

# A Study of Sexual Dimorphism in Finger Print Pattern in Indian Population.

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## ABSTRACT

**Background:** In Dermatoglyphics the finger palms and soles elevation pattern are studied. The term dermatoglyphics, the uniqueness of a person's fingerprints have been thought by some to be fixing to a person's personality and constructing genetic quality of each individual. **Methods:** In the present study, 400 students are taken from out of which 200 males and 200 females. Prints are taken and the ridge counts are studied with the help of a magnifying lens. They are identified as: Arches, Loops and Whorls in both genders. The Performa is prepared on a durable A4 sheet divided into five marked areas. The right hand thumb (1) index finger (2) middle finger (3) ring finger (4) little finger (5), followed by the left hand; thumb (6) index finger (7) middle finger (8) ring finger (9), little finger (10). **Result:** The most common fingerprint patterns in Indian population is loops (both ulnar and radial) (60.65%) followed by whorls (34.7%) and arch (53.5%). The most common fingerprint patterns in Indian males is ulnar loops (55.1%) similarly (64.6%) females had ulnar loops. The percentage of whorls in males and females were 38% and 31.4% respectively. The rarest finger pattern was arch (6%) in males and (4.7%) in females. **Conclusion:** Dermatoglyphics can play an important role in person identity and gender estimation. Thus this study we prove helpful in forensic science and also in slowing medico legal cases.

**Keywords:** Arches, Finger prints, Loops, Sexual dimorphism, Whorls.

## INTRODUCTION

The term Dermatoglyphics is the scientific study of the finger prints, lines mounts, and shapes of the hands. Dermatoglyphics refer to the formation of naturally occurring ridges on certain body parts namely palm, finger, soles, and toes. The word Dermatoglyphics originates from two Greek words Derma mean Skin and glyph implies cutting. In Dermatoglyphics the finger palms and soles elevation pattern are studied. The term dermatoglyphics, the uniqueness of a person's fingerprints have been thought by some to be fixing to a person's personality and constructing genetic quality of each individual. Bilateral asymmetry is one of the least comprehended parts of the dermal edge designs.

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The measure of asymmetry which is chiefly utilized as a part of population and genetic study is the right and left differences in the total finger ridges count.<sup>[1]</sup>

Acree described that the ridge count on the right hand is higher than that on the left hand.<sup>[2]</sup> Bosco conducted a study to determine whether gender had an impact on the finger ridge density.<sup>[3]</sup>

Compact solid state scanners are not very expensive and have superior and proven matching performance. Therefore now a day's more and more civilian and commercial administration are relying on fingerprint identification. Fingertips of human skin contain ridges and valleys which form unique patterns. During pregnancy the finger print patterns are fully developed and permanent throughout whole life time Fingerprints quality can temporarily damage in any injuries like cuts, burns, and bruises but patterns are restored when they healed up.<sup>[4,5]</sup>

During embryogenesis, the development of epidermal ridges are priced by the formation of volar pads( swelling of mesenchymal tissue) that first appear as elevations on the palm around 6.5 weeks post fertilization, followed by the digits approximately one week later. Volar pads exhibit

rapid growth between 6.5 and 10.5 week. Initially the pads appear evenly rounded, however by the 9th week, the pads begin to vary in both position and shape.<sup>[6]</sup>

There have been numerous studies on volar pad development and its influence on friction ridge path configuration and pattern formation, leading to individual uniqueness of finger prints.<sup>[7]</sup> Studied have also shown that there is a direct correlation between the location, shape and size of volar pads and friction ridge patterns. The shape of the volar pad can be the result of genetics or external physical influences or a combination of both.

The main aim of this study is to evaluate the commonest finger print pattern in the Indian population and also to assess the different type of finger pattern and establish a relationship between the finger print with the identity of the person. The commonest finger print patterns in both the genders were also studied.

## **MATERIALS AND METHODS**

In the present study, 400 students are taken from out of which 200 males and 200 females. The study was conducted for one year and subjects were studied from Teerthanker Mahaveer University, Moradabad, which belong to the Indian Population. The age of subjects ranges from 17-25 years.

### Inclusion Criteria: -

Belonging with Indian population,  
The subject having no congenital and acquired abnormalities.

Healthy subject,

Normal finger print without any deformity.

### Exclusion Criteria:

Any type of physical deformity,  
Any type of congenital anomalies related to finger print,

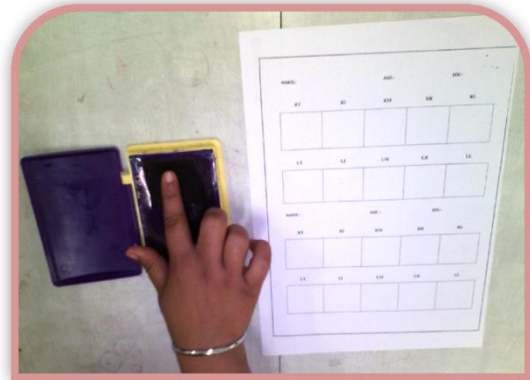
Any surgery of finger print.

If there is any trauma in finger print.

Fingerprints are collected after washing the hands with soap and drying. The material used is ink pad. The printer ink is uniformly spread on a plain glass slab. The finger are rolled laterally on the ink slab and then placed on a box of the white paper. The fingers are printed by rolling them from radial to ulnar side to include the patterns. After the fingerprint is acquired the further details name, sex and age are noted. Prints are taken and the ridge count are studied with the help of a magnifying lens, They are identified as: Arches, Loops and Whorls, Based on the outward show of ridge lines Delta and Core. The Performa is prepared on a durable A4 sheet divided into five marked areas. The right hand thumb (1) index finger (2) middle finger (3) ring finger (4) little finger (5), followed by the left hand; thumb (6) index finger (7) middle

finger (8) ring finger (9), little finger (10) [Figure 1].

Data was collected & analyzed. The mean & standard deviation was calculated. 'T' test was used to analyze the quantitative variables and chi-square test to analyze the qualitative variables. The P-value of <0.05 was considered as significant.



**Figure 1:** Method of taking finger impression.

## **RESULTS**

In the present study 400 students were taken from out of which 200 males and 200 females. The subjects were taken from North Indian Population of Teerthanker Mahaveer University Moradabad. Mean and standard Deviation were calculated for each variable. Gender wise distribution of right and left hand loops, whorls and arch of fingerprint pattern were studied.

The most commonly observed fingerprints were loop i.e. 2426 while the least commonly observed fingerprint were arch 214 and whorls 1388. Fingerprint patterns of arches and whorls were found commonly in male subjects but in the female population whorls were commonly found. In the male population frequency were found to be loops (55.9%) followed by whorls (38%) and arches (6%). In the female frequency were found to be loops (65.4%) followed by whorls (31.4%) and arches (4.7%). In the present study the most frequently seen pattern was loops, while in females whorls are most commonly seen [Table 1,2,3].

Highest frequency of fingerprint patterns were mostly loops (60.65%) followed by whorls (34.7%) and arches (53.5%). However percentage of whorls was maximum in Right ring finger (56%) as compared to loops of Right finger (41%) and arches of Right ring finger (3%) [Table 1, Figure 2].

Highest frequency of fingerprint patterns were mostly by loops (55.9%) followed by whorls (38%) and arches (6%). However, percentages of whorls were maximum in left ring finger (56%) as compared to loops of left finger (42%) and arches left ring finger (2%) [Table 2, Figure 3].

**Table 1:** Distribution of fingerprint patterns in Right and Left Hands in Male and Female.

Fingers	Loops		Total (Total)	Other patterns	
	(Ulnar)	(Radial)		(Whorls)	(Arches)
(RT)	190 (47.5%)	0	190 (47.5%)	198 (49.5%)	12 (3%)
(RI)	174 (43.5%)	10 (2.5%)	184 (46%)	152 (38%)	54 (13.5%)
(RM)	304 (76%)	0	304 (76%)	76 (19%)	20 (5%)
(RR)	164 (41%)	0	164 (41%)	224 (56%)	12 (3%)
(RL)	332 (83%)	0	332 (83%)	68 (17%)	2 (0.5%)
(LT)	220 (55%)	0	220 (55%)	166 (41.5%)	14 (3.5%)
(LI)	188 (47%)	22 (5.5%)	210 (52.5%)	158 (39.5%)	66 (16.5%)
(LM)	284 (71%)	0	284 (71%)	96 (24%)	22 (5.5%)
(LR)	190 (74.5%)	0	190 (74.5%)	204 (51%)	8 (2%)
(LL)	248 (62%)	0	248 (62%)	46 (11.5%)	4 (1%)
(TOTAL)	2349 (58.7%)	32 (8%)	2426 (60.65%)	1388 (34.7%)	214 (53.5%)

**Table 2 :-**Distribution of fingerprint patterns in Right and Left Hands in Male.

Fingers	Loops		Total (Total)	Other Patterns	
	(Ulnar)	(Radial)		(Whorls)	(Arches)
(RT)	86 (43%)	0	86 (43%)	106 (53%)	8 (4%)
(RI)	80 (40%)	10 (5%)	90 (45%)	78 (39%)	30 (15%)
(RM)	144 (72%)	0	144 (72%)	44 (22%)	12 (6%)
(RR)	64 (32%)	0	64 (32%)	132 (66%)	4 (2%)
(RL)	156 (78%)	0	156 (78%)	44 (22%)	2 (1%)
LT)	96 (48%)	0	96 (48%)	92 (46%)	12 (6%)
(LI)	82 (41%)	6 (3%)	88 (44%)	74 (37%)	36 (18%)
(LM)	148 (74%)	0	148 (74%)	44 (22%)	8 (4%)
(LR)	84 (42%)	0	84 (42%)	112 (56%)	4 (2%)
(LL)	162 (81%)	0	162 (81%)	34 (17%)	4 (2%)
(TOTAL)	1102 (55.1%)	16 (0.8%)	1118 (55.9%)	760 (38%)	120 (6%)

Highest frequency of fingerprint patterns were mostly by loops (65.4%) followed by whorls (31.4%) and arches (4.7%). However, percentages of whorls were maximum in Right Ring finger (46%) as compared to loops of Right Ring finger (50%) and arches left ring finger (4%) [Table 3, Figure 4].

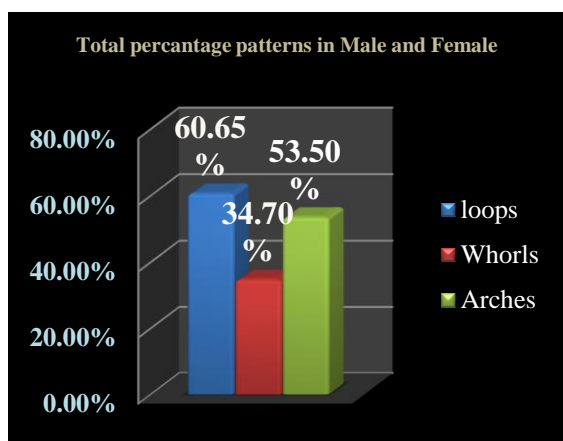
### DISCUSSION

The distribution of the finger print pattern was of the order that loops were the most common pattern (56.3%), followed by Whorls (39.5%) and Arches

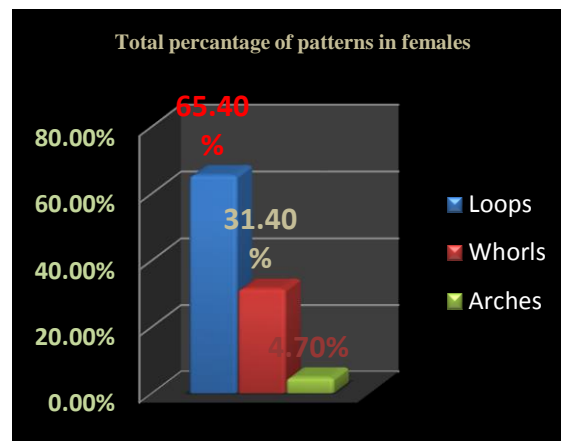
(4.2%) respectively.[8] This observation was similar to that of Nitin et al.<sup>[9]</sup> The finger print pattern loops were more common pattern in males (52.2%) than in females (60.8%) whorls were more common in males (44.1%) than in females (34.3%) and Arches in males (3.7%) than in females (4.9%). The frequency of the loops was higher in both right and left digits in males and females. Females show high frequency of loops in all the digits except the ring finger loops.

**Table 3:-**Distribution of fingerprint patterns in Right and Left Hands in Female.

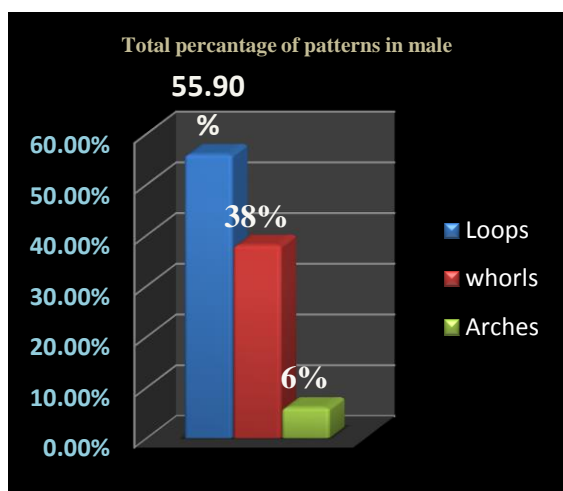
Fingers	Loops		Total (Total)	Other Patterns	
	(Ulnar)	(Radial)		(Whorls)	(Arches)
(RT)	104 (52%)	0	104 (52%)	92 (46%)	4 (2%)
(RI)	94 (47%)	0	94 (47%)	74 (37%)	24 (12%)
(RM)	160 (80%)	0	160 (80%)	32 (16%)	8 (4%)
(RR)	100 (50%)	0	100 (50%)	92 (46%)	8 (4%)
(RL)	176 (88%)	0	176 (88%)	24 (12%)	0 (0%)
(LT)	124 (62%)	0	124 (62%)	74 (37%)	2 (1%)
(LI)	106 (53%)	16 (8%)	122 (61%)	84 (42%)	30 (15%)
(LM)	136 (68%)	0	136 (68%)	52 (26%)	14 (7%)
(LR)	106 (53%)	0	106 (53%)	92 (46%)	4 (2%)
(LL)	186 (92%)	0	186 (92%)	12 (6%)	0(0%)
(TOTAL)	1292 (64.6%)	16 (0.8%)	1308 (65.4%)	628 (31.4%)	94 (4.7%)



**Figure 2:-** General frequency distribution of fingerprint patterns on the right and left hand male and female.



**Figure 4:-** General frequency distribution of fingerprint patterns on the right and left hands in Female.



**Figure 3:-** General frequency distribution of fingerprint patterns on the right and left hands in Male.

While whorls were highly frequent on the thumb, index and ring finger in that order and they were least on the middle and little fingers in male subjects. Arches were highly frequent in females than in males on all the digits except on the right ring finger. A bimanual difference in the distribution of the arches was significant in both sexes where females presented a high frequency of arches on the right hands except on the ring finger similarly males presented a high frequency of arches on the left hands except on the ring finger. The radial loop frequency was more in females than in males.<sup>[8]</sup>

Gangadhar. M.R, Rajashekara Reddy.K reported in a study that the basic pattern type loops (57.11%) were common followed by Whorls (27.89%) and Arches (15.00%) in the general population with

significant sex difference and insignificant bilateral difference.<sup>[10]</sup>

Amit A. Mehta et al, observed that the higher majority of loops were present in middle and little finger of both males and females and also maximum whorls were seen in ring finger of males.<sup>[11]</sup> Arches were more in index finger of both male and females which is in accordance with the study done by kanchan et al.<sup>[12]</sup>

Zalak Patel.et al, observed patterns which are loops (45.68%), whorls (46.91%) and arches (7.41%) respectively.<sup>[13]</sup>

The result of our study shows that loops were commonly found in both sexes i.e. (60.65%), followed by Whorls (34.7%) and Arches (53.5%) respectively.

Rastogi & Pillai had observed loops (60.95%) and whorls (32.55%) patterns which may be because of regional differences. In males, loop was predominated pattern which amounts to (51.06%) of total males followed by whorls (44.68%) and arch (4.26%). In females, whorl pattern was commonest pattern which amount to (50%) of total females followed by loop (38.24%) and arch (11.76%). Contrary to this finding whorls as most common pattern in males (55.78%) and loops predominating in females (52.42%).<sup>[14]</sup> Ching Cho. et al, had observed that whorls were abundant over loops in males (55.6%) as well as in females (65.6%).<sup>[15]</sup>

## CONCLUSION

The most common fingerprint patterns in Indian population is loops (both ulnar and radial) (60.65%) followed by whorls (34.7%) and arch (53.5%). The most common fingerprint patterns in Indian males is ulnar loops (55.1%) similarly (64.6%) females had ulnar loops. The percentage of whorls in males and females were 38% and 31.4% respectively. The rarest finger pattern was arch (6%) in males and (4.7%) in females.

Dermatoglyphics can play an important role in person identity and gender estimation. Thus this study we prove helpful in forensic science and also in slowing medico legal cases.

## REFERENCES

1. Holt SB. Genetics of dermal ridge: Bilateral Asymmetry in finger ridge counts. *Ann Eugen Lond.*1954; 18: 211-23.
2. Acree M. Is there a gender difference in finger print density. *Forensic science international.* 1999; 102(1): 35-44.
3. Bosco JIE, Rajanjam S, Shankar J. Thomas IM, Dermatoglyphic patterns in 46XY females. *Journal of the Indian Medical Association.*2001; 99(8):418-421.
4. Junqueira, L. C Carneiro. *Journal of basic histology*, 10th ed. Lange Medical Books: New York, 2003.
5. Freinkel, R. K Woodley, D T. *The biology of skin the Parthenon.* New York 2001.

6. Hanbi G. The Standard Items in the study and observation of Dermatoglyphics *Journal Hereditas Beijing.*1991; 13(1).
7. Champod, C. Lennard, C. J. Margot, P. and Stoilovic M. *Fingerprints and other ridge skin impressions.* CRC press 2004.
8. Muralidhar Reddy Sangam, Karumanchi, Kolla Anasuya. A study of finger prints bilateral asymmetry and sex difference in the region of Andhra Pradesh, *Journal of clinical and diagnostic research* June 2011;5(3):597-600.
9. Nitin MD, Balaraj BM, Manjunatha B, Mestri SC. A study of fingerprint classification and their gender distribution among the South Indian population. *Journal Forensic Leg Med* 2009; 16(8):460-463.
10. Gangadhar MR, Reddy R. Finger dermatoglyphics of Adikarnatakas: A scheduled caste population of Mysore city, Karnataka *Man in India* 1983;83(1&2):183-193.
11. Amit A, Mehta Anjulika, A. Mehta. Study of fingerprint patterns among medical students in vidarbha region India. *International journal of anatomy and research.* ISSN 2321-4287. 2015; 3(2):1043-45.
12. Kanchan T, Chattopadhyay S. Distribution of fingerprint patterns among medical students. *JIAFM.*2006; 28(2): 23-9.
13. Zalak Patel. A Study of Left Hand Thumb Imprint Patterns among Medical Students at Karamsad (Gujarat) *Journal Indian Acad Forensic Med.* April-June 2011; 33(2):221-9.
14. Rastogi P & Pillai KR. A study of fingerprints in relation to gender and blood groups. *Journal Indian Acad Forensic Med* 2010; 32 (1): 11-13.
15. Ching Cho. A finger dermatographics of the New zealand Samoans. *Korean J Bio Sci* 1998;2:50.

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