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

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ABSTRACT

Dermatoglyphics is the scientific study of the epidermal ridge configuration of hands and feet. Digital dermatoglyphics are unique and specific evidence that greatly contribute to personal identification in forensic science. Hand dominance is an uneven distribution of fine motor skills between the left and right hands. The objective of the study is to observe gender variation in fingerprinting pattern of thumb and index fingers and also to determine the relationship between handedness and digital dermatoglyphics. The study was conducted at Saveetha Medical College and Hospital. Ethical clearance for this study was obtained from the Ethical Clearance Committee of the institute. This cross-sectional study was conducted on a sample size of 500 students, of 18-25 years of age, pursuing their education in the constituent courses of Saveetha Medical College. Handedness was assessed using the Edinburgh Handedness Inventory. The fingerprints were obtained by a 'Lipstick' method. The prints were studied using a magnifying lens. The various patterns of fingerprints were observed, categorized and compared according to standard guidelines. A total of 500 students were studied. There were 228 right-handed males, 18 left-handed males, 233 right-handed females and 21 left-handed females. In right-handed males, the thumb showed a predominance of loop pattern in (57.9 %) study participants and in right-handed females loop pattern was observed in thumb was 61.1%. In the right-handed female thumb, loops were predominant patterns in 70.8. Arch pattern is distinctively absent for both right and left-handed thumb in both males and females. 19.3 % of female right-hander had arch patterns predominantly in their index finger. Widespread interest is developing in the field of medicine and forensic science with regard to epidermal ridges. Our present study was able to observe gender variations and variations in the dermatoglyphic pattern in the right and left-hander for the first two digits.

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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

Table 1: Fingerprint distribution patterns

Right Handed Males	Thumb	Percentage	1^{st} digit	Percentage
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		228	
Left Handed Males students	**Thumb**	**Percentage**	**1^{st} 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		18	
Right Handed Females	**Thumb**	**Percentage**	**1^{st} 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		233	
Left Handed Females	**Thumb**	**Percentage**	**1^{st} 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		21	

patterns and genetic disorders such as Trisomy 21

and Klinefelter Syndrome (Matsuyama and Ito, 2006; Nazarabadi *et al.*, 2007). Another study has also established its association with sickle cell anemia (Oladipo *et al.*, 2007). The analysis of dermatoglyphic patterns may help in terms of personal growth, education and for enterprises by improving one's career, providing personalized education and consolidating human resources, respectively (Boake, 2002). Although every individual has unique prints, they can be categorized into distinctive types. In 1892, Galton classified them into whorls, loops, and arches. Whorl–These are the patterns so constructed that the characteristic ridge courses follow circuits around the core. The shape of the pattern area may be either circular or elliptical. Whorls have two triradii and may have various shapes like whorl spiral, double whorl loop and whorl symmetrical. Loop - It is simple in contrast to the whorl. It possesses only one triradii. The Head of the loop refers to the twisted side of ridges. From the opposite extremity of the pattern, the ridges flow to the margin of digits. If the loop opens to the radial side, it is a radial loop and if to the ulnar margin, it is called an ulnar loop. Arch - the plain arch is composed of ridges which pass across the finger with slight bow distally. There are no triradii. The pattern present on the thumb and index finger of both hands were identified and tabulated in the present study. The epidermal ridges were found to form a definite pattern on the terminal segments of the digit and various other sites on the palm in a recent study done on dermatoglyphic patterns in bronchial asthma patients (Gupta and Prakash, 2003). The present study identifies the specific pat-

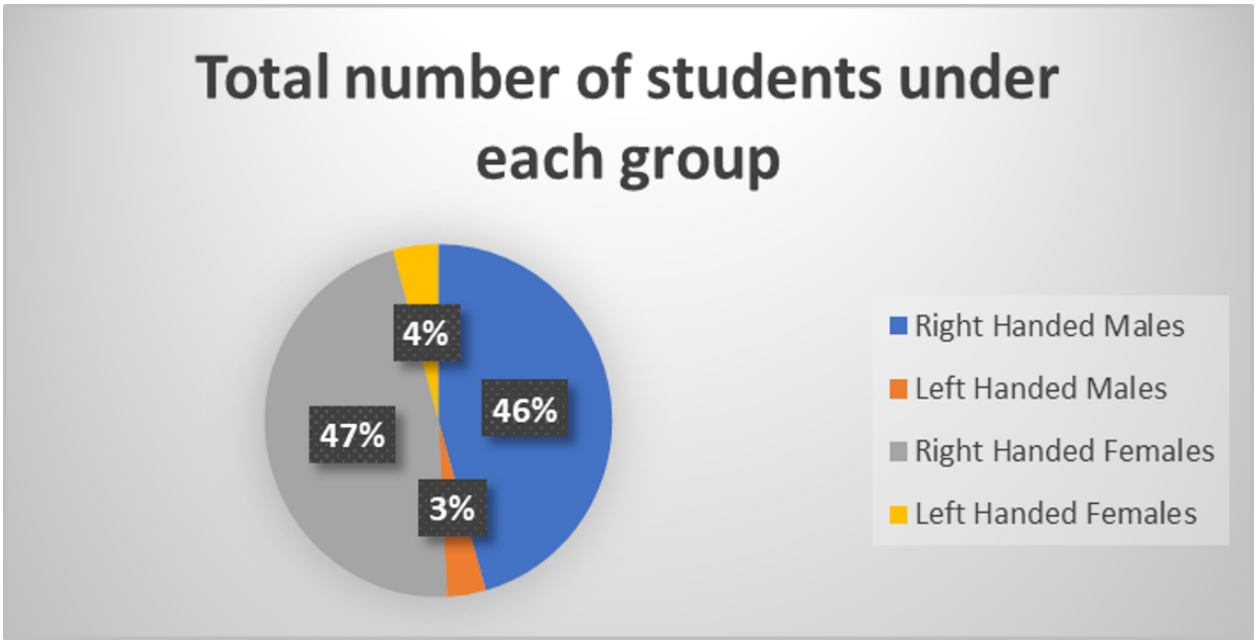

Figure 1: Distribution of students

Figure 2: Fingerprint patterns in the thumb- Loop patterns predominant in right-handed males and females for a thumb though more in females. In left-handers, loops were predominant again more predominant in females. The arch pattern was distinctively not noted in the study population thumb

terns of fingerprints and observes for predominant patterns in the right, the left-hander also for male 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 paramed-

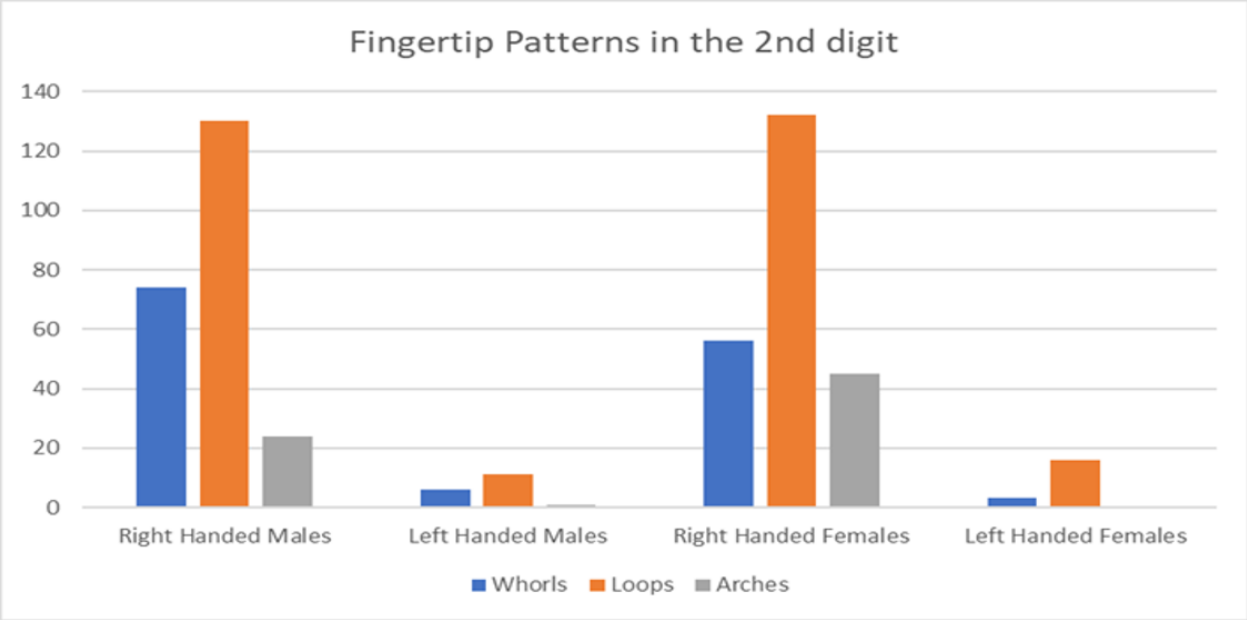

Figure 3: Fingerprint patterns in the index finger- Arches were more seen in right-handed females compared to right-handed males. In left-handed males, loops were predominant pattern similar to left-handed females. Arch pattern not seen in left-handed females

ical colleges. Institutional Ethics Committee (IEC) clearance was obtained before beginning the study 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 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.

Figure 4: Right-handed male thumb and index finger showing whorl patterns

Figure 5: Left-handed male thumb and index finger showing loop patterns

Figure 6: Right-handed female thumb and index finger showing whorl patterns

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%) Figures 2 and 3

Figure 7: Right-handed female thumb and index finger showing whorl patterns

The index finger showed the overall highest percentage of whorls (33.3%). Similar 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 thumb 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 index finger 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 thumb29%. 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).

CONCLUSION

Widespread interest is developing in the field of medicine and forensic science with regard to epidermal ridges. Our present study was able to observe gender variations in the thumb and index finger dermatoglyphic fingerprint patterns in the right and left-handers. Fingerprint patterns vary among the subjects and this is supposedly representative of the population with the loop being the commonest pattern. What is, however, interesting is the observation of the relative percentage distributions of handedness, fingerprint patterns and gender among the subjects. These results could be compared with other study groups on the basis of nationality and race, among other parameters. Another interesting peculiar factor that could influence handedness in the represented population is the cultural discouragement of left-handedness, especially in children. Such effects should also be noted if observed in any other research. The results of this study support the relationship between handedness and digital dermatoglyphics in the South Indian population college student population and can be used as supporting evidence for personal identification. More initiatives should be taken in the field of dermatoglyphics so that these features can be combined to aid in identifying humans.

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