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# Intergenerational Trend of Some Dermatoglyphic Traits in Vaidyas of West Bengal, India

**Mahua Sengupta and Bibha Karmakar**

Anthropology and Human Genetics Unit, Indian Statistical Institute, Calcutta, India

**A B S T R A C T**

*In order to investigate the intergenerational change of dermatoglyphics, fingerprints of 400 individuals were collected from an endogamous caste Vaidyas of Barasat, West Bengal. Results were compared with the data of an earlier sample of Banerjee collected in 35 years before on the same community of the same area. As it is generally known that dermatoglyphics is selectively neutral, thus if no other evolutionary forces play a role, we cannot expect any change of dermatoglyphic characters after several years. In the present study, non-significant change in the frequency of pattern and more or less same PII have been observed in both sexes. But significant quantitative differences were found between the two samples. These differences may not be due to the change of intra-uterine environment, rather due to the inter-observer error of these two studies and the small sample size of the earlier study. Because though same methods were used in both studies, inter-observer variation is much possible in ridge counting than pattern type determination.*

***Key words:*** *dermatoglyphics, intergenerational trend, Vaidyas, West Bengal, India*

## Introduction

One of the most important biological features of dermatoglyphics is that they comprise of the most useful traits for evaluating the environmental factors affecting embryonic development. These ridges are formed at the end of the first and beginning of the second trimester of embryonic development and remain unchanged through individual's life[1]. The only changes are in size, the growth of the ridges keeping place with the growth of hands and feet[2]. This permanency is a key factor in various biological investigations of dermatoglyphics, including studies of inheritance[3]. While several studies of permanency of dermatoglyphic features through later life of an individual are on record[4,5], there are fewer studies that

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have considered the developmental changes in dermatoglyphics of individuals within the same population, over a time span of several decades. Since inheritable phenotypic characteristics in some degree influenced by the forces of evolution i.e. mutation, natural selection, genetic drift, gene flow and non-random mating patterns, it is worthwhile to investigate evolutionary aspects of intergenerational changes of fingerprint patterns. As it is known that, though the dermal phenotypes are, for the most part, inherited, their final form is affected by intrauterine environment operating during the first trimester of pregnancy.

Thus, an attempt has been made in the present study to ascertain whether there is any change in dermatoglyphic characteristics between generations within the same population. The sample for the present study was collected during 2000 on the Vaidya community in a small -circumscribed area of Barasat in the district of North 24 parganas, West Bengal, India. This data is then compared with the sample (male 100 and female 100) of Dr. Banerjee who collected the student groups from the same population of the same area during 1965–66. He used this data (a-b ridge count) on a study[6] to compare this caste with other Bengali caste groups. He also utilized 161 individuals from this data in another study[7], where he used pattern frequency of the finger and pattern intensity index. The present study is compared with these two earlier published data.

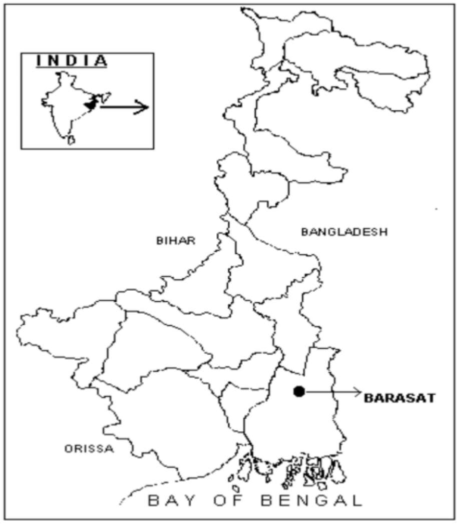


*Fig. 1. Map of West Bengal showing the geographical location of the studied population in 24 Parganas.*

## Materials and Methods

*Subjects*

The finger and palm prints were collected from the Vaidya population of Barasat in North 24 Parganas, West Bengal during 2000. The data consist of 400 normal healthy individuals-200 males and 200 females (below 20 years). As both the present and previous studies include student groups, there may not be any possibility of generational effect within each of these samples. However, care was taken in selecting unrelated individuals for the sample. Their geographical location is shown in Figure 1. Vaidyas are found mainly in West Bengal. They generally represent higher social statuses. There is no subpopulation found among them. The ancestors (2–3 generations before) of most of them were migrant persons, mainly from Bangladesh. From the present study, the new migrants have been excluded so that they cannot alter the population structure of the community. The amputee or handicraft individuals are also excluded from the study due to the lack of finger or palm prints. They practice Hinduism. Their mother tongue is Bengali. They are strictly endogamous, but practice clan (*Gotra*) exogamy. Consanguineous marriage is absent among them. They have a patrilinear society and exhibit a social structure based on it. Although traditionally they are recognized as physicians, today members of this caste generally don't follow their traditional professions and engage in diverse field.

*Print and statistical analysis*

Bilateral finger and palm prints of each individual were collected according to the widely used traditional ink method proposed by Cummins and Midlo[1]. The standard classification of dermatoglyphic patterns was used following Penrose[8]. Both the qualitative (frequency of different patterns, Pattern Intensity Index or PII of finger) and quantitative (total finger ridge count or TFRC and palmar a-b ridge counts) have been taken into consideration. PII was constructed following the common system of scoring zero for arches, one for loops and two for whorls. TFRC and a-b ridge count was estimated following the method of Holt[9]. Same methods were followed in the present study for classification of patterns or in ridge counting methods as used in the earlier studies[6, 7]. Statistical comparisons between the present and earlier studies were carried out through the use of $\chi^2$-test and student's t-test for qualitative and quantitative data, respectively.

## Results

The percentile frequency of dermatoglyphic patterns (all ten fingers combined together) of two studies has been presented in Table 1 and graphically in Figure 2. It has been found that in both the studies, ulnar loops are more preponderant than any other pattern types. In the present study, male shows slightly higher frequency of ulnar loops (57.85%) and radial loops (1.35%) and lower frequency of arches (5%) and whorls (35.80%) than that of the earlier study (ulnar loops 54.46%, radial loops 1.23%, arches 5.23%, whorls 39.08%). While female of the present sample shows higher frequency of ulnar loops (61.15%) and arches (4.05%) and lower frequency of whorls (33.25%) and radial loops (1.55%), than the earlier one (ulnar loops 60.99%, arches 2.64%, whorls 34.40%, radial loops 1.97%). PII was calculated from the frequency of

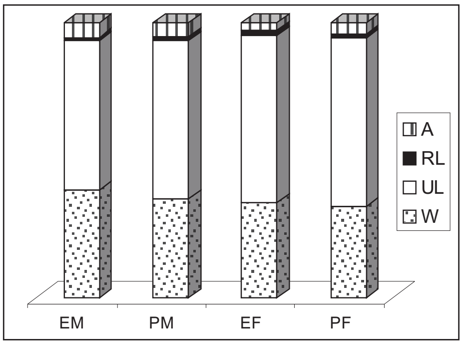


*Fig. 2. Comparison between two studies with respect to pattern frequency. EM – male of early study, PM – male of present study, EF – female of early study, PF – female of present study, A – arches, RL – radial loops; UL – ulnar loops; W – whorls.*

**TABLE 1**
COMPARISON OF PERCENTILE OCCURRENCE OF PATTERN TYPES AND PII BETWEEN THE TWO STUDIES (ALL FINGERS COMBINED)

| Source | Year of examination | Sex | N | Whorl | Ulnar loop | Radial loop | Arch | PII |
|---|---|---|---|---|---|---|---|---|
| Banerjee[7] | 1965–66 | M | 69 | 39.08 | 54.46 | 1.23 | 5.23 | 13.26 |
| | | F | 92 | 34.40 | 60.99 | 1.97 | 2.64 | 12.97 |
| Present study | 2000 | M | 200 | 35.80 | 57.85 | 1.35 | 5.00 | 13.08 |
| | | F | 200 | 33.25 | 61.15 | 1.55 | 4.05 | 12.92 |

**TABLE 2**
COMPARISON OF TWO QUANTITATIVE DERMAYTOGLYPHIC TRAITS BETWEEN TWO STUDIES

| Traits | Male | | | Female | | | Source |
|---|---|---|---|---|---|---|---|
| | N | X±SE | SD | N | X±SE | SD | |
| TFRC | 69 | 128.30±4.76 | 39.01 | 92 | 132.00±4.48 | 46.10 | Banerjee[7] |
| | 200 | 147.92±3.68 | 43.77 | 200 | 143.06±2.86 | 48.51 | Present study |
| a-b ridge count | 100 | 67.64±1.21 | 12.16 | 100 | 76.90±0.71 | 10.03 | Banerjee & Banerjee[6] |
| | 200 | 78.95±0.69 | 9.80 | 200 | 74.78±1.71 | 10.71 | Present study |

dermatoglyphic pattern as described earlier and has been presented in Table 1 and Figure 3. Vaidyas of both sexes in the present study exhibit slightly lower values of PII (male: 13.08 and female: 12.92) than the sample of the earlier study (male: 13.26 and female: 12.97) conducted by Banerjee[7]. The comparison of two quantitative variables (TFRC and a-b ridge count) between these two samples is shown in Table 2 and Figure 3. The means of TFRC and a-b ridge count along with their standard deviation and standard error have been presented. Present males show slightly higher TFRC (147.92±3.68) than the present female (143.06±2.86), though the values are not significantly difference (t=1.05, p>0.05). On the other hand, Vaidyas of both sexes in the present study have higher ridge count than the Vaidya group studied earlier (male: 128.30±4.76, female: 132.00±4.48). Same picture is found in case of a-b ridge count among males. The Vaidya males (78.95 ± 0.69) of the present study show higher a-b ridge counts than those obtained in the previous study (male: 67.64 ± 1.21), though females do not show the same trend (74.78 ±1.71 and 76.90±0.71, for earlier and present study, respectively). In order to find out the statistical significance of the mean difference between two groups, $\chi^2$-test and t-test were evaluated and presented in Table 3. The $\chi^2$ value reveals that, in sexes, the increase and decrease of different pattern frequency are not statistically significant (p>0.05). But in case of quantitative traits the picture is not same. The males (t=3.49) show significant difference in TFRC at 0.1% level, while females do not (t=1.85, p > 0.05). In case of a-b ridge count also, t-test elucidates significant difference only among the males (t=8.08, p<0.001), not among females (t=1.65, p>0.05). Statistical significance test of the PII cannot be determined since the standard deviations of PIIs of the earlier data are not available.

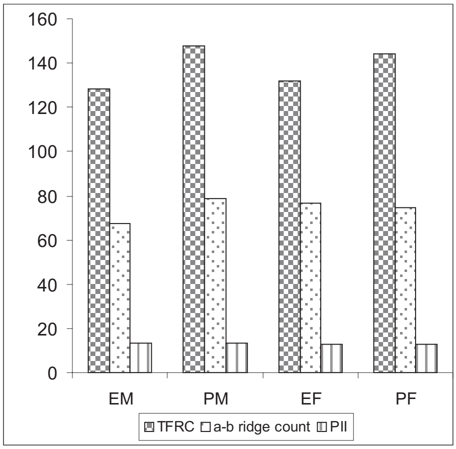


*Fig. 3. Comparison between two studies with respect to three dermatoglyphic traits. EM – male of early study, PM – male of present study, EF – female of early study, PF – female of present study.*

## Discussion

It is clear from the aforementioned results that there is not considerable difference between these two groups with re-

**TABLE 3**
STATISTICAL DIFFERENCE BETWEEN TWO SAMPLES

| Variables | Male | | Female | |
|---|---|---|---|---|
| | $\chi^2$ | t-value | $\chi^2$ | t-value |
| Whorl | 2.45 | – | 0.28 | – |
| Ulnar loop | 2.36 | – | 0.00 | – |
| Radial loop | 0.15 | – | 0.72 | – |
| Arch | 0.05 | – | 3.01 | – |
| TFRC | – | 3.49[a] | – | 1.85 |
| a-b ridge count | – | 8.08[a] | – | 1.65 |

[a] = $p<0.001$

gard to the frequency of primary patterns. In both sexes, the frequency of loops has slightly been increased and the frequency of whorls has slightly been decreased in the present study, but not any single difference is statistically significant. Probably due to the decrease of whorl in both sexes and increase of arch in females, the value of PII has slightly been decreased. Though we cannot compare statistically our results with the previous study of Banerjee[7] with regard to PII, these are not likely to be significant since the greatest difference was only 0.18. Figure 3 also supports it; because when the values of PII were drawn in the figure it virtually shows a straight line for this variable. Thus, the change in the pattern frequency and PII (which totally depends on the occurrence of different patterns) in the present study can be ignored.

Though no change has been observed in the occurrence of different dermatoglyphic patterns of a specific population even after more than three decades, considerable difference has been observed in case of TFRC and a-b ridge count, specially in case of male. High level of quantitative difference suggests a possibility of changes in the intrauterine environment after some decades. But the question arises which evolutionary forces may be responsible for the change of intrauterine environment? As both the samples were collected from the same ethnic populations of the same area, differences of their dermatoglyphic traits cannot be explained by genetic background. On the other hand, the traditionally endogamous nature of this caste may preclude the changes due to gene flow. As no new migrant is included in the present study, it is not possible that kin-structured emigration or new migrants altered the population structure of the community. This change might be a result of mutation and/or natural selection. But there is not any known example of mutation influencing the ridge counts. On the other hand, the time period between two studies is too short to play such an intensive role by natural selection alone. Thus the evolutionary forces are not likely to influence the intrauterine environment.

The magnitude of the quantitative difference, especially in case of male, is astonishing over such a short period of time (only after 35 years) and thus difficult to explain by selection. For males, TFRC is almost 20 ridges greater and for females more than 10 ridges. When a-b ridge count is considered, present male shows almost 12 ridges greater than the earlier male. Such degree of difference is commonly seen between two ethnic groups. It is well known that, PII and TFRC are positively correlated[10,11], but in the present sample though PII slightly decreases (i.e. fewer triradii, which means fewer whorls) TFRC increases. If we explain this inconsistent result as the occurrence of larger size of the patterns in the present sample and higher arch frequency among females of the later sample, still then there remains another notable things that both TFRC and a-b ridge counts have increased from the earlier study. As they are not correlated, this common direction indicates a little possibility of interobserver error, which is much more likely in ridge counting data, compared with pattern type determination. Actually, the different individuals were sampled in these two studies and though the methodologies used in these two studies for classification and ridge counting are standard and widely used, interobserver variation is not impossible. The ridge counting is not an entirely objective process and requires decisions what to include and exclude. In the previous study the finger ridge counts are quit low and sex-difference is just reverse of what is normally seen. A literature of Reddy and Malhotra[12] was published, which can be a good example of showing the TFRC in the different Indian populations. There is a marked sex difference in the a-b ridge count of the earlier study that is also not commonly observed. Chattopadhyay and Dash Sharma[13] also observed more or less similar a-b ridge count among Vaidyas of West Bengal, as found in the present study. Secondly, sampling variation may be another factor for these differences between two studies. The small samples, particularly of the earlier study, combined with interobserver difference in ridge counting are more plausible to explain than concluding the change of intrauterine environment in the past thirty-five years. If we agree with the above-discussed technical errors as the reason of significant quantitative difference, then we can say that our results corroborate with the authors who assume that dermatoglyphic patterns are selectively neutral,[14,15] though some exceptions have also been found in the literature[16–19]. Our results have failed to provide any evidence against the postulate of neutrality.

However, studies on possible trend of dermatoglyphic characters in a single population over an extended period of time are hardly available. Due to lack of such data in the literature, our result cannot be compared with earlier studies. To our knowledge, there is the only one study by Lambert and Henneberg[20] on the trend of dermatoglyphics of 115 cadavers of South Africa. The sample was divided into two birth cohorts (1893–1920 and 1921–1953). Non-significant difference of PII and ridge breadth and significant decrease in the frequency of the common pattern (like ulnar loop) was observed in the later cohort that they explained as a relaxation of natural selection. Though the present study cannot come to any satisfactory conclusion about such a marked quantitative difference, our results cannot disprove the hypothesis of the operation of stabilizing selection on dermatoglyphic pattern given by Lambert and Henneberg[20]. Further works with much more data, analyzing by a single observer, over a long time span of several decades of an endogamous community are required. This experiment needs to be analyzed digit-wise and pattern-wise separately to support or reject the concept of the present study. We think that the methodological issues cannot invalidate the importance of the present communication as our study along with its limitation may give some indication to how further investigation should proceed to obtain accurate result.

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*M. Sengupta*

*Anthropology and Human Genetics Unit, Indian Statistical Institute, 203 B. T. Road, Calcutta – 700 108, India*

## MEĐUGENERACIJSKE RAZLIKE DERMATOGLIFSKIH OSOBINA U POPULACIJI VAIDYAS, ZAPADNI BENGAL, INDIJA

## SAŽETAK

Cilj ovog istraživanja bio je procijeniti međugeneracijske razlike u dermatoglifskom crtežu. Prikupljeni su otisci prstiju 400 osoba endogamne kaste Vaidyas iz Barasata, Zapadni Bengal. Rezultati su uspoređeni s podacima prethodnog uzorka Banerjee koji je prikupljen prije 35 godina u istoj populaciji. Kao što je to opće poznato dermatoglifi su selektivno neutralni, te u odsutnosti drugih evolucijskih pritisaka ne očekuju se promjene u dermatoglifskim značajkama u istoj populaciji. U ovoj studiji, kod oba spola promjene u učestalosti dermatoglifskih crteža nisu bile statistički značajne a PII je također bio sličan. Međutim, dva uzorka značajno su se razlikovala u kvantitativnim dermatoglifskim karakteristikama. Ove razlike vjerojatno nisu uzrokovane promjenama intrauterinog okoliša, već vjerojatnije da su uzrokovane razlikom u načinu brojenja (»inter-observer errors«) dvaju studija te malim uzorkom prve studije. Premda su u obje studije korištene iste metode, razlike među mjeračima u očitavanju dermatoglifa vjerojatnije su u brojenju grebena nego u određivanju tipa dermatoglifskog crteža.