SUMMARY AND CONCLUSION
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"Dermatoglyphics" (derma- 'skin' glyphe-carve) - the term introduced by Cummins and Midlo (1926) is concerned with studies of dermal configurations including the quantitative and qualitative aspects, population variation, hereditary transmission, disease implication, forensic application and personal identification. These dermatoglyphic characters of man like other bilaterally distributed traits also show certain degree of asymmetry between the two sides of the body.

In the present work an attempt was made to study a) The general distribution of dermatoglyphic characters of finger (ulnar ridge counts, radial ridge counts, absolute ridge counts, total ridge counts, difference in ridge counts, finger pattern, finger pattern intensities) and palm (palmar ridge counts, palmar pattern intensities, main line index and main line terminations) b) The nature and magnitude of dermatoglyphic asymmetry among parents and sibs on the afore mentioned finger and palmar dermatoglyphic traits (except for finger patterns and main line terminations). c) Finally an attempt was made to identify the specific finger or palmar area which would be more liable to express dermatoglyphic asymmetry compared with other areas.

Bilateral finger and palm prints of 210 unrelated nuclear families of the Bengali Brahmin, an endogamous caste who practice Gotra exogamy, of Howrah consisting of husband, wife and their first two children irrespective of
their sex were used as the study sample. The samples were collected from four police station areas basing on the higher concentration of Bengali Brahmin families.

The addresses of the families were obtained from the voter lists according to their titles. Later the families were selected randomly and in case of non-availability of one or more of the family members or their non co-operation, next family was taken up for the study. An exclusion criterion was employed for selecting the families. A semi-structured schedule was used to collect the name of the head of household, address, pre-marital titles of wife, mother of wife and mother of husband, disease related information and genealogy of the family. The analysis of both the palm and finger prints was done according to the methodology described by Cummins and Midlo (1943), Holt (1968) and Loesch (1983).

In the present investigation, a somewhat different methodology has been followed to understand the nature and the magnitude of asymmetry of dermatoglyphic characters of finger and palm. First of all, considering the sex and pregnancy the whole data have been classified into six groups - father (N=210), mother (N=210), first male children (N=125), first female children (N=85), second male children (N=122) and second daughter (N=88). Next, the values of asymmetry have been obtained by subtracting absolute values of left side from the right (R-L) for all the variables of finger and palm.
After that, considering the minimum and maximum values of each variable certain groupings have been made in order to understand the nature of asymmetry, that is, whether the asymmetry value of a particular variable is more pronounced in left side than the right or vice versa.

The distribution of various quantitative and qualitative traits of digital dermatoglyphic features (ridge count, pattern, and pattern intensity) of all six groups for individual digit as well as for both the hands i.e. the combined values of all five fingers of right and left hand separately are summarized below.

**FINGER**

**RIDGE COUNT** The distribution trend shows that out of five ridge counts the ARC scored maximum followed by TRC, RRC, URC and DRC. The range of means of all ten digits varies from 187.8 - 150.4 for ARC, 139.1 - 118.8 for TRC, 132.4 - 113.0 for RRC, 56.9 - 38.3 for URC and 79.9 - 71.6 for DRC. Except DRC, for all other ridge counts the highest and lowest mean ridge counts are represented by father and D1 respectively. The mean ridge counts are higher on right hand for URC and ARC while the RRC, TRC and DRC show higher means on the left hand. Except DRC mean ridge counts are always higher among male groups (father, S1 and S2) than the female groups (mother, D1 and D2). Comparison of mean values with respect to parity shows higher mean ridge counts among first born male and second born female children.

Distribution of finger tip patterns shows preponderance of loop patterns followed by whorl and arches on both the
hands among all the sub-populations. Among fathers the percentages of patterns are 57.99 for loops (radial+ulnar), 37.75 for whorls and 4.24 for arches (simple+tented) whereas among mothers' the percentage of loops (ulnar+radial) is 58.53, for whorls it is 36.63 and for arches (simple+tented) 4.87. The percentage of whorls is relatively higher among fathers while loop patterns are relatively higher among mothers. Digitwise distribution of pattern types shows that the whorl is most frequent on digit IV, ulnar loop on digit V, radial loop on digit II, tented arches (topologically tented loops) on digit II and the simple arches on thumb and index fingers.

The bimanual differences show that whorls are more frequent on right hand whereas the loop patterns (radial as well as ulnar) on left hand. The patterns, simple and tented arch, are found frequently on left and right hand respectively. The bisexual differences show male dominance for the pattern whorl and to some extent radial loops whereas except the left hand of mother the percentages of ulnar loops are relatively frequent among females than the males. The pattern arch specially the tented one, is relatively frequent among the female compared with the male.

**Pattern Intensity** The pattern intensity values were found highest on digit IV and lowest on digit III and V. Among all the groups the pattern intensity values of right hand are always higher than the left. By and large the pattern intensity values are higher among males than the females.
On palm the mean ridge counts between a-d triradial points is highest followed by a-b, c-d, and b-c on both palms of all groups. In all groups the mean ridge counts of a-b are always higher on the left palm while the mean ridge counts between b-c and c-d are always higher on the right palm. The mean ridge counts are higher among the first born male children for c-d and a-d counts whereas in case of a-b and b-c the first born female children show higher means. Among the second born children (S2 and D2) except a-b all mean ridge counts are higher among D2. Comparison between the parent groups shows male dominance for all four ridge counts. The mean ridge counts of b-c and a-d are always higher among $S_1$ children whereas for the a-b and c-d it is the $S_2$ which show higher means. Among female children except a-b, the mean ridge counts are always higher among $D_2$ than the $D_1$.

**Palmar Pattern** The occurrence of palmar patterns in different palmar areas shows the following gradation $III > IV > H > II > I$ for the right hand while for the left hand it is $IV > III > H > I > II$ among all the sub-populations.

The most common patterns on the right palm are peripheral loop on area III followed by peripheral loop on area IV, central loop on hypothenar area and peripheral loop on hypothenar area. In case of left palm the peripheral loop on area IV is the commonest pattern followed by peripheral loop on area III. Other than these the sequence of pattern occurrence is same with the right palm. Overall the
occurrence of patterns are higher on the right palm compared with the left. Bisexual difference shows male dominance for the pattern occurrence.

**Pattern Intensity** The occurrence of mean pattern intensity values in different areas of the right and left palms are III>IV>III>I and IV>III>H>I>II respectively. The pattern intensity values of right hand is higher among the parents' and both the first born children groups while the left hand values are higher among second born females. The Second born male is the only group which shows equal pattern intensity values on both palms. The bisexual difference with respect to pattern intensity is not so marked although the mean values are higher among father and D₁ than the mother and S₁. An increment in the mean pattern intensity value with respect to parity was also noticed.

**Main Line Termination** The most frequent termination points on both the palms were found on 11, 9, 7, 5 for the main line D, C, B, and A respectively. All the percentages of main line termination are higher on the right palm than the left. Except mother the percentages of main line terminations are always higher among male compared with female.

**Main Line Index** Among all the sub-populations the main line index values are always higher on right palm compared with left indicating that the ridges of right hand are more transversely oriented than the left. The male members shows higher mean on both palms compared with the female.
ASYMMETRY

The distribution, magnitude and the nature for the finger ridge counts (URC, RRC, ARC, TRC, & DRC), finger pattern intensity, palmar ridge counts, palmar pattern intensity and main line index were studied among all the six subpopulations.

FINGER

Distribution The distribution of asymmetry values for the various ridge counts on individual digit show that the values are mainly distributed in groups-2 and 4 which indicate that the range of asymmetry for the ridge count URC, RRC and TRC mainly varies from -25 to -1 on the left and it is 1 to 25 on the right, whereas the asymmetry values for the ARC and DRC were relatively frequent in group 1 and 5.

Magnitude: The incidence of asymmetry among all the six groups, for five different ridge count measures could be judged by the percentages of symmetry values represented by group-3 (URC, RRC, ARC, TRC AND DRC) and group-4 (total hand).

Among the parent groups the incidence of asymmetry in each digit is always higher among fathers compared with mothers for the ridge count of URC, TRC and DRC. The ARC and RRC have shown a mixed trend.

The comparison between the children of first conception i.e. S₁ Vs D₁ shows higher incidence of asymmetry in S₁ than D₁ for the ridge counts URC and RRC. However, there are
some digits e.g. III, III & V and III of ARC TRC and DRC respectively where D₁ show higher asymmetry value than the S₁. Even though the comparison between the second born male and female children (S₂ Vs D₂) shows male dominance the D₂, compared with D₁ have a relatively higher percentage of asymmetrical cases.

In order to understand the effect of pregnancy order on the magnitude of asymmetry a comparison was made between S₁ and S₂ & D₁ and D₂. The results showed that for each type of ridge count out of five atleast three digits in each ridge count, specially the digits I, II and IV exhibit higher incidence of asymmetry among the S₁ this being maximum for the RRC where all five digits exhibit greater percentages of asymmetry in them. The comparison between D₁ and D₂ shows overall dominance of asymmetrical values among D₁ than the D₂ but a slightly different result was noticed particularly for the URC.

As the incidence of asymmetry is mostly distributed in groups-2 and 4 for individual digits and groups-3 and 5 for total hand, a comparison was made between these respective groups in order to understand the nature of asymmetry. For individual digits as well as for the total hand an overall dextral dominance was noticed among all the sub-populations, but the digitwise comparison expressed dextral dominance of asymmetry especially on I and II digits for the RRC, ARC and TRC.

**Nature:** In order to understand the nature of variation for the asymmetrical expression a comparison was made between
the groups 2 and 4 as the asymmetry values are mostly distributed in these groups. For individual digits as well as for the total hand an overall dextral dominance was noticed among all the subpopulations but digitwise comparison showed dextral dominance in digits I & II for the RRC, ARC, and TRC whereas in case of URC dextral dominance was noticed on digit V along with digit I.

Another important fact that has emerged in this study of asymmetry is that among all the five digits it is the middle finger or digit III which expresses highest fluctuation in both hands for all five types of ridge count.

Pattern Intensity:

Distribution: The results of pattern intensity have shown that the asymmetry values for the five fingers are mainly distributed in groups-4 and 6. The situation in which there is no triradius on one digit against the presence of two triradii on its corresponding digit, is absent in digit IV, rare in digits II, III and V and relatively common in digit I of right hand.

Magnitude: The magnitude of asymmetry for the pattern intensity on different digits as well as for the total hand suggests that it is the father group which shows relatively higher incidence of unequal number of triradius on digits I, III and V. In the mother group such cases are relatively common on digits II and IV and for the total hand. Comparison between the children of first conception \((S_1 Vs D_2)\) shows that the occurrence of unequal number of triradius
are frequent on digits IV and V and for the total hand in $S_1$ whereas on digits I, II and III this occurrence is relatively frequent among the $D_1$. The result of the other comparison ($S_2$ Vs $D_2$) shows that on digits I and II and for the total hand it is the $D_2$ who show maximum occurrence of unequal number of triradius.

**Nature:** The comparison between groups-4 and 6 shows that percentages of pattern intensity are relatively higher on the thumb, ring and little finger of right hand while the values are higher in index and middle finger of left hand.

**Palm**

**Ridge Count**

**Distribution:** The distribution patterns of asymmetry of palmar ridge counts are largely confined in groups-2 and 4 which suggests that the range of asymmetry for all palmar ridge counts varies from 1 to 25 ridges in the right palm and from -1 to -25 in the left.

**Magnitude:** In our study a considerable variation in the occurrence of asymmetry was observed in the four palmar areas. It could be seen from the percentage of symmetry (group-3) that the incidence of asymmetry is maximum for the area a-d, followed by a-b, c-d and b-c. Overall the incidence of asymmetry in the four palmar areas in relation to sexual dimorphism does not differ markedly. Although exceptions are there particularly between the second born group of children for the a-b and b-c count and the first born group of children for the c-d count. The incidence of
asymmetry for all four palmar ridge counts was found to be higher among the first born children \(S_1\) and \(D_1\) although in two separate cases (the \(D_2\) of c-d and \(S_2\) of a-d) the second born children showed higher incidence of asymmetry.

**Nature:** In order to understand the nature of asymmetry for the ridge counts a-b, b-c, c-d and a-d, a comparison was made between the mean values of groups 2 & 4 as these two groups include the highest number of asymmetrical cases. The result showed that the inter-digital areas b-c and c-d are of similar nature as all (except the \(S_2\) of c-d) the means of group-4 for both the ridge counts are higher than that of group-2 which suggests that the asymmetry is relatively greater in the right palm. In comparison with b-c and c-d the a-b count showed a sinistral shift for the a-b ridge count asymmetry. The fourth inter-digital ridge count, that is the a-d count as compared with the other two does not show any particular directionality.

**Pattern Intensity:** The incidence of asymmetry for the pattern intensity of palm is largely confined in groups-3 and 5 for all five palmar areas which suggests that the majority of our sample shows the presence of an extra loop on one hand compared with the other.

**Magnitude:** The comparison of percentage values between the parent groups shows that except the area II and III in all other areas the incidence of asymmetry is greater among mothers than the fathers. This bisexual difference is prominent in the area H and for the total palm otherwise
such differences are not so prominent. The children of opposite sexes i.e. $S_1$ Vs $D_1$ and $S_2$ Vs $D_2$ when compared to measure the sex influence a reverse trend of the parent group was noticed in which, except the $D_2$ of hypothenar area, all the percentages were markedly higher among male children.

**Nature:** The directionality of palmar intensity asymmetry showed right palm displacement for area III and left palm displacement for the area IV. Such directionality is moderately apparent for the area I and II in which the displacement is prominent on left palm and right palm respectively. Compared with the previous four palmar areas, the area H and the total palm does not show any clear cut side displacement.

**Main Line Index:**

**Distribution** The distribution pattern of asymmetry values for the main line index revealed that the difference between right and left values either vary form 1 to 5 for the right palm or within the range of -1 to -5 on the left palm. However, a large proportion of asymmetry values was noticed in group-5 of fathers where the number of cases are higher and the difference from right to left is within the range of 6 to 10.

**Magnitude:** As far as the magnitude of asymmetry for the main line index is concerned it was noticed that the incidence of asymmetry is relatively higher among fathers and both the first and second born male children as compared with their
female counterparts. However, the intensity of such differences is not always of similar magnitude. The influence of parity on the magnitude of asymmetry is best seen in male children where the $S_2$ show greater asymmetry. however, this is not so in the female children where the incidence of asymmetry was found higher among the $D_1$.

**Nature:** Considering the nature of displacement, the comparison of mean values between groups 2 and 4 suggests a prominent right side displacement among all the members. This dextral displacement is prominent among the male than in the female where the mother group shows almost zero directionality. However, among the $D_2$ a marked right palm displacement compared with the $D_1$ is noticeable.
CONCLUSION

From the foregoing account of asymmetry study of dermatoglyphic traits among the Bengali Brahmin population we may conclude our study as follows

1. For finger ridge counts the range of asymmetry varies from 1-25 ridges from left to right or right to left on individual digits.

2. Males (F, S1 and S2) show higher mean ridge count values of asymmetry for URC, TRC and DRC.

3. In some digits females (M, D1 and D2) show higher mean ridge count values of asymmetry for ARC and RRC.

4. The children of both the groups (S1, S2 and D1 and D2) also show the trend exhibited by the parent groups.

5. Digits I and V show maximum directionality compared with other digits.

6. Digit III shows maximum fluctuation for ridge count as well as pattern intensity.

7. Incidence of asymmetry is maximum in area a-d and least in b-c.

8. Sex influence is negligible for palmar ridge count asymmetry.

9. The dextral asymmetry is shown by b-c and c-d whereas sinistral by a-b.

10. Females show greater asymmetry values for pattern intensity for area H and total palm.

11. Dextral dominance is prominent for area III and left palm displacement for area IV.

12. Dextral dominance is also prominent for main line index.

13. Changes in asymmetry through parity do not show any clear cut trend.