leptoprosopic	42	10.5	33	8.2	75	9.4
Hyperleptoprosopic	11	2.7	8	2.0	19	2.4
Total	400	100.0	400	100.0	800	100.0

d.f. = 3 Chi-square = 15.662 (Significant at 5% probability level)

Table 6: Body Mass Index, by sex

Body Mass Index	*Males*		*Females*		*Total*	
	No.	*%*	*No.*	*%*	*No.*	*%*
Underweight	220	55.0	210	52.5	430	53.8
Normal weight	176	44.0	179	44.7	355	44.3
Overweight	4	1.0	10	2.5	14	1.8
Obesity	-	-	1	0.3	1	0.1
Total	400	100.0	400	100.0	800	100.0

d.f. = 2 Chi-square = 3.752 (Non- Significant at 5% probability level)

Table 7: Upper Extremity- Stature Index, by sex

Upper Extremity- Stature Index	*Males*		*Females*		*Total*	
	No.	*%*	*No.*	*%*	*No.*	*%*
Short arm	23	5.7	60	15.0	83	10.4
Medium arm	15	3.8	50	12.5	65	8.1
Long arm	362	90.5	290	72.5	652	81.5
Total	400	100.0	400	100.0	800	100.0

d.f. = 2 Chi-square = 43.291 (Significant at 5% probability level)

Table 8: Lower Extremity -Stature Index, by sex

Lower Extremity- Stature Index	*Males*		*Females*		*Total*	
	No.	*%*	*No.*	*%*	*No.*	*%*
Short legged	7	1.8	4	1.0	11	1.4
Medium legged	3	0.8	0	0.0	3	0.4
Long legged	390	97.5	396	99.0	786	98.3
Total	400	100.0	400	100.0	800	100.0

d.f. = 2 Chi-square = 3.864 (Non- Significant at 5% probability level)

Table 9:Biacromial Breadth -Stature Index, by sex

Biacromial Breadth -Stature Index	*Males*		*Females*		*Total*	
	No.	*%*	*No.*	*%*	*No.*	*%*
Narrow shouldered	44	11.0	28	7.0	72	9.0
Medium shouldered	70	17.5	71	17.8	141	17.6
Broad shouldered	286	71.5	301	75.2	587	73.4
Total	400	100.0	400	100.0	800	100.0

d.f. = 2 Chi-square = 3.946 (Non- Significant at 5% probability level)

Table 10:Bicristal Breadth - Stature Index, by sex

Bicristal Breadth - Stature Index	*Males*		*Females*		*Total*	
	No.	*%*	*No.*	*%*	*No.*	*%*
Narrow pelvic	111	27.7	117	29.2	228	28.5
Medium pelvic	169	42.3	143	35.8	312	39.0
Broad pelvic	120	30.0	140	35.0	260	32.5
Total	400	100.0	400	100.0	800	100.0

d.f. = 2 Chi-square = 3.863 (Non- Significant at 5% probability level)

humid climatic conditions, such as that of Santhals. It is stated in Allen's (1877) rule that within a polytypic warm blooded species there is an increase in the relative size of protruding organs such as extremities, ears and appendages with the increase in temperature of its habitat (cf. Malik and Bhattacharya, 1986). Hence, long upper and lower extremities of Santhals help them to adapt and survive efficiently in the hot climatic conditions of their surrounding. Besides, they are under weight in general. In line with the earlier studies, Santhal males of Bankura are also taller, heavier having greater linear anthropometric measurements, breadths and circumferences than their female counterparts. Statistically significant gender differences are observed in all anthropometric measurements. Succinctly, the Santhal of West Bengal is a population with efficient adaptive mechanism and an apparent morphological sex difference.

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