

Understanding Morphological Changes from Parental to Filial Generations: A Case Study of the Santhal

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Abstract

The present paper aims to investigate relations between parental and filial generations in morphological characteristics of the Santhal. For this purpose, a cross-sectional sample was collected from 18 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. The Santhal Fathers, Mothers, Sons and Daughters resemble in being Dolichocephalic, Mesorrhinic and Hypereuryprosopic. Almost all of them have longer arm and leg. In terms of body physique Fathers, Mothers, Sons and Daughters are predominantly Mesomorphic.

Key Words: Secular trend, Anthropometric measurements, Intergenerational changes, Somatotype components, Intrafamilial resemblances.

Introduction

Morphological characters of human beings are determined by the combined influence of genetic and environmental factors (Russell, 1976; Susanne, 1975). 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 interacts with infective load in a community to modify and distort the capacity of populations to achieve their potential size, fertility and life span. Adaptive mechanisms developed by populations to deal with the stresses are both biological and social (Malcolm, 1979).

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Changes in different morphological characteristics, from parental to filial generation, are complex phenomenon to which more than one factor 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 (Russell, 1976). 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, with many changes in socio-economical conditions, reveal various trends in growth (Simsek, 2005). In this regard, the findings of Bakwin and McLaughlin (1964) and Damon (1968) 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 (Castilho, 2001; Dey et al., 2001; Marmo et al., 2004 and Miranda et al., 2000). 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 (1975, 1977), Kaur and Singh (1981), Malik and Singh (1996), Roy and Singh (1992), Leung et al. (1996), Ulijaszek (2001), Ali et al. (2000), Krawczynski et al. (2003), Malina et al. (2004), Carrascosa et al. (2004), Moreno (2005) and Saha and Dasgupta (2006).

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

Materials and Methods

The Sample: Cross-sectional sample of 400 Santhal families, consisting of 1262 individuals, were surveyed from 18 villages of Ranibandh block of Bankura district

of West Bengal, India. The sample size of the present study has been determined in accordance with the statistical knowledge. The field work was conducted from January, 2003 to November, 2004, making several visits of the area with first one being the pilot survey. The selection of the district, block and the villages was based on Multi-stage cluster random sampling. Out of all the districts of West Bengal inhabited by the Santhal, Bankura was selected by using cluster random sampling. Similar method was used to select Ranibandh block. To meet the sample size, i.e., 400 families that met the requirement of having parents with at least one adult child, villages were selected randomly scattered all over the block. Unit of the study was a family having ever married women, her husband and at least one of their adult children. families that met the requirement of having parents with at least one adult child 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 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, like marriage certificate (if any), age at marriage, age at first child, employment letter (if any) and any other events that has relation with age of the subjects. 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 Population: The Santhal is the third largest tribal community in India after the Gond and the Bhil. The Santhal belong to the Proto-Australoid, (Guha, 1944), who considered that they arrived in India soon after the Negritos. The Santhal is 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, Korku, Savara and Gadaba languages spoken by nearby inhabiting smaller tribes (Culshaw, 1949). According to Grierson, this language is a division of *Munda* language (Grierson, 1928). The Santhal have been living in southern and western part of West Bengal for at least five hundred years.

Primary occupation of the Santhal 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 labour on the basis of gender. Since the

Santhal 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 (Mukherjee, 1962). The clans are strictly exogamous in nature and there are no intra-clan marriages.

Measurements: Nineteen Anthropometric measurements were taken on each subject following standard methods (Martin and Saller, 1857; Tanner et al., 1969). In addition three indirect measurements were calculated. Body indices were calculated as described by Martin and Saller (1957) and Brugsch (1917). Further, Somatotype was rated by using Heath and Carter Anthropometric Somatotyping method (Heath and Carter 1967; Carter, 1980). Statistical analysis was done by using computerized statistical softwares, viz. SPSS and MS Excel. In addition, subjects were interviewed to obtain information regarding their dietary intake and housing characteristics like, pattern of house, position of kitchen and sources of fuel.

Results and Discussion

Results of the investigation of socio-cultural features, such as, residence type and dietary intake are displayed in this section. The majority of the Santhal (97.0%) own single storied *kaccha* houses (Table 1). Only few can afford to have a pucca-single storied (2.2%) or pucca-double storied house (0.8%). Most of the houses have a room and a kitchen (79.0%). Sometimes, when they don't have a separate kitchen, they use the space outside their living room (14.7%) or a corner inside their living room (6.3%) for cooking purposes. Forest wood is the only type of fuel used by the Santhal. Both public well (60.7%) and hand pump (37%) are present in each village. As a consequence, rarely (2.3%) they go to the nearby river to fetch drinking water. In majority of the cases (90.3%) kerosene light their houses, however, some (9.7%) of them can afford to use electricity.

Dietary habits of the Santhal suggest that their staple diet is rice and they generally do not take wheat based preparations. Majority of them (80.6%) take meals thrice a day; whereas 15.0% take meals twice a day and a few (3.8%) can afford to have meals four times a day (Table 2). More than half of them (51.7%) do not take tea at all and even if they take it is generally without milk (40.8%). As milk is scarce, consumption of milk is almost negligible in most of the cases (98.5%) and only a few (1.5%) can afford to consume milk. Pulse intake is low among the Santhal and they take pulses only two (33.0%) or three (31.1%) days a week. The Santhal generally don't cultivate pulse and purchase it from market. They take green vegetables twice (57.1%), thrice (42.1%) or once (0.8%) a day. Although all of them are non-vegetarians, they can hardly afford to consume fish or meat. They usually take meat once (70.1%) or twice (22.3%) a month. Only few of them can

afford to consume non-vegetarian food thrice (4.5%) or four (3.1%) times a month. They do not purchase fruits from market but collect them from forest; therefore, the consumption of fruits depends on the season.

Among the Santhal, 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 3, 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 the Santhal, 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.

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 4). Gender plays an important role in intra-familial variations of Sum of skinfolds, where Fathers-Sons and Mothers-Daughters have resemblances, but Fathers-Daughters and Mothers-Sons have significant differences. A positive secular trend is apparent in almost all the body measurements, more so in Sons than in Daughters. Contrary to the general notion, usually the 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. Generally daughters have greater resemblance with their Mothers, while Sons show more proximity with their Fathers as far as their body measurements are concerned.

Frequency distribution of Cephalic index among the Santhal is presented in Figure 2. A little less than fifty percent of the Santhal are Dolichocephalic in their head form. In parental generation, more than fifty percent of the Santhal have Dolichocephalic head, in both males and females. In filial generation on the other hand, Dolichocephaly is less prevalent, especially in Daughters where predominance of Mesocephaly is noticed. Thus, generational changes are evident in head shape of the Santhal, which is transforming from longer head in the parental generation to broader head in the filial generation. Statistically significant differences are observed in all the four pairs, i.e. Fathers-Sons ($\chi^2 = 15.36^*$), Fathers-Daughters ($\chi^2 = 45.59^*$), Mothers-Sons ($\chi^2 = 13.16^*$) and Mothers-

Daughters ($\chi^2 = 10.76^*$). In Nasal index of the Santhal, predominance of Mesorrhinae is observed over other nasal form in Fathers, Mothers, Sons and Daughters (Figure 3). A generational change is evident in Nasal index, where Chamaerrhinae is relatively prevalent in filial generation and Leptorrhinae is more frequent in parental generation. Except Fathers-son ($\chi^2 = 9.63^*$) statistically non-significant differences in the Nasal index are observed among Fathers-Daughters ($\chi^2 = 2.39$), Mothers-Sons ($\chi^2 = 7.83$) and Mothers-Daughters ($\chi^2 = 4.17$), but not Fathers-Sons ($\chi^2 = 9.63^*$).

Total facial index of the Santhal suggests that Fathers are more varied in their facial form as compared to Mothers, Sons and Daughters (Figure 4). Members of the filial generation, i.e. Sons and Daughters show resemblance with their Mothers in Total facial index by exhibiting dominance of Hypereuryprosopic form over other categories in their Total facial index. Sons have statistically significant differences with their Fathers ($\chi^2 = 36.58^*$) and Mothers ($\chi^2 = 9.60^*$), whereas Daughters show significant difference with Fathers ($\chi^2 = 16.79^*$), but not with Mothers ($\chi^2 = 1.90$).

In Body mass index of the Santhal, a noteworthy shift from parental to filial generation is observed, where majority of the members from parental generation, i.e. Fathers and Mothers, fall under the category Underweight and mentionable percentage of the members from filial generation, i.e. Sons and Daughters, fall under the category Normal weight (Figure 5). It might be due to the improved nutritional condition in the filial generation than in the parental generation (Ghosh and Malik, 2008), as it is known that body mass index is more nutritionally than genetically related (Khongsdier, 2001). Sons have significant differences with their Fathers ($\chi^2 = 43.64^*$) and Mothers ($\chi^2 = 36.52^*$). However, Daughters do not show any statistical differences with their Fathers ($\chi^2 = 5.50$) and Mothers ($\chi^2 = 2.78$).

Upper Extremity-Stature Index of the Santhal indicates that majority of Fathers, Mothers, Sons and Daughters fall under the category Long arm (Figure 6). Statistically significant differences are observed among Fathers-Sons ($\chi^2 = 24.75^*$) and Fathers-Daughters ($\chi^2 = 28.16^*$), while with Mothers neither Sons ($\chi^2 = 1.84$) nor Daughters ($\chi^2 = 0.36$) show any significant differences. This observation confirms some degree of maternal resemblance in Upper extremity-stature index among the Santhal. Lower extremity-stature index of the Santhal suggests that Fathers, Mothers, Sons and Daughters predominately fall under the category Long leg (Figure 7). Significant differences are observed among Mothers-Sons ($\chi^2 = 12.89^*$) and Mothers-Daughters ($\chi^2 = 6.41^*$), whereas with Fathers neither Sons ($\chi^2 = 5.08$) nor Daughters ($\chi^2 = 3.68$) show any significant differences. This indicates paternal resemblance in Sons and Daughters in their Lower extremity-stature index.

Mesomorphic component is dominant among Santhal Fathers, Mothers, Sons and Daughters (Figure 8). Maternal resemblance is apparent in Mesomorphy, as both Sons and Daughters show affinity with their Mothers than with their Fathers. In Endomorphic and Ectomorphic components, a role of gender is 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. Sons have statistically significant differences with Fathers in Mesomorphic and Ectomorphic components, whereas with Mothers in Endomorphic component (Table 6). Daughters show significant differences with Fathers but not with Mothers in all the Somatotype components.

Overall both Sons and Daughters have certain degree of affinity with their Fathers and Mothers in being Dolichocephalic, Mesorrhinae and Hypereuryprosopic. Almost all of them have long arm and leg and are predominantly mesomorphic. Sex differences are apparent in almost all the body measurements. For example, the 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 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. Susanne (1977) had 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 to reach 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 (Ali et al., 2000; Carrascosa et al., 2004; Kaur and Singh, 1981; Krawczynski et al., 2003; Malik and Singh, 1996; Malina et al., 2004; Roy and Singh, 1992; Simsek 2005; Susanne, 1975, 1977 and Ulijaszek, 2001). This positive secular trend in the present population could be explained as the result of genetic factors and improvement of social indicators. In general, the Santhal of this area belong to low socio-economic class. Although all of them are non-vegetarians, they cannot afford it more than once or twice a month. Presence of positive secular trend in such kind of population, suggests crucial role played by the genetic factors. Besides, the Santhal have become more aware of their health, especially women's health and nutrition (Ghosh and Malik, 2008). This became possible for them, as the number of primary health centers, in the block under study, have increased in past thirty years (Ghosh and Malik, 2009). All these factors might have helped the members of filial generation to attained maximum

realization of their hereditary growth potentials. Hence, generational changes in the Santhal are positive and towards healthier, well built and better developed filial generation.

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References

- Ali, M.A., T. Uetake, and F. Ohtsuki. 2000. 'Secular changes in relative leg length in post-war Japan,' *American Journal of Human Biology*, vol.12, no.3: 405-416.
- Bakwin, H. and S.D. McLaughlin. 1964. 'Secular increase in height. Is the end in sight?' *Lancet*, vol. 284, no.7371: 1195-1196.
- Carrascosa, A., D. Yeste, A. Copil, M. Gussinye. 2004. 'Secular growth changes. Weight, height and body mass index values in infant, children, adolescent and young adults from Barcelona population,' *Medicina Clinica*, vol.123, no.12: 445-51.
- Carter, J.E.L. 1980. *The Heath and Carter Somatotype Method*. San Diego: San Diego State University Syllabus Service.
- Castilho, L.V. and M.M. Lahr. 2001. 'Secular trends in growth among urban Brazilian children of European descent,' *Annals of Human Biology*, vol. 28, no. 5: 564-574.
- Census of India*. 2001. www.censusindia.com.
- Culshaw, W.J. 1949. *Tribal Heritage: A study of the Santhals*. London: Lutterworth Press.
- Damon, A. 1968. 'Secular trend in height and weight within Old American families at Harvard, 1870-1965,' *American Journal of Physical Anthropology*, vol. 29, no.1: 45-50.
- Dey, D.K., E. Rothenberg, V. Sundh, I. Bosaeus, B. Steen. 2001. 'Height and body weight in elderly adults: a 21-years population study on secular trends and related factors in 70-year-olds,' *Journal of Gerontology series: A Biological Science and Medical Science*, vol. 56, no.12: 780-784.
- Ghosh, S. and S.L. Malik. 2008. 'Auditing Gender Equality among Santhals,' *Indian Journal of Millennium Development Studies*, vol 3, no,1: 117-128.
- Ghosh, S. and S.L. Malik. 2009. 'Assessment and Administration of Health in a Tribal Community of India,' *The Internet Journal of Biological Anthropology*, vol. 3, no. 2.
http://www.ispub.com/journal/the_internet_journal_of_biological_anthropology/volume_3_num_2_59/article/assessment-and-administration-of-health-in-a-tribal-community-of-india.html.
- Grierson, G. 1928. *Linguistic Survey of India*. Calcutta.
- Guha, B.S. 1944. *Racial elements in the Populations*. Oxford: Oxford University Press.
- Heath, B.H. and J.E.L. Carter. 1967. 'A modified somatotype method,' *American Journal of Physical Anthropology*, Vol. 27, no.1: 57-74.

- Kaur, D.P. and R. Singh. 1981. "Parent-adult offspring correlations and heritability of body measurements in a rural Indian population," *Annals of Human Biology*, vol. 8, no. 4: 333-339.
- Khongsdier, R. 2001. "Body mass index of adult males in 12 populations of northeast India," *Annals of Human Biology*, vol. 28, no. 4: 374-383.
- Krawczynski, M., J. Walkowiak, A. Krzyzaniak. 2003. "Secular changes in body height and weight in children and adolescents in Poznan, Poland, between 1880 and 2000," *Acta Paediatrica*, vol. 92, no. 3: 277-282.
- Leung, S.S., J.T. Lau, Y.Y. Xu, L.Y. Tse, K.F. Huen, G.W. Wong, W.Y. Law, V.T. Yeung, W.K. Yeung, N.K. Leung. 1996. "Secular changes in standing height, sitting height and sexual maturation of Chinese--the Hong Kong Growth Study, 1993," *Annals of Human Biology*, vol. 23, no. 4: 297-306.
- Malcolm, L.A. 1979. "Some Biosocial Determinants of the Growth, Health and Nutritional status of Papua New Guinean Preschool Children," In W.A. Stini, (eds.), *Physiological and Morphological Adaptation and Evolution*. Hague: Mouton publishers: 233-241.
- Malik, P. and R. Singh. 1996. "Filial transmission of body measurements." In L.S. Sidhu and S.P. Singh (eds.), *Human Biology- Global Developments*. Ludhiana: USG Publishers and Distributors: 83-94.
- Malina, R.M., M.E. Pena Reyes, S.K. Tan, P.H. Buschang, B.B. Little, S. Koziel. 2004. "Secular change in height, sitting height and leg length in rural Oaxaca, southern Mexico: 1968-2000," *Annals of Human Biology*, vol. 31, no. 6: 615-33.
- Marmo, D.B., M.P. Zambon, A.M. Morcillo, L.M. Guimarey. 2004. "Secular trends of growth of schoolchildren from Paulinia, Sao Paulo-Brazil (1979/80 ó 1993/94)," *Revista da Associação Médica Brasileira*, vol. 50, no. 4: 386-390.
- Martin, R. and K. Saller. 1857. *Lehrbuch der Anthropologie*. Stuttgart: Gustav Fischer Verlag.
- Miranda Fredricks, A., S.V. Buuren, R.J.F. Burgmeijer, J.F. Meulmeester, R.J. Beuker, E. Brugman, M.J. Roede, S.P. Verloove-vanhorick, J. Wit. 2000. "Continuing positive secular growth change in the Netherlands 1955-1997," *Pediatric Research*, vol. 47, no. 3: 316-323.
- Moreno, L.A., A. Sarrfa, J. Fleta, A. Marcos, M. Bueno. 2005. "Secular trends in waist circumferences in Spanish adolescents, 1995 to 2000-02," *Archives of Disease in Childhood*, vol. 90, no. 8: 818-819.
- Mukherjee, C.L. 1962. *The Santhals*. Calcutta: A. Mukherjee and Co. Pvt. Ltd..
- Roy, G. and R. Singh. 1992. "Parent-adult offspring correlations of anthropometric measurements in an urban Indian population," *Journal of Human Ecology*, vol. 3, no. 2 : 125-132.
- Russell, M. 1976. "Parent-child and sibling-sibling correlations of height and weight in a rural Guatemalan population of preschool children," *Human Biology*, vol. 48, no. 3: 501-515.
- Saha, R. and P. Dasgupta. 2006. "Secular Trends in Measures of Cephalo-Facial Traits among Bengalee Boys Aged 7.0ó16.0 Years from Kolkata between 1982ó1983 and 1999ó2001," *International Journal of Anthropology*, vol. 21, no. 1: 33-43.

- Simsek, F., B. Ulukol, S.B. Gulnar. 2005. "The secular trends in height and weight of Turkish school children during 1993-2003," *Child: Care, Health and Development*, vol. 31, no. 4: 441-7.
- Susanne, C. 1975. "Genetic and environmental influences on morphological characteristics," *Annals of Human Biology*, vol. 2, no. 3: 279-287.
- Susanne, C. 1977. "Multivariate analysis of head measurements in Punjabi families," *Annals of Human Biology*, vol. 5, no. 2: 179-183.
- Tanner, J.M., J. Hiernaux, S. Jarnan. 1969. "Growth and physique studies," In J.S. Weiner and J.A. Lourie (eds). *Human Biology- A guide to field Methods. IBP Hand book no, 9*. Oxford: Blackwell Scientific Publication: 315-340.
- Ulijaszek, S.J. 2001. "Socio-economic status, body size and physical activity of adults on Rarotonga, the Cook Island," *Annals of Human Biology*, vol. 28, no. 5: 554-563.

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Table 1: Housing characteristics of the Santhal

Items	Categories	No.	%
Construction of house	Kaccha and single storeyed	388	97.0
	Pucca and single storeyed	9	2.2
	Pucca and double storeyed	3	0.8
Position of kitchen	Separate kitchen	316	79.0
	Kitchen inside the living room	25	6.3
	Kitchen outside the living room	59	14.7
Sources of drinking water	Hand pump	148	37.0
	Public well	243	60.7
	River	9	2.3
Sources of light in a house	Electricity	39	9.7
	Kerosene	361	90.3
No. of rooms in a house	One	60	15.0
	Two	187	46.5
	Three	112	28.0
	Four or more	41	10.5

Table 2: Dietary habits of the Santhal

Dietary habits		No.	%
Meals taken per day	Once	2	0.6
	Twice	60	15.0
	Thrice	323	80.6
	Four times or more	15	3.8
Tea intake	Never	207	51.7
	With sugar and milk	30	7.5
	With sugar and without milk	163	40.8
Pulse taken per week	One day	94	21.5
	Two days	138	33.0
	Three days	132	31.1
	Four days	37	8.3
	Seven days	28	6.1
Green vegetable / day	Once	3	0.8
	Twice	229	57.1
	Thrice or more	168	42.1
Meat or Fish / month	Once	280	70.1
	Twice	89	22.3
	Thrice	19	4.5
	Four times or more	12	3.1
Milk taken per week	Never	394	98.5
	Once or more	6	1.5

Table 3: 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

Table 4: Test of significance in Body measurements among Fathers-Sons, Fathers-Daughters Mother-Sons and Mothers-Daughters
 * P < 0.05 MDI = Mean Difference Index

Body Measurements	Fathers-Sons		Fathers-Daughters		Mothers-Sons		Mothers-Daughters	
	MDI	T- test	MDI	T- test	MDI	T- test	MDI	T- test
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 Skinfolds, mm	-0.04	1.33	-0.36	9.49*	0.32	9.10*	0.00	0.50

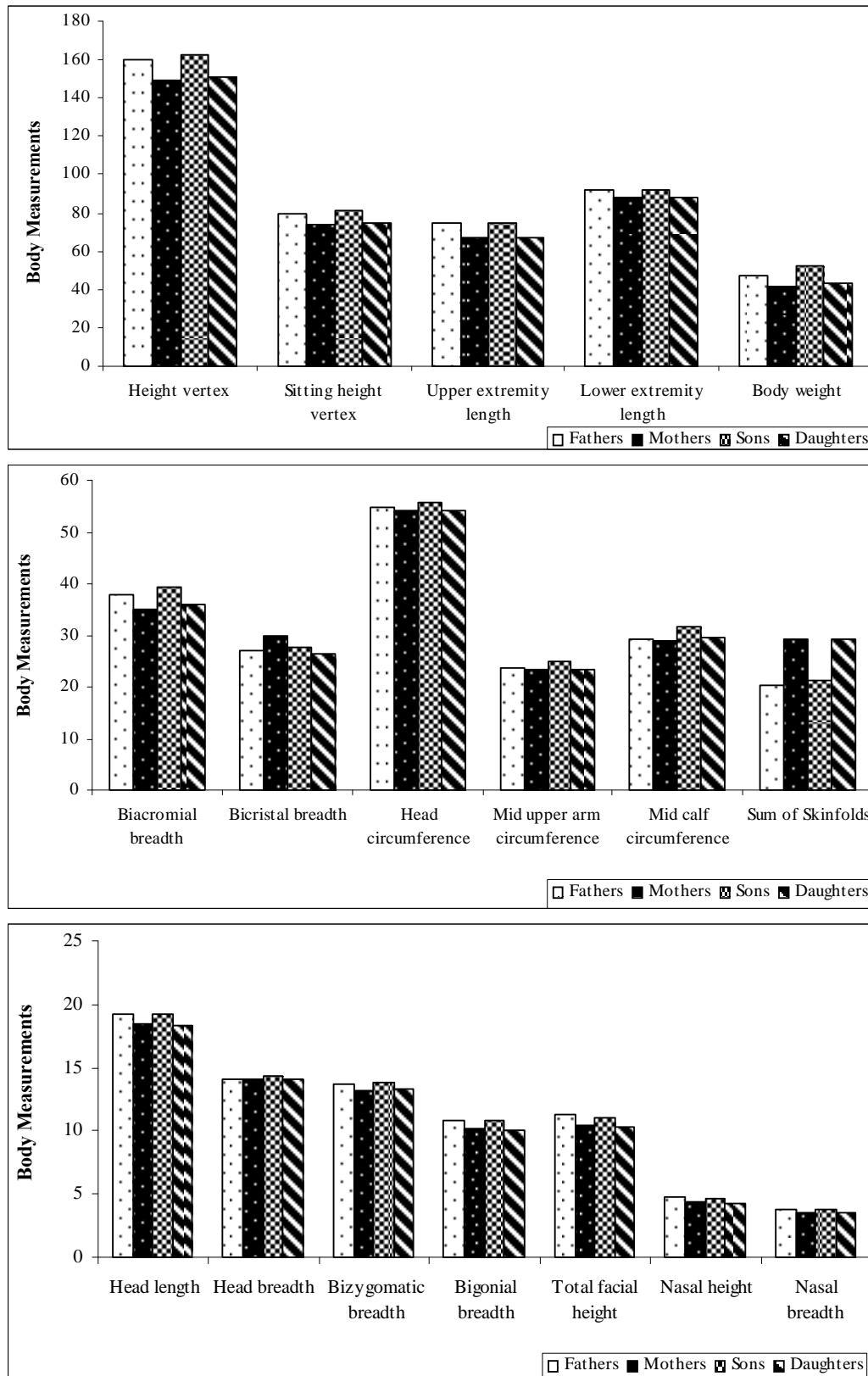


Figure 1: Intra-familial Variations in Body measurements (all measurements in cm and weight in kg)

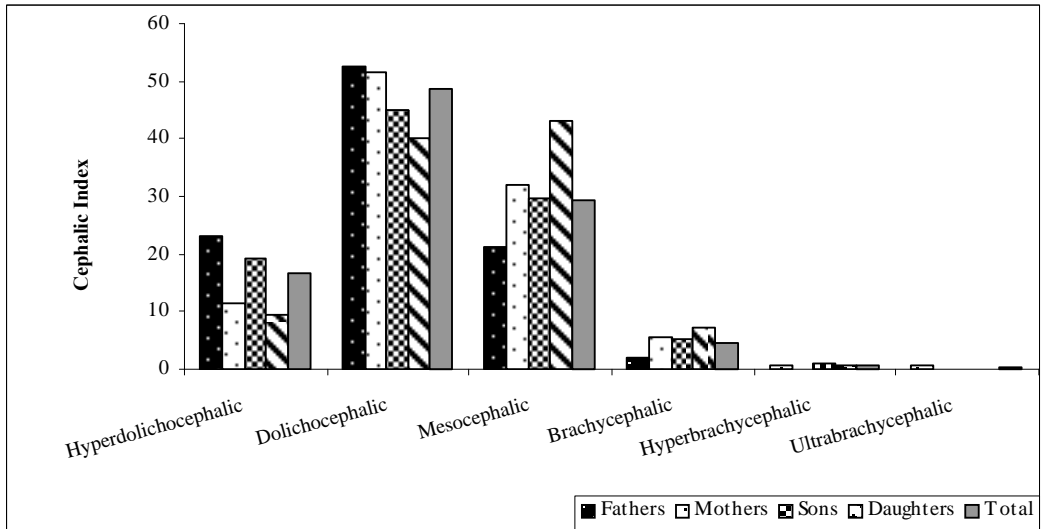


Fig. 2: Intra-familial Variations in Cephalic Index

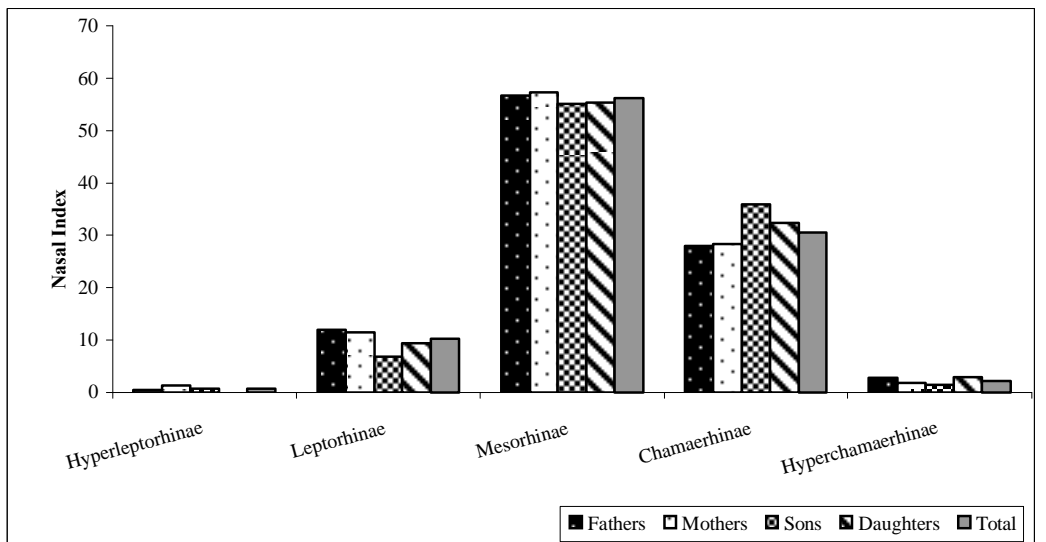


Fig. 3: Intra-familial Variations in Nasal Index

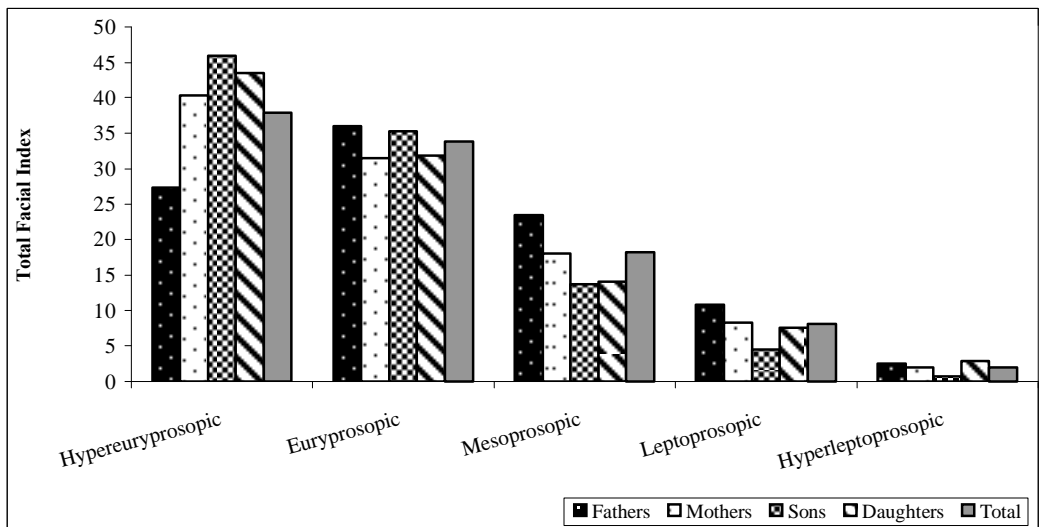


Fig. 4: Intra-familial Variations in Total Facial Index

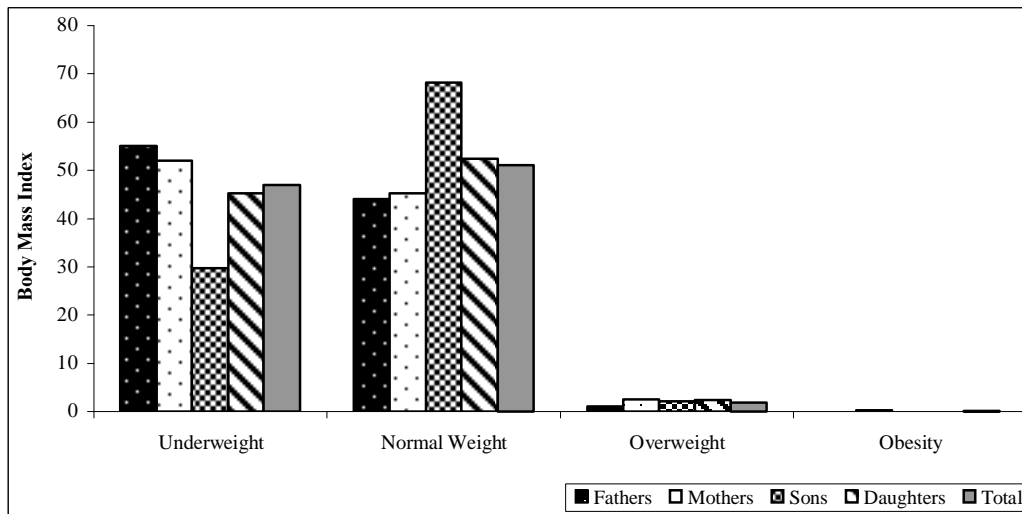


Fig. 5: Intra-familial Variations in Body Mass Index

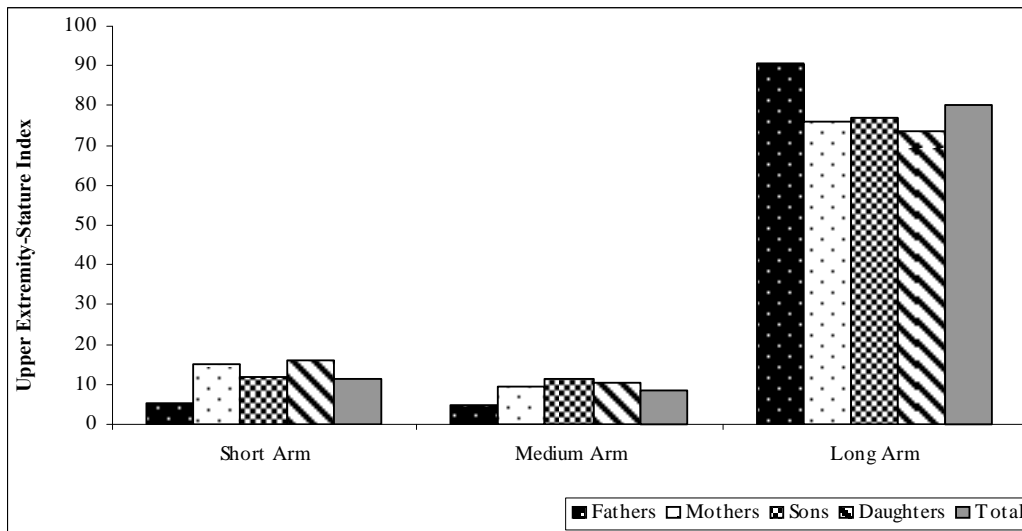


Fig. 6: Intra-familial Variations in Upper Extremity-Stature Index

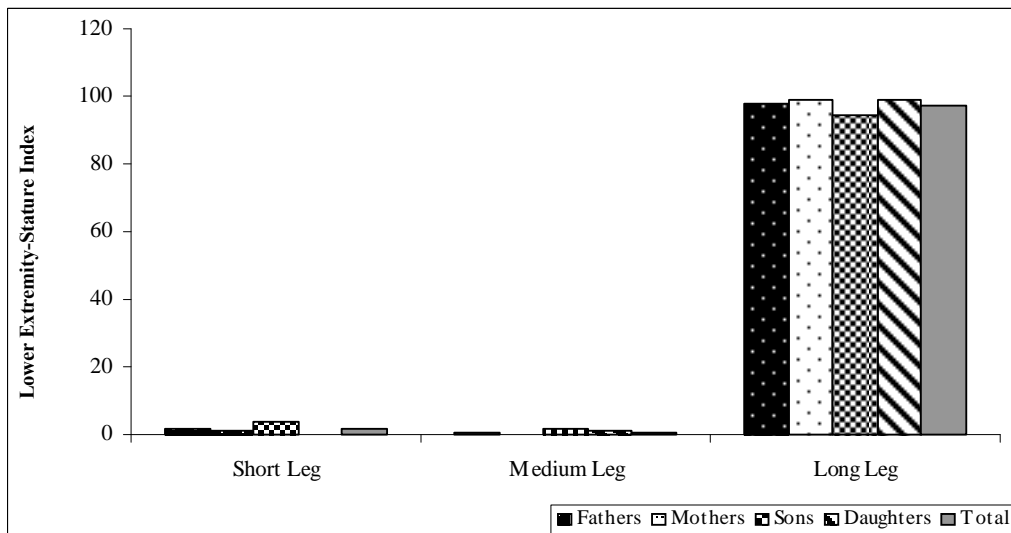


Fig. 7: Intra-familial Variations in Lower Extremity-Stature Index

Table 5: Descriptive statistics of Somatotype components of Fathers, Mothers, Sons and Daughters

Somatotype Components	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.
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 6: Test of significance in Somatotype components among Fathers, Mothers, Sons and Daughters

Somatotype components	Fathers-Sons		Fathers-Daughters		Mothers-Sons		Mothers-Daughters	
	MDI	T- test	MDI	T- test	MDI	T- test	MDI	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

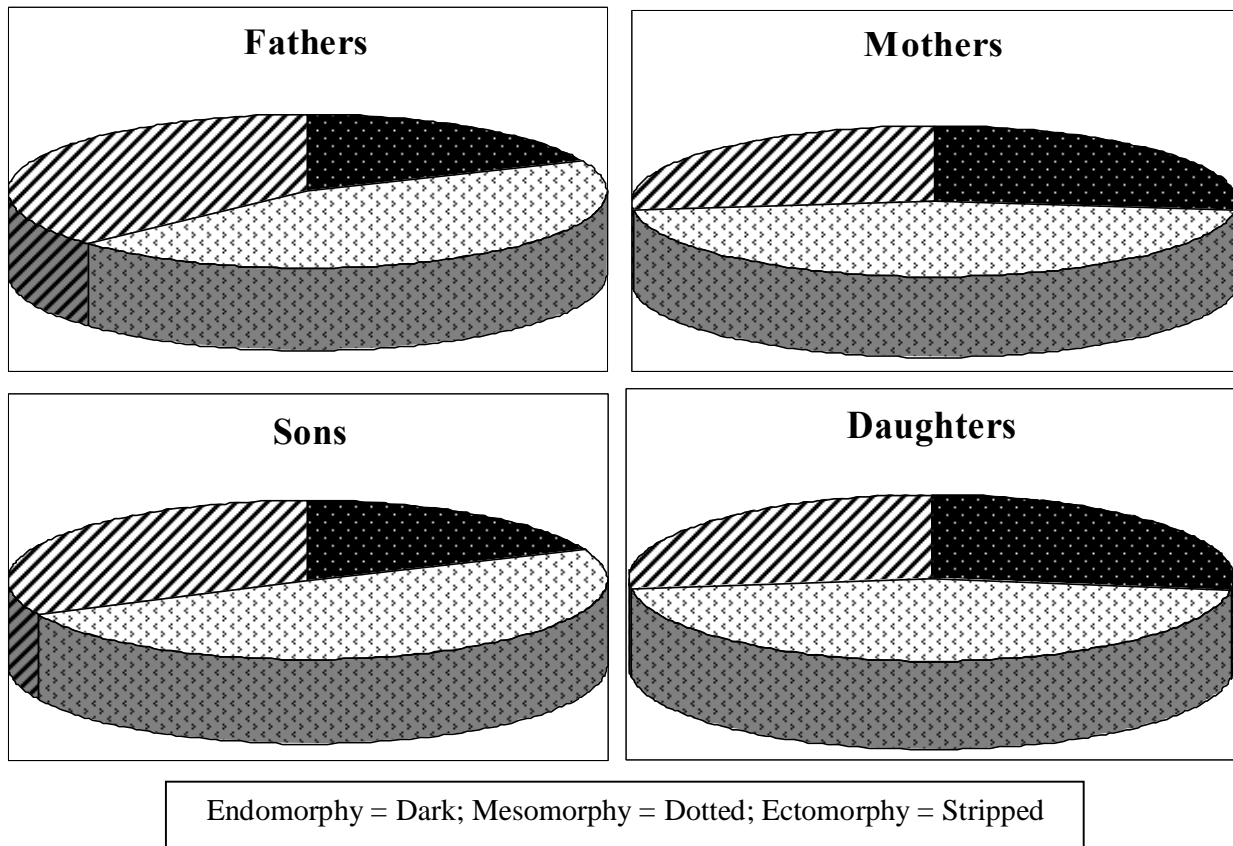


Fig. 8: Intra-familial Variations in Somatotype Components