

A Study of Finger Prints: Bilateral Asymmetry and Sex Difference in the Region of Andhra Pradesh

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ABSTRACT

Introduction: Fingerprints are considered to be the most reliable criteria for personal identification. The present study was undertaken to observe the distribution of finger print pattern in males and females, and to observe the bilateral asymmetry in the region of Andhra Pradesh.

Material and Methods: The study was carried out in 506 individuals in NRI medical college, Chinakakani, Guntur, Andhra Pradesh. In the study 268 were males and 238 were females.

Finger prints are collected by Cummins ink method, then studied and analyzed statistically.

Results: Whorls were of high frequency on thumb, index and ring fingers in males. But females presented high frequency of loops on all fingers except ring finger. There is a significant bimanual difference. Whorls are more common in right hands. Arches and radial loops are more on left index finger.

Conclusion: Such studies may be useful particularly in Forensic Medicine.

Key Words: Finger prints, Sex difference, Bimanual difference

INTRODUCTION

Dermatoglyphics is the study of the pattern of the fine ridges on the fingers, palms and the soles. The term 'dermatoglyphics' was coined by Cummins. The type of finger print is unique and it is based on the genetic characteristics of each individual. They form the most reliable criteria for personal identification. Bilateral asymmetry is one of the least understood aspects of the dermal ridge patterns. The measure of asymmetry which has mainly been used in population and genetic studies is the right and left difference in the total finger ridge count. Holt [1] described that the ridge count on the right hand was higher than that on the left. Acree [2] conducted a study to determine whether gender had an impact on the finger ridge density. Bosco [3] described that sex chromosomes influenced the size of the cells, which in turn could affect the ridge counts. Karlik [4] showed that males had a higher ridge count and breadth than females, which was associated with a higher right ward directional asymmetry in the ridge counts.

The present study was taken up to study the pattern and the intensity of finger prints and the influence of sex and handedness in the region of Andhra Pradesh, as there was no available literature in this aspect.

MATERIAL AND METHODS

This study was carried out in the Department of Anatomy, NRI Medical college, Chinakakani, Guntur district, Andhra Pradesh, in 506 individuals, out of which 268 (53%) were males and 238 (47%) were females. The duration of the study was from 2009 to 2011 (2 years). The male: female ratio was 1.12:1. Fingerprints are collected after washing the hands with soap water and drying. The Cummins ink method was used. Printers ink was uniformly spread on a plain glass slab and prints were taken. Later, the fingerprints were studied with the help of a hand lens. The pattern of the fingerprint and the ridge count were studied. The results were analyzed statistically.

OBSERVATIONS

The general 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. The results of the study have been tabulated.

DISCUSSION

The general 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 [Table/Fig 8, 9 and 10]. This observation was similar to that of Nitin et al [5], who stated that the most frequent pattern was the ulnar loop in the total population.

On every digit, except on ring finger, ulnar loops were the most abundant pattern. Their frequency ranging downwards from 72.5% on the little finger, 66.2% on the middle finger, 50.6% on the thumb, 41.6% on the index finger and 40.2% on the ring finger. Whorls were more numerous on the ring finger (56.4%), followed by the thumb (46.2%) and the index finger (41.8%). The middle and the little fingers presented a sharp reduction in the frequency of the whorls (27.6% and 25.4% respectively). Arches were abundant on the index (9.8%) finger, followed by the middle (4.7%) finger, the thumb (2.6%), the ring (2.5%) and the little (1.7%) fingers. Radial loops were abundant on the index (6.8%) finger, followed by the middle (1.5%) and the little (0.9%) fingers. The thumb (0.6%) and the little (0.4%) finger showed the least frequency of the radial loops [Table/Fig-1].

There was a significant bimanual difference, whorls were slightly more common on the right hands. Radial loops and arches were more frequent on the left index finger than on the right one. Arches were more frequent on the left middle finger than on the right one [Table/Fig-1].

But there was a significant difference in the frequency of the patterns in males and females. In the present study, loops were

higher in females (60.5%) than in the males (52.3%). A similar observation was made by GG Reddy [6]. In the present study, whorls were more frequent in males (44%) than in females (34.3%) and arches were more frequent in females (5.5%) than in males (3.7%). Whorls were highly frequent on the thumb, the index and ring fingers respectively and they were least on the middle and little fingers where the frequency of the loops was high. In contrast to this, females presented a high frequency of loops on all the digits except on the ring finger. 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. In contrast to this, 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 [Table/Fig-2 & 3].

According to Dankmeijer [7], the index of the arch/ whorls appeared to be more significant in the comparative statistics. In the present study, the pattern type index was 14.19 in females and 8.47 in males. The value of the pattern intensity may be stated either as the number of triradii per individual [8] or as the average number of triradii per finger [9]. The pattern intensity index in the present study was 12.94 per individual and 1.294 per digit in females; 14.02 per individual and 1.402 per digit in males. This observation was similar to the findings of GG Reddy [6] who reported the pattern intensity index in males as 14.17 and as 12.84 in females.

The ridge count consisted of the number of ridges which cut or touched a straight line which ran from the triradius to the core or the centre of the pattern. TFRC – Total finger ridge count was the count of the number of ridges from the triradius to the core pattern and was counted for all the digits of both the hands. Since the whorl has two triradii, the maximum number of ridges from one of the two triradii to the core was counted. AFRC – Absolute finger ridge count was the counting of all the ridges of all the digits of both the hands from all the triradii to the core. Since the whorl has

	Loops			Whorls	Arches
	Ulnar	Radial	Total		
RT	257 (50.8%)	4 (0.8%)	261 (51.6%)	231 (45.6%)	14 (2.8%)
RI	223 (44.1%)	16 (3.1%)	239 (47.2%)	220 (43.5%)	47 (9.3%)
RM	354 (69.9%)	5 (0.9%)	359 (70.9%)	131 (25.9%)	16 (3.2%)
RR	194 (38.3%)	4 (0.8%)	198 (39.1%)	296 (58.5%)	12 (2.4%)
RL	365 (72.1%)	2 (0.4%)	367 (72.5%)	131 (25.9%)	8 (1.6%)
LT	256 (50.6%)	2 (0.4%)	258 (51%)	236 (46.6%)	12 (2.3%)
LI	198 (39.1%)	53 (10.5%)	251 (49.6%)	203 (40.1%)	52 (10.3%)
LM	316 (62.5%)	10 (1.9%)	326 (64.4%)	148 (29.3%)	32 (6.3%)
LR	213 (42.1%)	5 (0.9%)	218 (43%)	275 (54.4%)	13 (2.6%)
LL	368 (72.7%)	2 (0.4%)	370 (73.2%)	126 (24.9%)	10 (1.9%)
Total	2744 (54.2%)	103 (2%)	2847 (56.3%)	1997 (39.5%)	216 (4.2%)

[Table/Fig-1]: Showing frequencies of pattern types and digital distribution

	Loops			Whorls	Arches
	Ulnar	Radial	Total		
RT	118 (44%)	0	118 (44%)	146 (54.5%)	4 (1.5%)
RI	97 (36.2%)	6 (2.2%)	103 (38.4%)	142 (53%)	23 (8.6%)
RM	171 (63.8%)	4 (1.5%)	175 (65.3%)	87 (32.5%)	6 (2.2%)
RR	99 (36.9%)	2 (0.8%)	101 (37.7%)	159 (59.3%)	8 (3%)
RL	179 (66.8%)	2 (0.8%)	181 (67.6%)	85 (31.7%)	2 (0.7%)
LT	127 (47.4%)	0	127 (47.4%)	135 (50.4%)	6 (2.2%)
LI	102 (38.1%)	18 (6.7%)	120 (44.8%)	119 (44.4%)	29 (10.8%)
LM	166 (61.9%)	4 (1.5%)	170 (63.4%)	86 (32.1%)	12 (4.5%)
LR	118 (44%)	3 (1.1%)	121 (45.1%)	143 (53.4%)	4 (1.5%)
LL	184 (68.7%)	0	184 (68.7%)	78 (29.1%)	6 (2.2%)
Total	1361 (50.8%)	39 (1.4%)	1400 (52.2%)	1180 (44.1%)	100 (3.7%)

[Table/Fig-2]: Showing the frequencies of pattern types and digital distribution in males

	Loops			Whorls	Arches
	Ulnar	Radial	Total		
RT	139 (58.4%)	4 (1.7%)	143 (60.1%)	85 (35.7%)	10 (4.2%)
RI	126 (52.9%)	10 (4.2%)	136 (57.1%)	78 (32.8%)	24 (10.1%)
RM	183 (76.9%)	1 (0.4%)	184 (77.3%)	44 (18.5%)	10 (4.2%)
RR	95 (39.9%)	2 (0.9%)	97 (40.8%)	137 (57.5%)	4 (1.7%)
RL	186 (78.2%)	0	186 (78.2%)	46 (19.3%)	6 (2.5%)
LT	129 (54.2%)	2 (0.9%)	131 (55.1%)	101 (42.4%)	6 (2.5%)
LI	96 (40.4%)	35 (14.7%)	131 (55.1%)	84 (35.3%)	23 (9.6%)
LM	150 (63%)	6 (2.5%)	156 (65.5%)	62 (26.1%)	20 (8.4%)
LR	95 (39.9%)	2 (0.9%)	97 (40.8%)	132 (55.4%)	9 (3.8%)
LL	184 (77.3%)	2 (0.9%)	186 (78.1%)	48 (20.2%)	4 (1.7%)
Total	1383 (58.1%)	64 (2.7%)	1447 (60.8%)	817 (34.3%)	116 (4.9%)

[Table/Fig-3]: Showing the frequencies of pattern types and digital distribution in females

TFRC	Males	Females
Mean ± S.D	151.75 ± 48.1	130.44 ± 43.7
95% Confidence interval for actual mean	146.0 thru 157.5	124.9 thru 136.0
Median	161	132
High value	244	218
Low value	4	10
P- value (t- test)	<0.0001	<0.0001

[Table/Fig-4]: showing TFRC in Males and Females

AFRC	Males	Females
Mean ± S.D	197.31 ± 83.0	161.08 ± 63.3
95% Confidence interval for actual mean	187.3 thru 207.3	153.0 thru 169.2
Median	200	163
High value	379	303
Low value	4	10
P- value (t- test)	<0.0001	<0.0001

[Table/Fig-5]: Showing AFRC in Males and Females

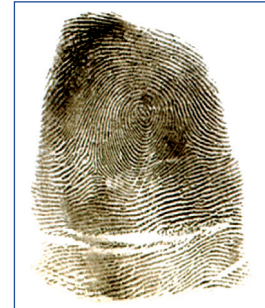
two triradii, the number of ridges from both the triradii to the core was counted. Absolute and total finger ridge counts were more in males than in females [Table/Fig-4 & 5]. Ridge counts were more in males than in females [Table/Fig-6 & 7]. A similar observation was made by Richard Green et al [10] and Kunter et al [11]. In both the sexes, ridge counts were more on the right hands than on the left hands. High ridge counts were observed on the thumb and the middle fingers of both the sexes. The ridge count was least on the index fingers of both the sexes as the frequency of the arches was elevated.

	Mean ± S.D	95% Confidence interval for actual mean	Median	High	Low
RT	19.769 ± 6.17	18.72 thru 20.82	21.00	32.0	0
RI	13.672 ± 6.40	12.58 thru 14.77	15.00	30.0	0
RM	13.985 ± 5.51	13.04 thru 14.93	15.00	25.0	0
RR	17.00 ± 5.78	16.01 thru 17.99	18.00	33.0	0
RL	14.396 ± 5.04	13.53 thru 15.26	16.00	23.0	0
LT	17.933 ± 5.76	16.95 Three 18.92	19.00	32.0	0
LI	12.679 ± 6.56	11.56 thru 13.80	14.00	30.0	0
LM	14.604 ± 6.00	13.58 thru 15.63	16.00	28.0	0
LR	16.418 ± 5.66	15.45 thru 17.38	17.00	30.0	0
LL	13.701 ± 4.87	12.87 thru 14.53	15.00	23.0	0

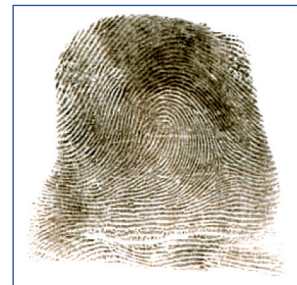
[Table/Fig-6]: showing digital distribution of ridge count in males

	Mean ± S.D	95% Confidence interval for actual mean	Median	High	Low
RT	15.950 ± 5.87	14.88 thru 17.02	17.00	30.0	0
RI	11.176 ± 5.89	10.11 thru 12.25	13.00	24.0	0
RM	12.244 ± 5.47	11.25 thru 13.24	13.00	24.0	0
RR	15.109 ± 5.48	14.41 thru 15.81	16.00	26.0	0
RL	12.328 ± 4.66	11.73 thru 12.92	13.00	23.0	0
LT	14.546 ± 5.75	13.81 thru 15.28	15.00	27.0	0
LI	10.882 ± 6.37	10.07 thru 11.70	12.00	24.0	0
LM	12.168 ± 6.09	11.39 thru 12.95	13.00	24.0	0
LR	14.580 ± 5.88	13.83 thru 15.33	15.00	27.0	0
LL	12.395 ± 4.62	11.80 thru 12.99	13.00	23.0	0

[Table/Fig-7]: showing digital distribution of ridge count in females



[Table/Fig-8]: Showing the whorl pattern



[Table/Fig-9]: Showing the loop pattern



[Table/Fig-10]: Showing arch pattern

CONCLUSION

The present study revealed that there were significant sex and bimanual differences in the distribution of the finger print pattern. So, such studies may be of great value in forensic medicine, but the influence of regional variations and genetic factors should not be overlooked.

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