

## STUDY OF FINGERPRINT PATTERNS AMONG MEDICAL STUDENTS

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### ABSTRACT

**Background:** The study of fingerprint patterns in palms and soles is called as Dermatoglyphics. Fingerprint patterns are unique for different individuals and remain unchanged throughout one's life. Fingerprints form the most reliable criteria for identification of individual in criminology. The dermatoglyphics has become significant for the clinicians in recent years owing to its diagnostic value. Although many studies have been conducted in the dermatoglyphic patterns, details of distribution of fingerprints in individual digits are very few. So the present study has been carried out to observe the distribution of fingerprints in different digits in males and females.

**Materials and Methods:** Fingerprints of 600 students of Dhanalakshmi Srinivasan medical college and hospital, Perambalur, South India were taken using the ink method.

**Results:** The incidence of loops, whorls and arches were 59.4%, 33.9% and 6.7% respectively in both males and females. Whorls were higher on the ring finger, loops were more on the little finger and arches were higher on the index finger.

**Conclusion:** Though different patterns show preferences in different fingers, bilateral variations and significant sexual dimorphism could not be established.

**KEY WORDS:** Dermatoglyphic, Fingerprints, Dermal Ridges, Sexual Dimorphism.

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### INTRODUCTION

The study of epidermal ridges and their configuration on the palmar aspect of hand and plantar surface of foot is called as Dermatoglyphics [1]. The terminology Dermatoglyphics was derived from the Greek words (derma, skin and glyphs means curved) and was first coined by Harold

Cummins in 1926 from Tulane University [2]. These epidermal ridges correspond to underlying pattern of dermal papillae. The arrangement of ridges is unique for the individual[3]. The dermatoglyphic pattern appears early at 10<sup>th</sup> week of intrauterine life. Development of ridges was found to be affected by genetic and environmental factors. Dermatoglyphic patterns

remain unchanged throughout one's life unless destroyed by deep burns [4]. The fact that skin of palm and soles has ridges that are unique to each individual has been used for personal identification in criminology.

Generally the pattern of fingerprint is divided into three types, namely arch, loop and whorl. The arch type is further divided into two sub-groups: simple and tented and the loop type is divided to two subgroups: radial and ulnar. The whorl type is divided to five groups as simple, central pocket loop, twinned loop, lateral pocket loop and accidental. In general population, the line pattern is consisted of 4%, 55% and 41% of arch, loop and whorls respectively [5].

#### Fingertip Patterns

**ARCH (A):** An arch is the simplest pattern. It consists of more or less parallel ridges. The ridges curve the pattern area. The curve is proximally concave. The curve is gentle in low arch and sharp in high arch. Simple or Plain Arch: ridges cross fingertip from one side to the other without recurving. It is not a true pattern. Tented Arch: ridges meet at a point. So their smooth sweep is interrupted. The triradius is located near the midline axis and distal phalanx. Triradius is the point of confluence of ridges. The ridges usually radiate from this point in three different directions [6].

**LOOP (L):** It is the most frequent pattern on fingertip. In this configuration series of ridges enter and leave the pattern area on same side. Ulnar Loop (Lu): In Ulnar Loop ridges opens on the ulnar side. Radial Loop (Lr): In Radial Loop ridges open on the radial side.

**WHORLS (W):** According to Galton's classification [7], whorl is any ridge configuration with two or more triradii. According to Henry's classification [8], whorl is a ridge configuration in which ridges actually encircles core and more complex patterns are called as 'composite'. Whorls are usually classified into Simple/Plain Whorls (spiral or concentric) and Double Loop Whorls (Twin loop or Lateral pocket loop). In Concentric Whorl, the ridges are arranged as concentric rings or ellipse (around the core). In Spiral Whorl, the ridges spiral around the core in clockwise or anti-clockwise direction. Mixed Whorl contains circles and ellipse or spirals in

the same pattern. Central Pocket Whorl contains a smaller whorl within a loop. Either Lateral Pocket Whorl or Twin Loop are morphologically similar and have 2 triradii. In lateral pocket whorl both ridges emanating from each core emerge on the same side of the pattern. In twin loop whorl the ridges emanating from each core open towards the opposite margin of the finger. Complex patterns, which cannot be classified as one of the above patterns, are called accidentals. They represent a combination of two or more configurations.

Although the distribution of different fingerprint patterns is known worldwide [9] the availability of published literature on the distribution of fingerprint patterns on individual digits is minimal. Hence our study aimed at documenting the distribution of fingerprint patterns on different digits in males and females and to report if any variation occurs between both sexes for both hands.

#### MATERIALS AND METHODS

The study was carried at Dhanalakshmi Srinivasan Medical College and Hospital, Perambalur, Tamilnadu. The material consisted of 6000 fingerprints taken from 600 medical students among which 300 were males and 300 were females. Written informed consent was taken from the study subjects before taking the fingerprints.

The cross sectional study was conducted in 2015 after getting approval from Institutional ethics committee. Healthy subjects who participated voluntarily were included in the study and their age ranged from 17 - 22 yrs. Subjects with permanent scars on their fingers and with hand deformities were excluded from the study. The fingerprints were taken by using Ink method as described by Cummins and Midlo [2]. The Kores duplicating ink, ink pad, glass plate, roller, gauze pads, soap, white paper, magnifying hand lens and soap were used for obtaining fingerprints. Subjects were advised to wash their hands and made to dry. Ink was applied on the ink pad and uniformly smeared. The fingers were rolled on the ink slab and then placed on a white paper with one lateral edge and rolled over in opposite direction. Thus an imprint of ten fingertips of both hands were recorded on the

white paper. After the prints were dried sheets were marked with name, age and sex. After taking the imprints of all fingers, the ink was removed by using soap and water. The qualitative analysis of fingertip patterns were studied with help of a magnifying lens. In our study, the classification of fingerprints into Loops, Arches and Whorls was considered. The qualitative data obtained from the fingerprints were tabulated, compared and analyzed.

## RESULTS

Table 1 shows the distribution of fingerprint patterns in right and left hands of 600 medical students. Among 6000 fingerprints taken, loops (59.4%) were the most common pattern followed

by whorls (33.9%) and arches (6.7%) were the least common. Whorls were higher in ring fingers (49.8%), followed by index (38%) and thumb (35.4%). Loops were most often observed on little finger (76%) followed by middle finger (66.3%) and thumb (60.4%). Frequency of arches were higher in index finger (13%). Table 2 shows the sexual dimorphism of fingerprint patterns. Arches were higher on middle fingers of females (12.2%) when compared to males (4%). In males whorls, loops and arches were 32.8 %, 61.3% and 5.9% respectively. In females whorls were 35 %, loops 57.7% and arches were 7.3 %. From this it is evident that the difference in overall distribution of fingerprint pattern in both hands of males and females was insignificant.

**Table 1:** Distribution of Fingerprint patterns in Right and left Hands. n – Number of subjects

Digits		n	Whorls	%	Loops	%	Arches	%
Thumb	Right	600	212	35.3	369	61.5	19	3.1
	Left	600	213	35.5	356	59.3	31	5.1
	R + L	1200	425	35.4	725	60.4	50	4.2
Index	Right	600	228	38	301	50.1	71	11.8
	Left	600	229	38.1	285	47.5	86	14.3
	R + L	1200	457	38	586	48.8	157	13
Middle	Right	600	139	23.1	422	70.3	39	6.5
	Left	600	168	28	374	62.3	58	9.7
	R + L	1200	307	25.6	796	66.3	97	8.1
Ring	Right	600	318	53	259	43.1	23	3.9
	Left	600	280	46.7	292	48.7	28	4.6
	R + L	1200	598	49.8	551	45.9	51	4.3
Little	Right	600	133	22.1	444	74	23	3.9
	Left	600	115	19.2	467	77.8	18	3
	R + L	1200	248	20.7	911	75.9	41	3.4
All digits	Right	3000	1030	34.3	1795	59.8	175	5.9
	Left	3000	1005	33.5	1774	59.1	224	7.4
	R + L	6000	2035	33.9	3569	59.4	399	6.7

**Table 2:** Distribution of fingerprint patterns among males and females. n – Number of subjects

Digits		n	Whorls	%	Loops	%	Arches	%
Thumb	Male	600	208	34.7	371	61.8	21	3.5
	Female	600	217	36.1	354	59	29	4.9
Index	Male	600	222	37	297	49.5	81	13.5
	Female	600	235	39.1	289	48.2	76	12.7
Middle	Male	600	152	25.3	424	70.7	24	4
	Female	600	155	25.8	372	62	73	12.2
Ring	Male	600	282	47	290	48.3	28	4.7
	Female	600	316	52.7	261	43.5	23	3.8
Little	Male	600	120	20	458	76.3	22	3.7
	Female	600	128	21.3	453	75.5	19	3.2
All digits	Male	3000	984	32.8	1840	61.3	176	5.9
	Female	3000	1051	35	1729	57.7	220	7.3

## DISCUSSION

The finger ridge pattern is unique for an individual and the development of ridge pattern is genetically determined and remain unchanged throughout life. The epidermal ridge patterns are formed between 10<sup>th</sup> and 24<sup>th</sup> week of gestation [10]. The critical growth of the brain also occurs during this period. Since the skin and brain develop from the same ectoderm, dermatoglyphic variations are evidence for early developmental brain disturbances [11]. The percentage of worldwide distribution of loops, whorls, arches and composite is 65%, 25%, 7% and 2-3% respectively [9]. In our study the higher percentage of patterns were loops (59.4%) followed by whorls (33.9%) and then arches (6.7%). This is in conformity with the worldwide distribution and with the most of the studies conducted previously [12, 13]. But whorls were predominant pattern, followed by loops and then arches in the study done by Rastogi [14] and the study among British individuals [15]. In the present study maximum percentage of loops were seen on the little finger and middle finger which coincides with the results of Kanchan et al [16] and Mehta et al [17]. The maximum whorls were seen on the ring finger which also coincides with Kanchan et al and Mehta et al. Arches were higher in the index finger which is similar to the results of Mehta et al and British individuals.

## CONCLUSION

Loops were the predominant pattern in both males and females. Frequency of whorls were comparatively higher and that of loops lower when compared with worldwide distribution percentage. Significant increase in the frequency of loops was seen in the little finger followed by thumb. Higher percentage of loops was observed on the ring finger whereas highest preponderance of arches was present in index finger. Distribution of dermatoglyphic patterns was almost similar on both hands and both sexes. So we could not establish the bilateral variations and gender based differences.

**Conflicts of Interests: None**

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