Fingerprint patterns of thumb and index in the right and left-handed male and female medical and paramedical students

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INTRODUCTION

The father of American fingerprint analysis, Dr. Harold Cummins, coined the term ‘dermatoglyphics.’ It refers to the scientific study of the configuration of epidermal ridges of hands and feet. Fingerprints (digital dermatoglyphics) serve as a unique form of evidence and has greatly contributed to personal identification in the field of forensic science (Girard and Girard, 2006). They are unique for every individual and are strongly influenced by genetics. Studies have also shown links between dermatoglyphic patterns and genetic disorders such as Trisomy 21.
Table 1: Fingerprint distribution patterns

|                                      | Thumb | Percentage | 1st digit | Percentage |
|--------------------------------------|-------|------------|-----------|------------|
| **Right Handed Males**               |       |            |           |            |
| No. of students showing predominant Whorl pattern | 96    | 42.1%      | 74        | 32.4%      |
| No. students showing predominant of Loop pattern | 132   | 57.9%      | 130       | 57%        |
| No. students showing predominant of Arch pattern | 0     | 0%         | 24        | 10.5%      |
| TOTAL students                       | 228   | 42.1%      | 228       | 42.1%      |
| **Left Handed Males students**       | Thumb | Percentage | 1st digit | Percentage |
| No. students showing predominant of Whorl pattern | 7     | 38.8%      | 6         | 33.3%      |
| No. students showing predominant of Loop pattern | 11    | 61.1%      | 11        | 61.1%      |
| No. students showing predominant of Arch pattern | 0     | 0%         | 1         | 5.5%       |
| TOTAL students                       | 18    | 38.8%      | 18        | 38.8%      |
| **Right Handed Females**             | Thumb | Percentage | 1st digit | Percentage |
| No. students showing predominant of Whorl pattern | 68    | 29.1%      | 56        | 24%        |
| No. students showing predominant of Loop pattern | 165   | 70.8%      | 132       | 56.6%      |
| No. students showing predominant of Arch pattern | 0     | 0%         | 45        | 19.3%      |
| TOTAL students                       | 233   | 29.1%      | 233       | 29.1%      |
| **Left Handed Females**              | Thumb | Percentage | 1st digit | Percentage |
| No. students showing predominant of Whorls | 8     | 38%        | 3         | 14.2%      |
| No. students showing predominant of Loops | 13    | 61.9%      | 16        | 76.1%      |
| No. students showing predominant of Arches | 0     | 0%         | 2         | 9.5%       |
| TOTAL students                       | 21    | 38%        | 21        | 38%        |
and female participants. Handedness refers to the uneven distribution of fine motor skills between the left and right hand, otherwise known as hand dominance (Raymond and Pontier, 2004). Determination of the handedness of both the assailant and the victim are important in various aspects of forensic science (Stark, 2011). On establishing the relationship between handedness and digital dermatoglyphics will definitely contribute to forensic investigations.

**MATERIALS AND METHODS**

It is an observational study conducted with a sample size of 500 study subjects, of 18-25 years of age, selected randomly from medical and paramedical colleges. Institutional Ethics Committee (IEC) clearance was obtained before beginning the study.
Figure 3: Fingerprint patterns in the index finger. Arches were more seen in right-handed females compared to right-handed males. In left-handed males, loops were predominant pattern similar to left-handed females. Arch pattern not seen in left-handed females.

with IEC number SMC/IEC/2008/05/121. Written informed consent was taken from the participants were included in the study. Participants were required to demonstrate 10 unimanual tasks for determining hand dominance (Oldfield, 1971).

Predominant right-handers and predominant left-handers were taken. The students were asked to wash their hands thoroughly and dry them before obtaining fingerprints. The fingerprints were obtained by a non-ink method ‘Lipstick’ method, which is easy, subject friendly and efficient for analysis (Gupta, 2013). The method required a dark shade of ‘Lipstick’, a foam rubber pad and a white sheet of paper. The lipstick was applied evenly on the right thumb and right index finger of the right-handed participants and left thumb and left index finger of left-handed participants. Then the sheet of paper was placed on top of the foam rubber pad on a flat, stable surface. The subject’s fingers were placed on this and gently pressed. Strips were labeled appropriately (right or left hand) digit using roman numerals. (The thumb as I and the index finger as II) and also right or left-handed males and females. Fingerprints were obtained for each individual in this manner. Fingerprint patterns were broadly classified as follows; loop (ulnar loop and a radial loop was counted as a loop), whorl (double loop whorl, plain whorl, central pocket loop and accidental whorl was counted as whorl) and arch (plain arch and the tented arch was counted as an arch). Prints were studied using a magnifying lens to identify the fingerprint patterns appropriately. The various patterns of fingerprints were observed, categorized and compared. The objectives of the study are to observe gender variation in fingerprinting pattern of thumb and index fingers and also to determine the relationship between handedness and digital dermatoglyphics.

RESULTS AND DISCUSSION

Total numbers of students studied were 500, out of which there were 228 right-handed males, 18 left-handed males, 233 right-handed females and 21 left-handed females, as seen in Figure 1. Table 1 shows the fingerprint distribution pattern in the right-handed males, females and left-handed males and females, respectively. Figure 2 and Figure 3 depict the graphical representation of the fingerprint patterns of the thumb and index finger. In right-handed males, the predominant pattern seen was looped in both the thumb (57.9%) and index finger (57%). Whorls were 42.1% and 32.4% in the thumb and index finger, respectively. There was no arch pattern seen in the thumb and were 10.5% in the index finger. In left-handed males, the predominant pattern was found to be loops again, with 61.1% in both the thumb and index finger. Whorls were found to be 38.8% and 33.3% in the thumb and index finger, respectively. The arch pattern was not observed in the thumb and was 5.5% in the index finger. In left-handed males, the predominant pattern was found to be loops again, with 61.1% in both the thumb and index finger. Whorls were found to be 38.8% and 33.3% in the thumb and index finger, respectively. The arch pattern was not observed in the thumb and was 5.5% in the index finger. In right-handed females, the predominant pattern observed was looped, 70.8% and 56.6% in the thumb and index finger, respectively. Whorls
were 29.1% and 24% in the thumb and index finger, respectively. There was no arch pattern seen in the thumb and were 19.3% in the index finger. In left-handed females, the loops were found to be predominant, 61.9% and 76.1% in the thumb and index finger, respectively. Whorls were found to be 38% and 14.2% in the thumb and index finger, respectively. The arch pattern was not observed in the thumb and was 9.5% in the index finger. The total number of students studied was 500 out of which 228 right-handed males, 18 left-handed males, 233 right-handed females and 21 left-handed females, as seen in Figure 1.

It was observed that the right-handed males showed a higher percentage of whorls in both digits compared to right-handed females. The thumb showed the overall highest percentage of whorls (42.1%) compared to right-handed females, this group also showed a high variation from the predominant loop pattern in the index finger. Figures 2 and 3.

The index finger showed the overall highest percentage of loops (70.8%) in both right and left-handed females. The index finger of right-handed females it was found that there were more arches (19.3%) compared to left-handed females (9.5%). It was observed that the index finger showed the overall highest percentage of arches and the distinctively arch pattern was not observed in the thumb of the study population. The right-handed females also showed a higher predominance of loops, almost equal to that of right-handed males. Figures 2 and 3.

The thumb showed the overall highest percentage of loops (76.1%) for left-handers. The left-handed males showed about 5.5% of predominant arch pattern compared to 10.5% of a right-handed index finger. The arch pattern was distinctively absent in the left-handed index finger of females compared to being a predominant pattern in 19.3% of a right-handed female index finger. These differences in arch patterns in index finger are significant and of forensic importance. Figures 4, 5, 6 and 7 shows the fingerprints of thumb and index fingers in all the 4 groups i.e., Right-handed males, left-handed males and right-handed females, left-handed females as taken as impressions on white paper strips after applying lipstick.

It has been known that the digital dermatoglyphic pattern is peculiar to a person. As a means of specific identification, this is of enormous importance. In this study, fingerprint patterns of the thumb and index finger of 500 students have been examined and observed. The results showed that there was a predominance of loop pattern seen in all 4 groups of students. In right-handed males, the arch and whorl fingerprint patterns were observed to be high for...
thumb and index fingers compared to left-handed males. In left-handed females, the arch pattern was distinctively absent in index finger compared to right-handed females. Arch patterns were comparatively less in the index finger of left-handed males compared to right-handed males.

In the past, few studies have been conducted on different ethnic groups for observing gender variation in the dermatoglyphic patterns. The results of some studies are similar to the present study. In their study on Caucasian school children in southwestern Ohio, Cromwell and Rife observed that the number of arches was higher on the index finger of the right hands (Cromwell and Rife, 1942). We had similar observations in our study, right-handed males and right-handed females having 10.5% and 19.3% of predominant arch patterns, respectively.

In our study, we found that there was a predominance of whorls in left-handed female thumb 38% compared to right-handed female thumb 29%, whereas for index finger left-handed females had less whorls 14.2% compared to right-handed females 24%. For right and left males, whorls patterns in both the digits were similar. In the study conducted by Coren on Canadians, it was found that left-handers were more likely to have arches and loops, and fewer whorls pattern than right-handers (Coren, 1994). Our study showed results that were similar to the above study for the index finger of left-handed females.

In Karev’s study on Bulgarian individuals, he found that whorls were less frequent and loop more frequent in all digits for right-handed people similar to the present study (Karev, 2008). The current study shows that the whorl pattern was more frequently seen in left-handed female thumb 38% compared to right-handed female thumb 29%. On the other hand, both right and left-handers males a similar number of whorl pattern dominance in their thumbs.

Cho did a study on Koreans and found that left-handers exhibited more arches than the right-handers and less whorls than the right-handers (Cho and Kim, 2010). In our study, we observed that the index finger of 10.5% of right-handed males and 19.3% right-handed females showed a higher number of arches when compared to 5.5% of left-handed males and 9.5% of left-handed females respectively. Thus arches pattern was comparatively more in the index finger of right-handed females compared to left-handed males and females in this present study.

Overall among the three different types of fingerprint patterns, whorls and loops were predominant in the present study, too, as in the above studies. (Cromwell and Rife, 1942; Rife, 1943; Coren, 1994; Karev, 2008; Cho and Kim, 2010).

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