

Assessing Intergenerational Differences in Anthro-Physiological Variables: Case Study of a Tribal Population

Sudipta Ghosh

Department of Anthropology
University of Delhi
Delhi, India

S. L. Malik

Department of Anthropology
University of Delhi
Delhi, India

Citation:

Sudipta Ghosh & S. L. Malik: Assessing Intergenerational Differences in Anthro-Physiological Variables: Case Study of a Tribal Population: *The Internet Journal of Biological Anthropology* . 2007; Volume 1, Number 1.

Abstract

The present paper aims to investigate relations between parental and filial generations in morphological characteristics of Santhals. For this purpose, a cross-sectional sample of 400 Fathers, 400 Mothers, 292 Sons and 170 Daughters were examined and measured. Data were collected from number villages of Ranibandh block of Bankura district of West Bengal, using multi-stage cluster random sampling. Both Santhal Sons and Daughters have great affinity with their Fathers and Mothers. Significantly higher mean values of Stature and other linear body measurements in Sons and Daughters, as compared to their Fathers and Mothers respectively might indicate a positive secular trend. Sex differences are evident in most of the body measurements. In terms of body physique Fathers, Mothers, Sons and Daughters are predominantly Mesomorphic. Both systolic and diastolic blood pressure show slightly higher values in parental generation than in filial generation.

Introduction

Adult morphological features are determined by the combined influence of genetic and environmental factors. Of these environmental factors, both social and cultural factors determine to a major extent the biological interrelationships between growth, health, fertility and morbidity pattern. Interwoven with these variables is the impact of poor nutrition that modifies the capacity of populations to achieve their potential size, fertility and life span. Adaptive mechanisms developed by populations to deal with the stresses of environment are both biological and social¹.

Changes in different morphological characteristics, from parental to filial generation, are complex phenomenon to which more than one factors seems to bear a causal relationship. Further, the intergenerational changes in environment suggest that the growth and maturation of parents and child will not be

conditioned by the same environmental factors ² . During the course of the past two centuries a striking increase of mean stature and an earlier sexual maturation, usually called positive secular growth change, has been observed in most of the populations of the world. Secular changes in growth and development can be considered as the changing pattern of somatic development of children in a particular population from one generation to another. Developing countries, which have many changes in socio-economical conditions, reveal various trends in growth ³ . In this regard, the findings of Bakwin and McLaughlin ⁴ and Damon ⁵ are believed to be indications that the secular increase in height has come to an end among the economically favored Americans. It is held that the well-to-do Americans, being stimulated by environmental amelioration, have already reached the upper limits of plasticity. Therefore, the rate of increase or the rate of secular trend appears to be higher in developing countries, especially among the lower classes.

It is generally assumed that this secular change is elicited by a change of environmental conditions, in particular by removing factors that can block full expression of the biological potential, such as infectious diseases, inadequate nutrition, poverty and suffering. Thus, a positive secular change is assumed to reflect improvements in the nutritional, hygienic and health status of a population ⁶ , ⁷ , ⁸ , ⁹ . Continuing increase in certain body dimensions reflecting a general increase in body size in different populations representing different ethnic communities have been reported by various scholars like Susanne ¹⁰ , ¹¹ , Kaur and Singh ¹² , Malik and Singh ¹³ , Roy and Singh ¹⁴ , Leung et al. ¹⁵ , Ulijaszek ¹⁶ , Ali et al. ¹⁷ , Krawczynski et al. ¹⁸ , Malina et al. ¹⁹ , Carrascosa et al. ²⁰ , Moreno ²¹ and Saha and Dasgupta ²² .

Hence, keeping these objectives in mind a cross-sectional study has been conducted on Santhals, a small, close knit, endogamous tribal population from West Bengal. The sample of the present study is socially homogenous. This study aims to investigate intra familial similarities and differences in various body measurements, body physique and physiological characters among Santhals, focusing on intergenerational changes.

Materials and Methods

The Sample: Cross-sectional sample of 400 Santhal families, consisting of 1262 individuals, were surveyed from several villages of Ranibandh block of Bankura district of West Bengal. The selection of the district, block and the villages was based on Multi-stage random cluster sampling. 18 villages were randomly selected, using this method, and surveyed to conduct the present study. Unit of the study was a family having ever married women, her husband and at least one of their adult children. In the present study, an ever-married woman from each selected family has been henceforth referred as 'Mothers', her husband as 'Fathers', their sons as 'Sons' and their daughters as 'Daughters'. If available, in a family data on both son and daughter, but not on two sons or two daughters were collected. In case of multiple adult children in a family simple random sampling was used to select: (i) one son, (ii) one daughter or (iii) one son and one daughter, as the case may be. The subjects comprised 400 Fathers, aged 40-87 years (mean age 57.5 years); 400 Mothers, aged 35-83 years (mean age 48.6 years); 292 Sons, aged 18-63 years (mean age 26.3 years) and 170 Daughters, aged 18-50 years (mean age 24.5 years). Nearly 85 percent of such families that met the requirement were covered from these 18 villages. Anthropometric and physiological measurements were taken on each subject. Date of birth of subjects 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 ²³ . All the subjects between 25.500 and 26.500 years were classified in the age group 26 years, whereas those falling between 48.500 and 49.500 were included in the age group of 49 years and so on.

The Place: Ranibandh is one of the 22 Community Development Blocks of district Bankura. The area is undulating, relatively hard and is reddish lateritic in nature. The total land area of the block is 428 km² with a population density (244 per km²), the lowest as compared to the other blocks. The total population of the block is 1,08,591. The sex ratio of Ranibandh (964 females per 1000 males) is the highest as compared to the other blocks and is also higher than that of the district, as well as the state average. The total number of tribal population of this block is 49,321 out of these 24,912 are males and 24,409 are females ²⁴ . The tribal populations inhabiting in Ranibandh block are Santhal, Sardar, Munda and Bumij. Ranibandh is predominantly a Santhal region and some of the villages are exclusively occupied by them. The block has 208 villages that are governed by 8 Gram Panchayats, namely, 1) Puddi, 2) Ambikanagar, 3) Rajakata, 4) Rudra, 5) Haludkanali, 6) Ranibandh, 7) Barikul, and 8) Raotora.

The Population: Santhals are the third largest tribal community in India after the Gonds and the Bhils. The Santhal inhabit in a wide area of West Bengal,

Bihar, and Orissa. In West Bengal, they are mainly distributed in the district of Malda, Birbhum, Bankura, Midnapur and 24th Paragana. Their habitational places are generally covered with the forest and the hills. These are intercepted by numerous streams and springs. Most part of the countryside is covered with the Sal forest that contributes to the well being of the dwellers.

Santhals belong to the Proto-Australoid, according to Guha ²⁵, who considered that they arrived in India soon after the Negritos. Santhals are the largest tribe to retain an aboriginal language, known as *Santali*, belonging to Austro-Asiatic, sub-family of the Austric family. This language is closely related to Mundari as well as Ho, Korcu, Savara and Gadaba languages spoken by nearby inhabiting smaller tribes ²⁶. The Santhals have been living in southern and western part of the West Bengal for at least five hundred years. It has been found that few of the Santhal villages in Bankura district are over three hundred years old.

Primary occupation of the Santhals is agriculture, while food gathering and hunting are their important subsidiary occupations. In addition, animal husbandry also contributes marginally to their livelihood. Both men and women take part in agricultural activities, with a division of labor on the basis of gender. The community life of the Santhals hovers around their village. The houses are built on either side of the village street, which is wide enough to cross two bullock carts at a time. This kind 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. Since Santhals live in a patrilineal society, every male of their society 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 ²⁷.

Marriage is not permissible for those who do not perform this rite, and those who die without observing this ceremony will be buried instead of cremated after their death. In Santhal society a political unit, named *Panchayat*, maintains law and order in the society. It governs by a number of officials. The village headman or *Manjhi* is the man of greatest consequence in the community. The post of the village headman is hereditary; the eldest son of the headman becomes the next headman. There is often a deputy headman, the *Paranik*, who works as an adviser. Another important position in the political organization is the post of the *Jogmanjhi*, who is the guardian of morals of the young men in the village. *Naeke*, the village priest, is entrusted with the duties of worshiping the village deities. The humblest of the village officials is the *Godet*, the messenger of the headman. 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) *Bede* ²⁸. *Pauria*, *Chore* and *Bede* 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. In marriage system, Monogamous marriage is the most prevalent one among Santhals, though polygynous marriage is also found in some cases. There are seven accepted forms of marriages or *Bapla* namely, *Kring Bahu Bapla*, *Ghardi Jawaee Bapla*, *Itut Bapla*, *Sanga Bapla*, *Kiring Jawaee Bapla*, *Tunki Dipil Bapla* and *Nirbolok Bapla*.

Measurements: Nineteen Anthropometric measurements were taken on each subject following standard methods ²³, ²⁹. 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, 16) Skinfold at triceps, 17) Skinfold at subscapula, 18) Skinfold at suprailliac and 19) Skinfold at calf.

In addition three indirect measurements were calculated. These are; 1) Total upper extremity length, 2) Total lower extremity length and 3) Sum of skinfolds. In addition, physiological parameters like, I) Blood pressure (both Systolic and Diastolic), II) Heart rate, III) Pulse rate and IV) Handgrip strength were collected from each subject. Further, Somatotype was rated by using Heath and Carter's Anthropometric Somatotyping method ³⁰, ³¹.

Statistical Analysis: In statistical analysis, Mean, Standard error (S.E.) and Coefficient of variation (C.V.) were estimated in Fathers (400), Mothers (400), Sons (292) and Daughters (170) for all the Anthropometric measurements and Somatotype components mentioned above, by using computerized statistical softwares, viz. SPSS and MS Excel. Additionally, the significances of the intra familial differences in all these variables were examined by using T-test.

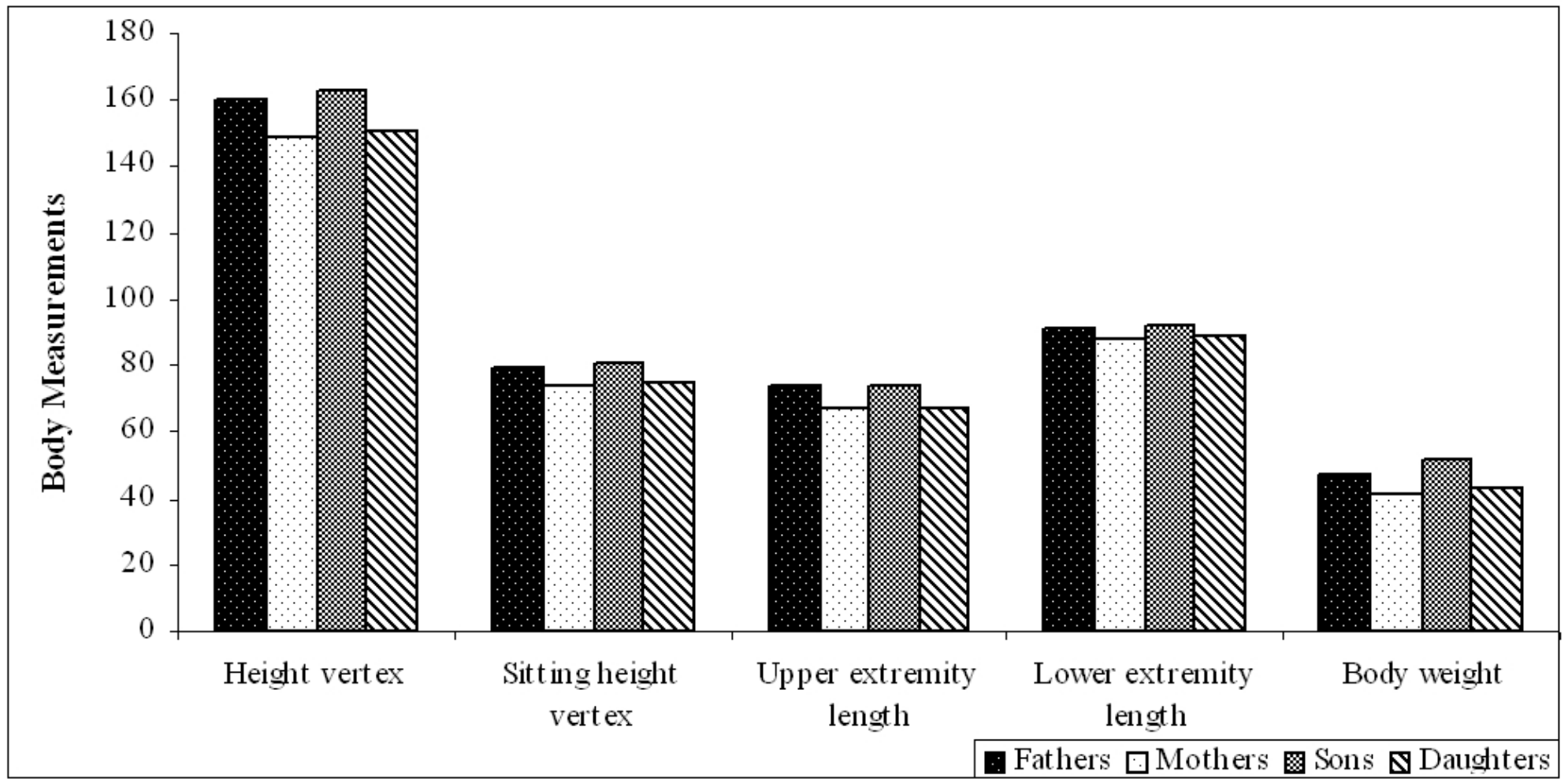
Results And Discussion

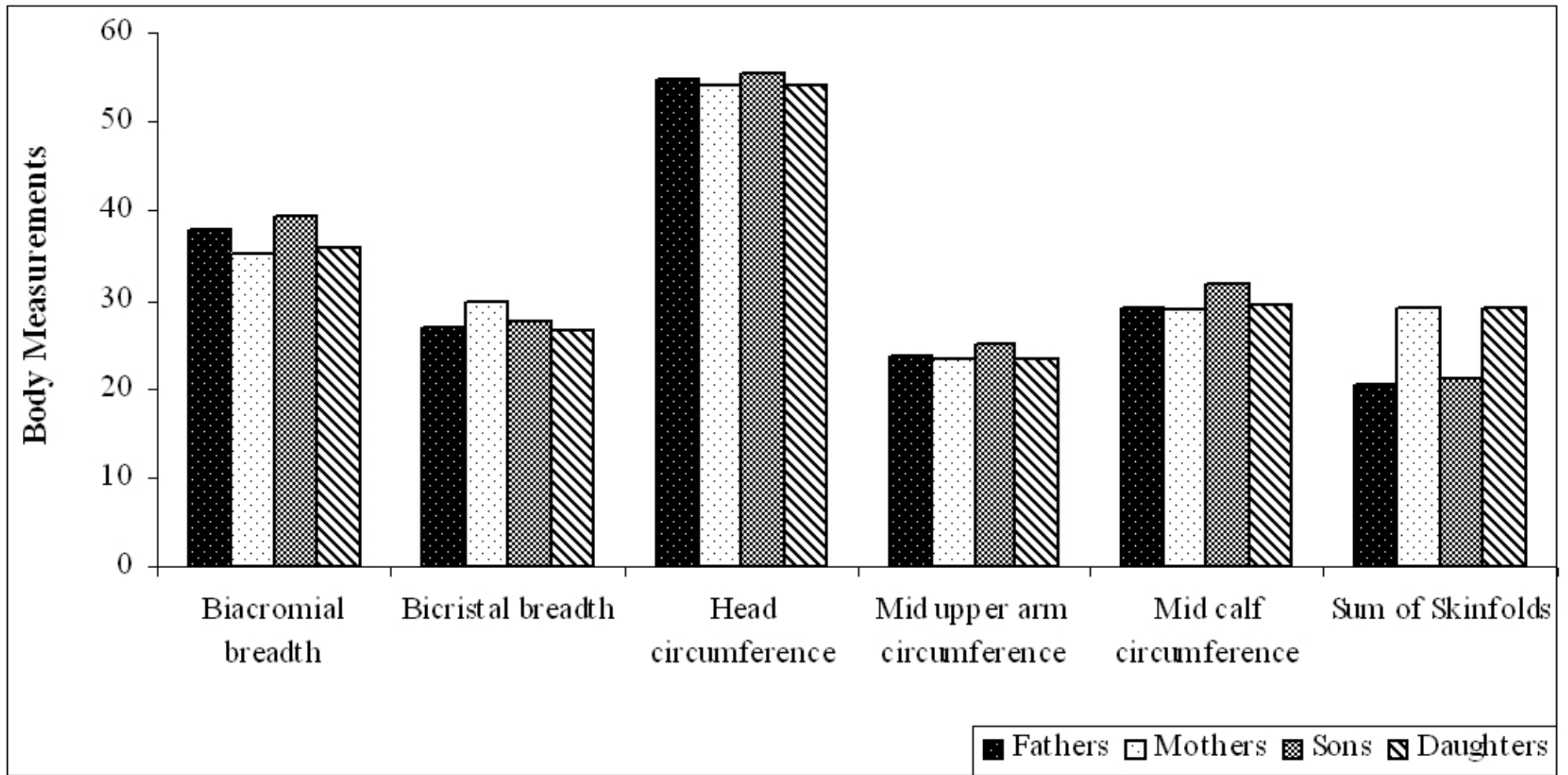
In this section intra-familial similarities and differences in body measurements, body physique and physiological parameters among Santhals of Bankura would be discussed. In Santhals, Sons and Daughters are markedly taller and heavier with longer extremities, bigger bone widths and greater circumferences and skinfolds as compared to Fathers and Mothers respectively (Table 1, Figure 1). On the other hand, Fathers and Mothers show higher mean values in most of the Head and face measurements, like Head length, Head breadth, Nasal height, Nasal breadth, Bigonial breadth and Total facial height, than Sons and Daughters respectively. Among these four groups of Santhals, i.e. Fathers, Mothers, Sons and Daughters, Sons have greater mean values in most of the body measurements, except for Total upper extremity length and Head and face measurements, where Fathers show marginally higher values. Sex difference is visibly evident in this population, as Fathers and Sons have relatively higher mean values than Mothers and Daughters in all the body measurements, except for bicristal breadth, which is comparatively greater in Mothers.

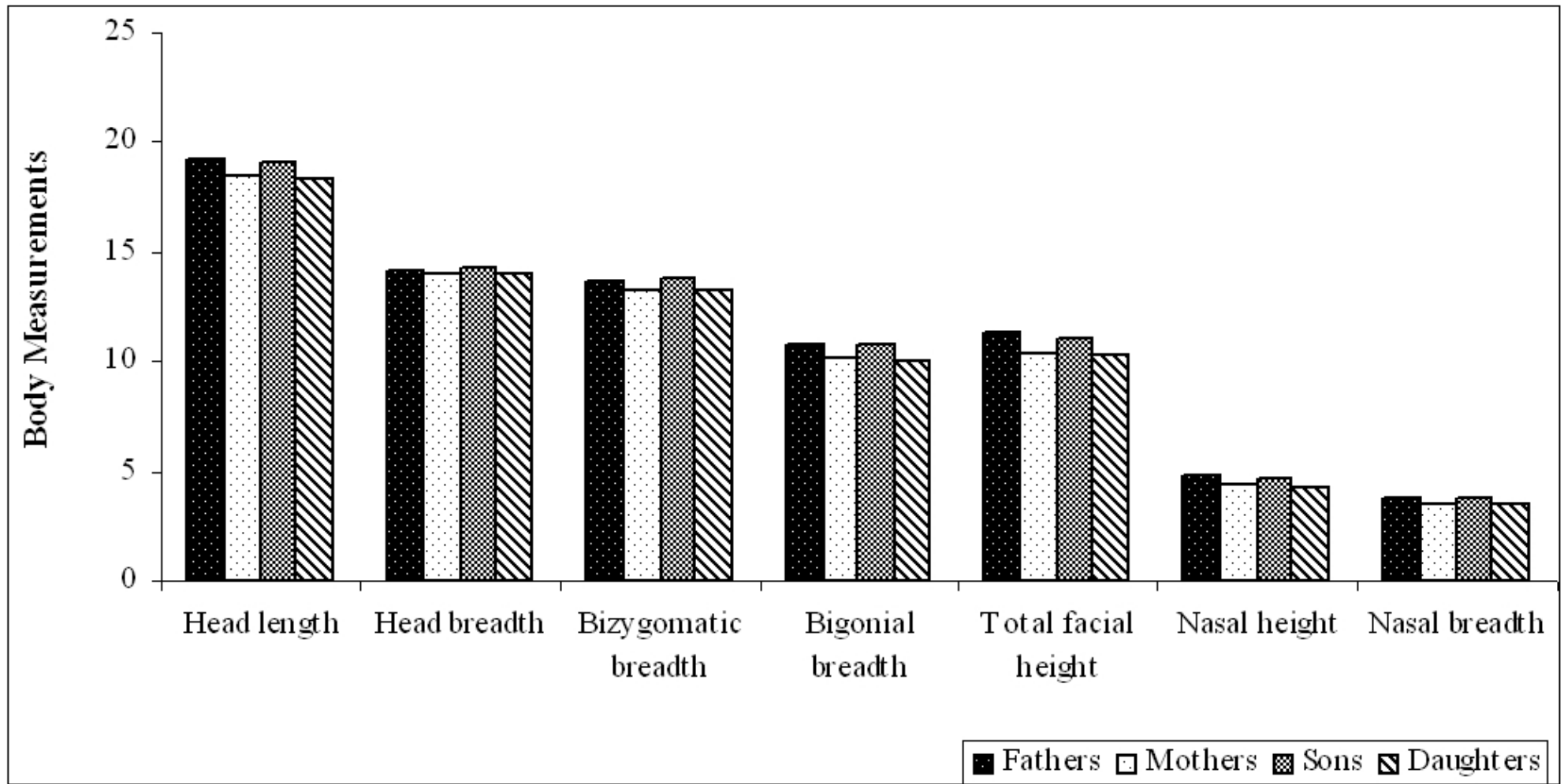
Table 1: Descriptive statistics of Body measurements of Fathers, Mothers, Sons and Daughters

Body Measurements	Fathers (400)			Mothers (400)			Sons (292)			Daughters (170)		
	Mean	C.V.	S.E.	Mean	C.V.	S.E.	Mean	C.V.	S.E.	Mean	C.V.	S.E.
Height vertex, cm	159.84	3.94	0.32	148.94	3.82	0.29	162.88	3.87	0.37	150.79	3.96	0.46
Sitting height vertex, cm	79.29	4.86	0.19	73.71	4.82	0.18	81.10	4.61	0.22	74.51	4.31	0.25
Total upper extremity length, cm	74.39	5.12	0.01	67.17	4.88	0.16	74.37	5.30	0.23	67.58	9.78	0.50
Total lower extremity length, cm	91.70	4.69	0.22	88.16	4.16	0.18	92.29	5.24	0.28	88.32	4.78	0.32
Body weight, kg	47.15	14.29	0.34	41.38	16.05	0.33	51.94	12.01	0.37	42.86	13.65	0.45
Biacromial breadth, cm	37.96	6.42	0.12	35.14	6.69	0.12	39.45	6.43	0.15	35.87	6.08	0.17
Bicristal breadth, cm	27.09	6.96	0.09	29.97	7.25	0.10	27.55	7.04	0.11	26.49	6.37	0.13
Head circumference, cm	54.87	3.20	0.09	54.20	2.95	0.08	55.55	2.80	0.09	54.25	2.59	0.11
Mid upper arm circumference, cm	23.72	9.55	0.11	23.39	10.36	0.12	25.01	7.16	0.11	23.43	8.36	0.15
Mid calf circumference, cm	29.25	8.43	0.12	28.84	8.36	0.12	31.66	6.79	0.13	29.54	7.53	0.17
Head length, cm	19.26	4.44	0.04	18.46	3.77	0.04	19.20	4.14	0.05	18.37	3.68	0.05
Head breadth, cm	14.13	4.05	0.03	14.01	3.99	0.03	14.28	4.27	0.04	14.12	3.74	0.04
Nasal height, cm	4.79	9.20	0.02	4.38	9.87	0.02	4.65	9.99	0.03	4.27	7.61	0.03
Nasal breadth, cm	3.82	10.29	0.02	3.48	8.87	0.02	3.78	7.51	0.02	3.47	9.28	0.03
Bizygomatic breadth, cm	13.73	4.34	0.03	13.25	4.34	0.03	13.82	4.24	0.03	13.28	4.56	0.05
Bigonial breadth, cm	10.82	5.80	0.03	10.15	6.51	0.03	10.80	6.27	0.04	10.09	6.50	0.05
Total facial height, cm	11.30	5.82	0.03	10.39	6.74	0.04	11.03	6.30	0.04	10.32	6.36	0.05
Sum of Skinfolds, mm	20.43	41.82	0.42	29.16	47.60	0.69	21.18	38.21	0.47	29.29	38.75	0.87

Figure 1: Intra-familial Variations in Body measurements (all measurements in cm and weight in kg)







Heterogeneity in body measurements, as evident from coefficient of variation, is the highest in Sum of skinfolds as compared to other body measurements, more so in parental generation than in filial generation (Table 1). This is perhaps because of the fact that deposition and distribution of body fat is influenced by numerous environmental factors. It varies with changes in nutritional status, socio-economic status, occupation, etc. Among Santhals of West Bengal, a considerable degree of dispersion is also observed in Body weight and Mid upper arm circumference. Nose form has high variability in this population, as both Nasal height and Nasal breadth have large coefficient of variations. Head shape, on the other hand, exhibits low variability in Santhal Fathers, Mothers, Sons and Daughters, as manifested from coefficient of variation of Head circumference, Head length and Head breadth. Similar low variability is observed in Stature.

Statistically significant differences are observed in all the body measurements among Mothers-Sons and Fathers-Daughters, except for Head breadth and circumferential measurements in the latter pair (Table 2). Gender plays an important role in intra-familial variations of Sum of skinfolds, where Fathers-Sons and Mothers-Daughters have resemblances and Fathers-Daughters and Mothers-Sons have significant differences with each other. No considerable differences are observed in Extremity length and a couple of Head and face measurements of Fathers and Sons, while in rest they show statistically significant differences. Among Mothers and Daughters, statistically significant differences are observed, except for Lower extremity length, Head and Mid upper arm circumferences, Head breadth and Nasal breadth. A trend of positive secular trend is apparent in almost all the body measurements, more so in

Sons than in Daughters. This is perhaps because Daughters are nutritionally deprived and Sons are relatively privileged among Santhals. Contrary to the general notion usually Santhal Daughters show close resemblance with their Fathers in Mid upper arm and Mid calf circumferences. This closeness could be because of the lesser degree of muscle mass in Fathers and greater degree of subcutaneous fat deposition in Daughters. However overall, Daughters have greater resemblance with their Mothers, while Sons show more proximity with their Fathers as far as their body measurements are concerned.

Table 2: Test of significance in Body measurements among Fathers-Sons, Fathers-Daughters Mother- Sons and Mothers-Daughters

Body Measurements	Fathers-Sons		Fathers-Daughters		Mothers-Sons		Mothers-Daughters	
	<i>MDI</i>	<i>T- test</i>	<i>MDI</i>	<i>T- test</i>	<i>MDI</i>	<i>T- test</i>	<i>MDI</i>	<i>T- test</i>
Height vertex, cm	-0.02	8.04*	0.06	19.76*	-0.09	39.76*	-0.01	4.79*
Sitting height vertex, cm	-0.02	7.35*	0.06	16.31*	-0.10	30.82*	-0.01	2.72*
Total upper extremity length, cm	0.00	0.47	0.10	22.26*	-0.10	30.43*	-0.01	1.47*
Total lower extremity length, cm	-0.01	1.60	0.04	9.38*	-0.05	14.84*	0.00	0.30
Body weight, kg	-0.10	10.49*	0.10	6.73*	-0.23	23.99*	-0.04	1.97*
Biacromial breadth, cm	-0.04	12.19*	0.06	13.14*	-0.12	33.77*	-0.02	3.59*
Bicristal breadth, cm	-0.02	4.43*	0.02	4.96*	-0.02	4.76*	0.02	3.69*
Head circumference, cm	-0.01	5.43*	0.01	4.93*	-0.03	12.72*	0.00	0.11
Mid upper arm circumference, cm	-0.05	7.97*	0.01	1.51	-0.07	11.01*	0.00	0.67
Mid calf circumference, cm	-0.08	15.52*	-0.01	1.09	-0.09	19.07*	-0.02	2.36*
Head length, cm	0.00	0.90	0.05	14.35*	-0.04	18.23*	0.01	2.62*
Head breadth, cm	-0.01	4.07*	0.00	0.21	-0.02	7.41*	-0.01	1.38
Nasal height, cm	0.03	4.91*	0.12	14.00*	-0.06	7.64*	0.03	2.62*
Nasal breadth, cm	0.01	0.82	0.10	11.43*	-0.08	14.43*	0.00	0.38
Bizygomatic breadth, cm	-0.01	2.47*	0.03	9.41*	-0.04	16.85*	0.00	0.27
Bigonial breadth, cm	0.00	0.89	0.07	12.00*	-0.06	14.88*	0.01	2.00*
Total facial height, cm	0.02	6.32	0.09	15.14*	-0.06	12.77*	0.01	2.69*
Sum of Skinfolde, mm	-0.04	1.33	-0.36	9.49*	0.32	9.10*	0.00	0.50

* P < 0.05

MDI = Mean Difference Index

Mesomorphic component is dominant among Santhal Fathers, Mothers, Sons and Daughters (Table 3). Maternal effect is apparent in Mesomorphy, as both Sons and Daughters resemble more with their Mothers than with their Fathers. In Endomorphic and Ectomorphic components, sex differences are clearly evident. For example, in females (Mothers and Daughters) these two components are co-dominant, whereas in males (Fathers and Sons) Ectomorphy dominates over Endomorphy (Figure 2). In somatotype components, Mesomorphic component shows comparatively greater homogeneity in this population, as evident from coefficient of variation, more so in filial generation than in parental generation. Among Santhals, gender has a role to play in the variations of Endomorphic and Ectomorphic components. For example, in males (Fathers and Sons) relatively greater dispersion is observed in Endomorphic component than in Ectomorphic component, whereas, in females (Mothers and Daughters) similar magnitude of dispersion is noticed in both Endomorphic and Ectomorphic components. Sons have statistically significant differences with Fathers in Mesomorphic and Ectomorphic components, whereas with Mothers in Endomorphic component (Table 4). Daughters show significant differences with Fathers but not with Mothers in all the Somatotype components.

Table 3: Descriptive statistics of Somatotype components of Fathers, Mothers, Sons and Daughters

Somatotype Components	Fathers (400)			Mothers (400)			Sons (292)			Daughters (170)		
	<i>Mean</i>	<i>C.V.</i>	<i>S.E.</i>	<i>Mean</i>	<i>C.V.</i>	<i>S.E.</i>	<i>Mean</i>	<i>C.V.</i>	<i>S.E.</i>	<i>Mean</i>	<i>C.V.</i>	<i>S.E.</i>
Endomorphy	1.98	49.22	0.05	3.16	48.73	0.08	2.04	43.47	0.05	3.18	40.41	0.10
Mesomorphy	4.81	25.86	0.06	5.43	24.26	0.07	5.33	19.59	0.06	5.31	22.77	0.09
Ectomorphy	3.98	34.42	0.08	3.17	49.50	0.08	3.50	33.91	0.07	3.15	45.32	0.11

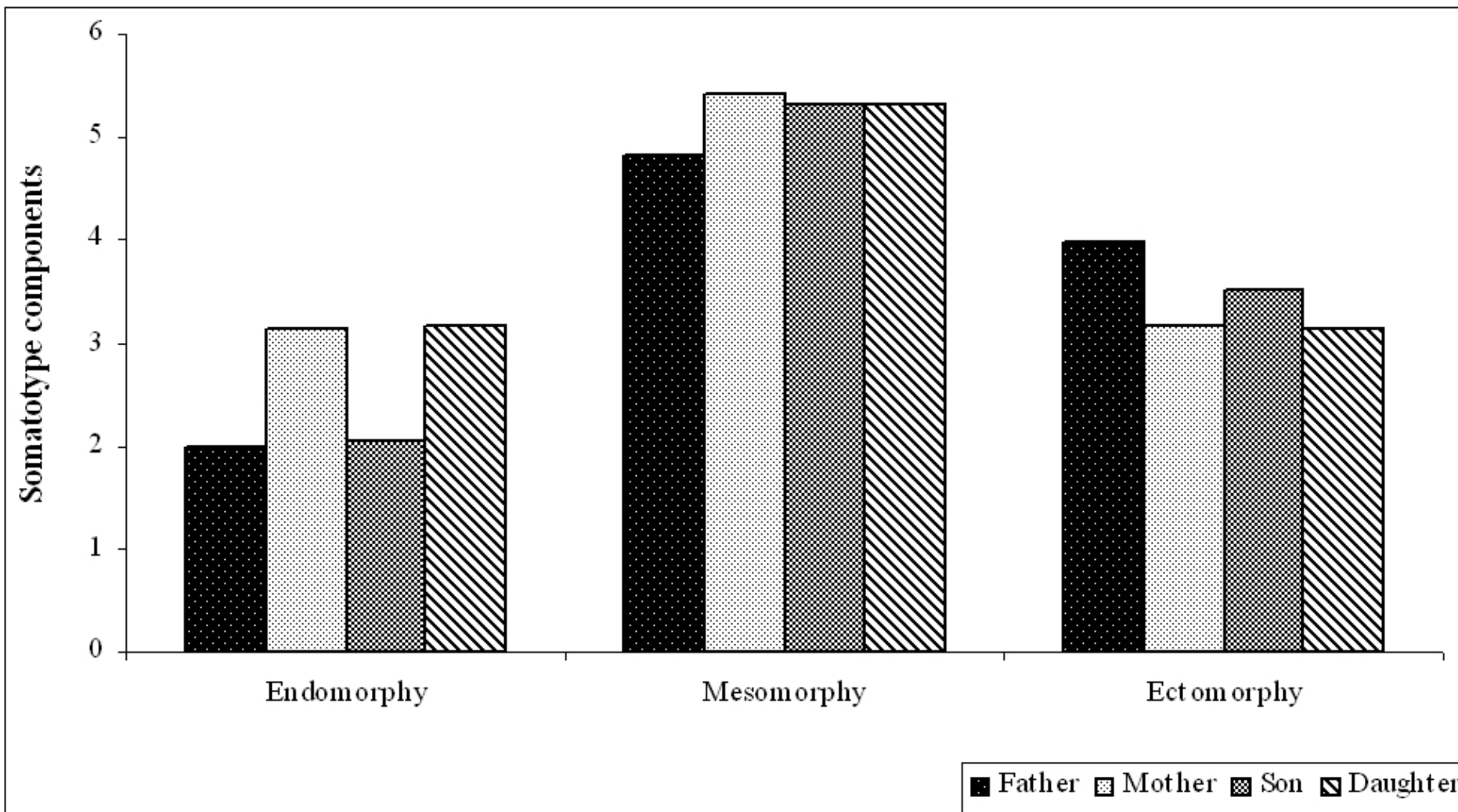
Table 4: Test of significance in Somatotype components among Fathers, Mothers, Sons and Daughters

Somatotype components	Fathers-Sons		Fathers-Daughters		Mothers-Sons		Mothers-Daughters	
	<i>MDI</i>	T-test	<i>MDI</i>	T-test	<i>MDI</i>	T-test	<i>MDI</i>	T-test
Endomorphy	-0.03	0.80	-0.47	11.24*	0.43	11.47*	-0.01	0.38
Mesomorphy	-0.10	6.43*	-0.10	4.26*	0.02	0.41	23.00	1.74
Ectomorphy	0.13	4.67*	0.23	6.74*	-0.10	3.09	0.01	0.46

* P < 0.05

MDI = Mean Difference Index

Figure 2: Intra-familial Variations in Somatotype Components

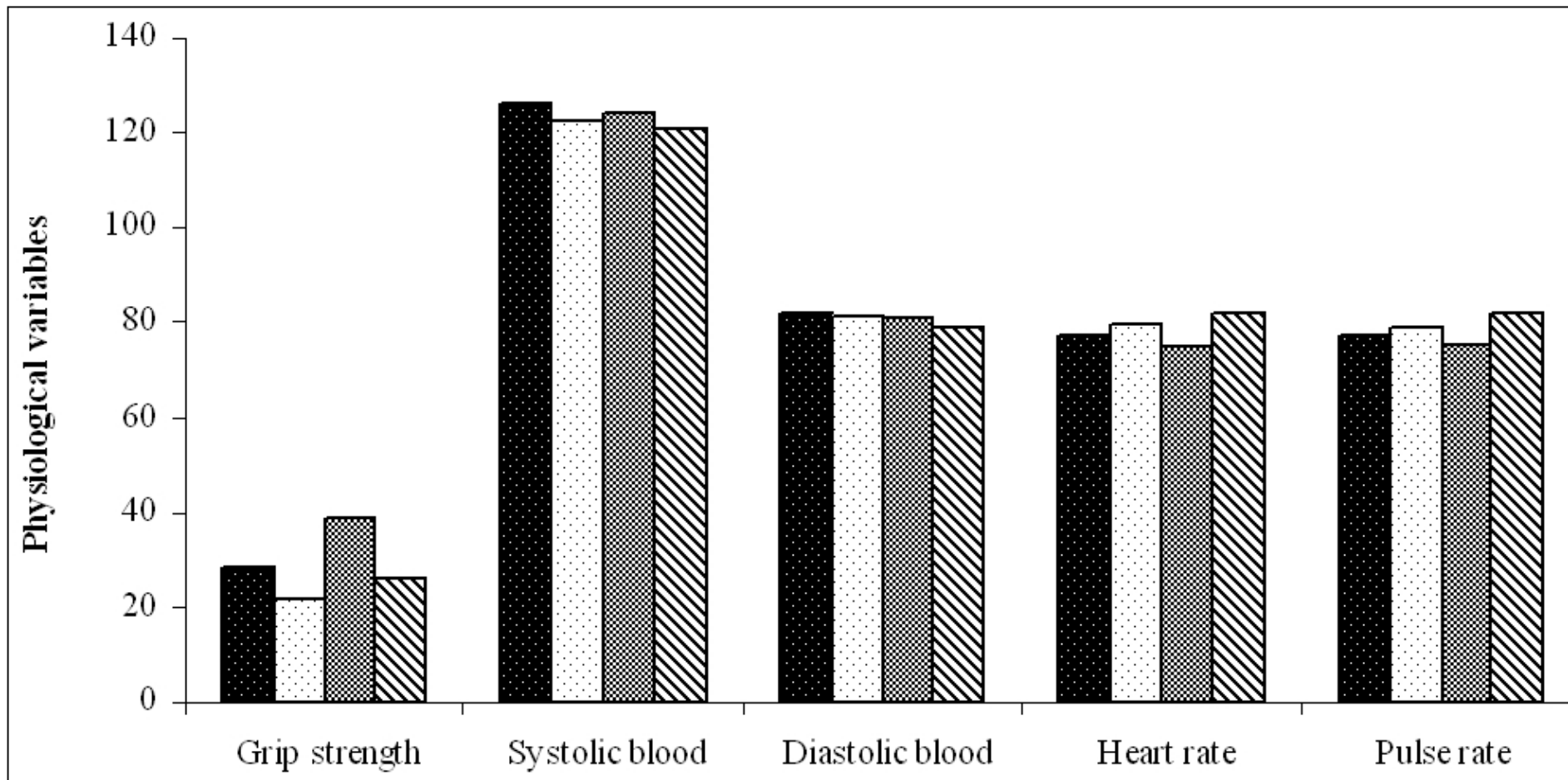


Physiological functions of Santhal Fathers, Mothers, Sons and Daughters are presented through descriptive statistics in Table 5. Muscular strength, as estimated from Handgrip strength, is greater in Sons and Daughters than Fathers and Mothers respectively. Among Santhal fathers, mothers, sons and daughters, sons have the greatest Muscular strength. Blood pressures, both Systolic and Diastolic, are relatively higher in Fathers and Mothers as compared to Sons and Daughters respectively (Figure 3). In physiological variables, the highest and the lowest dispersion, as evident from coefficient of variation, are observed in Handgrip strength and Systolic blood pressure respectively. Higher divergence in Handgrip strength is more apparent in parental generation than in filial generation. Among Santhals, gender has played a role in the variation of Heart and Pulse rates. For example, in males (Fathers and Sons) relatively greater dispersion is observed in these rates, whereas, in females (Mothers and Daughters) relatively lesser magnitude of divergence is noticed in both Heart and Pulse rates.

Table 5: Descriptive statistics of Physiological variables of Fathers, Mothers, Sons and Daughters

Physiological Variables	Fathers (400)			Mothers (400)			Sons (292)			Daughters (170)		
	<i>Mean</i>	<i>S.E.</i>	<i>C.V.</i>	<i>Mean</i>	<i>S.E.</i>	<i>C.V.</i>	<i>Mean</i>	<i>S.E.</i>	<i>C.V.</i>	<i>Mean</i>	<i>S.E.</i>	<i>C.V.</i>
Grip strength	28.2	7.2	25.6	21.5	5.3	24.6	38.6	5.8	15.2	25.7	5.2	20.1
Systolic blood pressure	126.0	0.7	10.4	122.8	0.6	9.7	124.5	0.5	6.9	120.6	0.7	7.7
Diastolic blood pressure	82.1	0.5	10.9	81.6	0.4	11.1	81.1	0.5	11.1	78.8	0.6	10.6
Heart rate	77.2	0.6	14.8	79.7	0.5	12.9	74.7	0.7	15.6	82.1	0.8	12.6
Pulse rate	77.1	0.6	15.0	79.3	0.5	12.4	75.5	0.7	15.0	82.2	0.8	13.0

Figure 3: Intra-familial Variations in Physiological variables



pressure

pressure

■ Fathers □ Mothers ▣ Sons ▤ Daughters

In this population, sex differences are evident in physiological functions. For example, Handgrip strength and Blood pressure (both Systolic and Diastolic) are higher in Fathers and Sons as compared to Mothers and Daughters respectively. On the other hand, Heart rate and Pulse rate are greater in females (Mothers and Daughters) in comparison with males (Fathers and Sons). In Systolic blood pressure, a trend of maternal influence is evident in both Sons and Daughters, as they do not show any statistically significant differences with their Mothers at 5% probability level (Table 6). In rest of the physiological parameters that are taken into account in the present study, both Mother-Sons and Mothers-Daughters pairs show statistically significant differences, except for Diastolic blood pressure in the former pair. Both Fathers-Sons and Fathers-Daughters pairs, on the other hand, show statistically significant differences in all the physiological variables.

Table 6: Test of significance in physiological variables among Fathers, Mothers, Sons and Daughters

Physiological Variables	Fathers–Sons		Fathers–Daughters		Mothers–Sons		Mothers–Daughters	
	<i>MDI</i>	T-test	<i>MDI</i>	T-test	<i>MDI</i>	T-test	<i>MDI</i>	T-test
Grip strength	-0.31	21.76*	0.10	5.00*	-0.57	46.17*	-0.18	9.04*
Systolic blood pressure	0.01	3.07*	0.04	4.07*	-0.01	1.52	0.02	1.92
Diastolic blood pressure	0.01	2.27*	0.04	3.81*	0.01	1.51	0.04	2.69*
Heart rate	0.03	3.45*	-0.06	5.49*	0.06	6.08*	-0.03	1.99*
Pulse rate	0.02	2.80*	-0.06	6.04*	0.05	4.58*	-0.04	2.36*

* P < 0.05

MDI = Mean Difference Index

Succinctly, both Sons and Daughters have certain degree of affinity with their Fathers and Mothers. All of them are predominantly mesomorphic with normal blood pressure, heart and pulse rates. Members of the parental generation (Fathers and Mothers) are 'Short' in stature, whereas, members filial generation (Sons and Daughters) fall under the category 'Lower medium'. Sex differences are apparent in body measurements and physiological functions. For example, Santhal Fathers and Sons are taller, heavier with broader shoulder, greater circumferences and bigger head and face in comparison with Mothers and Daughters. On the other hand, subcutaneous fat deposition is higher among Mothers and Daughters as compared to Fathers and Sons. In physiological variables, Fathers and Son have higher blood pressures and greater muscular strength, whereas, Mothers and Daughters have higher heart and pulse rates. In this population, Sons resemble their Fathers while Daughters resemble their Mothers in terms of different body measurements. Considerably higher mean values of different body measurements in Sons and Daughters, as compared to their Fathers and Mothers respectively indicate a positive secular trend, as Susanne (11) has suggested in this regard that in cross-sectional studies secular trend is principally responsible for the higher mean values of the height and sitting height measurements in the younger generations. This observation of secular trend is further strengthened by the fact that the parents are not yet reached senescence, as mean ages of Fathers and Mothers are 57.5 and 48.6 years respectively. These observations are in agreement with the study made by previous investigators who observed secular trend in filial generation in various body measurements 3 , 10 , 11 , 12 , 13 , 14 , 16 , 17 , 18 , 19 , 20 . This

indication of positive secular trend in the present population could be explained as the result of economic development and improvement of social indicators, like relatively more hygienic nutrition in the filial generation. Santhals have become more aware of their health, especially women's health and nutrition. They take their pregnant women to nearby primary health center instead of midwives. This became possible for them, as the number of primary health centers, in the block under study, have increased in past thirty years. All these factors must have helped the members of filial generation to attained maximum realization of their hereditary growth potentials. Hence, generational changes in Santhals are positive and towards healthier, well built and better developed filial generations.

Acknowledgment

We gratefully acknowledge the financial assistance rendered by the Ministry of Tribal Affairs, Govt. of India, for this investigation.

References

1. Malcolm LA. Some Biosocial Determinants of the Growth, Health and Nutritional status of Papua New Guinean Preschool Children. In: Stini WA, editor. Physiological and morphological adaptation and evolution. Mouton publishers: Hague; 1979 p. 233-241.
2. Russell M. Parent-child and sibling-sibling correlations of height and weight in a rural Guatemalan population of preschool children. *Hum Biol.* 1976; 48(3): 501-515.
3. Simsek F, Ulukol B, Gulnar SB. The secular trends in height and weight of Turkish school children during 1993-2003. *Child Care Health Dev.* 2005; 31(4): 441-7.
4. Bakwin H, McLaughlin SD. Secular increases in height. Is the end in sight? *Lancet.* 1964; 2: 1195-1196.
5. Damon A. Secular trend in height and weight within Old American families at Harvard, 1870-1965. *Am.J.Phys.Anth.* 1968; 29: 45-50.
6. Miranda Fredricks A, Buuren SV, Burgmeijer RJF, Meulmeester JF, Beuker RJ, BrugMan E, et al. Continuing positive secular growth change in the Netherlands 1955-1997. *Pediatric Research.* 2000; 47: 316 -323.
7. Castilho LV, Lahr MM. Secular trends in growth among urban Brazilian children of European descent. *Ann Hum Biol.* 2001; 28(5): 564-574.
8. Dey DK, Rothenberg E, Sundh V, Bosaeus I, Steen B. Height and body weight in elderly adults: a 21-years population study on secular trends and related factors in 70-year-olds. *J Gerontol A Biol Sci Med Sci.* 2001; 56(12): 780-784.
9. Marmo DB, Zambon MP, Morcillo AM, Guimarey LM. Secular trends of growth of schoolchildren from Paulinia, Sao Paulo-Brazil (1979/80 - 1993/94). *Rev Assoc Med Bras.* 2004; 50(4): 386-390.
10. Susanne C. Genetic and environmental influences on morphological characteristics. *Ann Hum Biol.* 1975; 2(3): 279-287.
11. Susanne C. Multivariate analysis of head measurements in Punjabi families. *Ann Hum Biol.* 1977; 5(2): 179-183.
12. Kaur DP, Singh R. Parent-adult offspring correlations and heritability of body measurements in a rural Indian population. *Ann Hum Biol.* 1981; 8(4): 333-

13. Malik P, Singh R. Filial transmission of body measurements. *Hum Biol.* 1996: 83-84.
14. Roy G, Singh R. Parent-adult offspring correlations of anthropometric measurements in an urban Indian population. *J Hum Ecol.* 1992: 3(2): 125-132.
15. Leung SS, Lau JT, Xu YY, Tse LY, Huen KF, Wong GW, et al. Secular changes in standing height, sitting height and sexual maturation of Chinese--the Hong Kong Growth Study, 1993. *Ann Hum Biol.* 1996: 23(4): 297-306.
16. Ulijaszek SJ. Socio-economic status, body size and physical activity of adults on Rarotonga, the Cook Island. *Ann Hum Biol.* 2001: 28: 554-563.
17. Ali MA, Uetake T, Ohtsuki F. Secular changes in relative leg length in post-war Japan. *Am J Hum Biol.* 2000: 12(3): 405-416.
18. Krawczynski M, Walkowiak J, Krzyzaniak A. Secular changes in body height and weight in children and adolescents in Poznan, Poland, between 1880 and 2000. *Acta Paediatr.* 2003: 92(3): 277-282.
19. Malina RM, Pena Reyes ME, Tan SK, Buschang PH, Little BB, Koziel S. Secular change in height, sitting height and leg length in rural Oaxaca, southern Mexico: 1968-2000. *Ann Hum Biol.* 2004: 31(6): 615-33.
20. Carrascosa A, Yeste D, Copil A, Gussinye M. Secular growth changes. Weight, height and body mass index values in infant, children, adolescent and young adults from Barcelona population. *Med Clin (Barc).* 2004: 123(12): 445-51.
21. Moreno LA, Sarrfa A, Fleeta J, Marcos A, Bueno M. Secular trends in waist circumferences in Spanish adolescents, 1995 to 2000-02. *Arch. Dis. Child.* 2005: 90: 818-819.
22. Saha R, Dasgupta P. Secular Trends in Measures of Cephalo-Facial Traits among Bengalee Boys Aged 7.0-16.0 Years from Kolkata between 1982-1983 and 1999-2001. *International Journal of Anthropology.* 2006: 21(1): 33-43.
23. Tanner JM, Hiernaux J, Jarnan S. Growth and physique studies. In: Weiner JS, Lourie JA, editors. *Human Biology- A guide to field Methods.* IBP Hand book no, 9. Blackwell Scientific Publication: Oxford; 1969. p. 315-340.
24. Census of India. West Bengal. [Updated 2001]. Available from: <http://www.censusindia.com/>.
25. Guha BS. Racial elements in the population. Oxford University Press: Oxford; 1944.
26. Culshaw WJ. Tribal Heritage: A study of the Santhals. Lutterworth Press: London; 1949.
27. Mukherjee CL. The Santhals. A. Mukherjee and Co. Pvt. Ltd : Calcutta; 1962.
28. Datta-Majumdar N. The santal: Study in culture change. Govt, of India press: Calcutta; 1956.
29. Martin R, Saller K *Lehrbuch der Anthropologie.* Gustav Fischer Verlag: Stuttgart; 1857.

30. Heath BH, Carter JEL. A modified somatotype method. *Am J Phys. Anthropol.* 1967; 27: 57-74.
31. Carter JEL. *The Heath and Carter Somatotype Method*. 3rd edition. San Diego State University Syllabus Service: San Diego; 1980.