FINGERPRINT PATTERN DISTRIBUTION AMONG THE JAT SIKH POPULATION OF PUNJAB

JASWINDER SINGH CHOUHAN, HUSANPREET KAUR AND MUKESH KUMAR THAKAR

ABSTRACT

Fingerprint is one of the important means to identify any person. Different population groups distributed all over the world have different percentage of fingerprint pattern types. Dermatoglyphic of some of the ethnic groups have been studied to find out the difference in frequency of their pattern types. This information of population study becomes important for investigating officers to identify the perpetrators from their fingerprints found at crime scene. Keeping this in mind an attempt has been made to collect the fingerprints (distal phalanges only) of all the ten fingers. This is only possible if sufficient dermatoglyphics data is available to investigators. Half of the job of the investigator is done if it is possible to determine the sex of the perpetrator so the present study was conducted on Jat Sikh population of Punjab state (India) to determine the frequency of occurrence of different fingerprint patterns among the individuals of selected population. Fingerprints from 200 individuals were collected including 97 females and 103 males between the age of 18- 45 years from the Jat Sikh population of Punjab. The frequency of different pattern types was found to be maximum for ulnar loops followed by whorls pattern, central pocket loop, radial loop, plain arch, twinned loop, lateral pocket loop and minimum of tented arch. The results were statistically evaluated. The t-test was applied which was found to be significant in case of males (p < 0.05) and insignificant in case of females.

Keywords: *Jat Sikh, Fingerprints, Pattern Distribution, Dermatoglyphics*

INTRODUCTION

The identity of the suspect is main concern in forensic investigations. Fingermarks are considered to be one of the best means of identification. The common methods of identification lie in finding the First level details (pattern types), Second level

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details (minutiae/ridge characteristics/Galton's details) and Third level details (Edgeoscopy and Poroscopy). Because of uniqueness and persistence, the fingerprints are used worldwide for personal identification and have become an infallible tool for investigators in both civil and criminal cases. Kuken *et al.,* (2005) also observed that fingerprints cannot be duplicated and are unchallengeable as fingerprints are formed by buckling instability in basal cell layer of embryo. A number of scientists have worked on fingerprints to study the Dermatoglyphics of different populations and ethnic groups across the world (Kanchan and Chattopadhyay, 2006; Ekanem *et al.,* 2009; Nithin *et al.,* 2009; Nanakorn *et al*., 2013; Kapoor and Badiye, 2015; Bansal *et al*., 2014; Koneru *et al.,* 2014; Karki and Singh, 2014 and Gupta and Shah, 2019). But very little or almost no data is available related to the fingerprint pattern types present in Jat Sikh populations of Punjab. Therefore, in the present study, an attempt has been made to study the fingermarks of the 'Jat-Sikhs' population residing in Northern Indian State of Punjab. The results obtained from the present study expected to help the investigators to differentiate between the people belonging to two different populations. Further, the fingerprints of two sexes of the populations can also be differentiated on the basis of results obtained after statistical analysis.

MATERIALS AND METHODS

In the present study, fingerprint samples of 200 individuals belonging to Jat Sikh population of Punjab state (97 females and 103 males), ranging in age from 18 years to 45 years were collected on a white sheet. The individuals with any scar, injury, permanent deformity or any disease were excluded from study. Rolled fingerprints from 10 distal phalanges of each individual were collected on white A4 sheet after washing and drying the hands of all the subjects. Hands were also wiped with swab of absolute alcohol/acetone to remove any dust/dirt and oily material from the distal phalanges of all the subjects.

The fingerprint samples were obtained by spreading ink uniformly on a clean glass plate with the help of cotton pad or roller. A4 white sheet was placed on a smooth and leveled surface of convenient height to take fingerprints. Ink was applied on complete distal phalanges and some part of middle phalanges and prints were taken by rolling the fingers in one direction from radial to ulnar direction on white sheet. Utmost care was taken to avoid smudging either due to excessive pressure and slippage of finger tips on the paper while collecting sample. Each fingerprint sample was then marked with a unique number so as to identify the finger and sample donor.

Before taking finger prints, a verbal and written consent was obtained from all the individuals after making them understand that their fingerprints will be used for research purpose only and every care has been taken to safeguard their fingerprints from being used for any unethical purpose.

Analysis: After sample collection, all the fingerprints were digitalized to form a magnified image. Then these prints were analyzed one by one by marking the type lines, core and delta points. After identification of patterns, all the samples were classified according to the Henry's classification system into different pattern types, viz., Arches (plain and tented arch), Loops (ulnar and radial loop), Whorls and Composites (central pocket loop, lateral pocket loop, twinned loop and accidental). All the pattern types have been entered into an excel sheet. Then, the spread sheet has been prepared to calculate the frequency of different fingerprint patterns present in the Jat Sikh population of Punjab.

RESULTS

For the present study, a total of 2000 fingerprints samples collected from Jat Sikh population residing in Punjab state of India were analyzed to assess their pattern types, in which 970 fingerprint samples from females and 1030 samples from males were used to calculate the frequency of each for pattern types and the results were analyzed statistically. Chi Square test was applied to test the significance of relation among the fingerprint patterns of male and female Jat Sikh population of Punjab.

The distribution of fingerprint patterns has been found to be varying amongst various populations and ethnic groups, in India and across the globe. This knowledge becomes crucial in the forensic investigation. Thus, fingerprint pattern types and various specific characteristics have been utilized world-wide to compare finger prints for personal identification. In the present study, an attempt has been made to determine the frequency distribution of various fingerprint patterns to establish the most and least predominant patterns. The results of present study were tabulated and then compared with the other Indian populations in relation to their frequency of occurrence of pattern types and are shown in Table-1.

Table-1: Comparison of the Fingerprint Patterns Type Data of Jat Sikh with Data of various other Populations

Population	SEX	*N*	Frequency of dermatoglyphics patterns (%)				Authors
			Loops	Whorls	Arches	Composites	
Jat Sikh (India)	M	103	55.63	26.79	2.91	13.78	Present Study
	F	97	59.48	23.81	4.74	11.85	
Muslims (Central India)	M	40	52.33	28.17	3.50	16.00	Kapoor and Badiye (2014)
	F	40	48.17	27.83	5.33	18.67	
Dhimals of North Bengal (Bengal)	M	101	42.16	55.10	2.75	--	Biswas (2011)
	F	101	48.24	50.19	1.57	--	
Rengma Nagas of Nagaland (India)	M	104	46.96	52.19	0.49	--	Banik *et al.,* (2009)
	F	103	42.52	55.69	1.79	--	
South Indians (India)	M	250	51.4	41.08	5.68	--	Nitin *et al.,* (2009)
	F	250	38.16	35.36	4.52	--	
Medical Students (Gangtok, India)	M	55	56.8	38.7	4.5	--	Kanchan *et al.,* (2006)
	F	55	58.2	37.3	4.5	--	
Rajput (Himachal Pradesh, India	M	50	49	49	2	--	Singh and Garg (2004)
	F	50	53.33	46.86	1.81	--	
Rarhi Brahmins (Bengal)	M	100	53.8	43.90	2.3	--	Chattopadhyay et al. (1969)
	F	38	64.47	31.32	4.21	--	
Danguria Tharu of Uttar Pradesh (India)	M	379	54.69	41.42	3.87	--	Srivastava (1963)
	F	300	55.33	40.5	4.16	--	

Out of the total 2000 fingerprints collected from Jat Sikh population, 84 were of arch patterns (including 66 plain arches and 18 tented arches). Loop patterns were found to be 1150 (including 1031 Ulnar loops and 119 Radial loops). Whorls patterns were found to be 507 in number. Composite patterns were found to be present in 259 fingerprints (including 182 Central Pocket Loops, 27 Lateral Pocket Loops, 48 Twinned Loops and 2 Accidental patterns) as shown in Table-2 and Figure-1.

Table-2: Pattern wise Distribution of Fingerprints in Jat Sikh population Subjects

S. No.		Fingerprint pattern type	Male	Female	Percentage frequency
1	Arches (84)	Plain arch	29	37	3.30%
2		Tented arch	9	9	0.90%
3	Loops (1150)	Ulnar loop	498	533	51.55%
4		Radial loop	75	44	5.95%
5	Whorls (507)	Whorl	276	231	25.35%
6	Composite (257)	Central pocket loop	103	79	9.10%
7		Lateral pocket loop	13	14	1.35%
8		Twinned loop	26	22	2.40%
9	Accidental (2)	Accidental	1	1	o.1%

It is also evident from the table 2 and graph 1 that the frequency of ulnar loop was found to be maximum (51.55%) and are more frequent in females than males, followed by Whorl (25.35%) which are more frequent in males as

compared to females. In other words, the ulnar loop patterns are more common in females, whereas the whorl patterns are more common in males.

In some of the patterns like Central Pocket Loop (9.10%), Radial Loop (5.95%), Plain Arch (3.30%), Twinned Loop (2.40 %), Lateral Pocket Loop (1.35%), Tented Arch (0.90%) and Accidental (0.1%) the frequencies were found to be less than 10 percent (Table 2 and Graph-1).
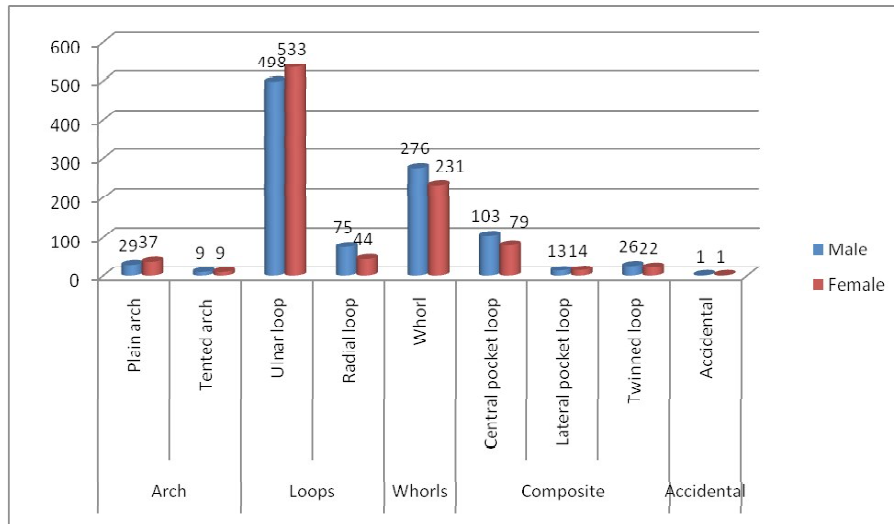
Figure-1: Pattern wise Distribution of Fingerprints in Jat Sikh population of Punjab

Table-3: Frequency distribution of patterns in Right and Left hand of Males

Sr. No.	Pattern Type	Total numbers of Fingerprints					Percentage
		Number of samples having pattern					
		Right hand	Percentage	Left hand	Percentage	Total	
1	Arch	17	3.30	21	4.07	38	3.68
2	Loop	276	53.59	297	57.66	573	55.63
3	Whorl	162	31.45	114	22.13	276	26.79
4	Composite	60	11.65	83	16.11	143	13.88
		515		515		1030	
Chi Square				13.238			
P-value				0.004			

Figure-2: Frequency distribution of patterns in Right and Left hand of Male Population
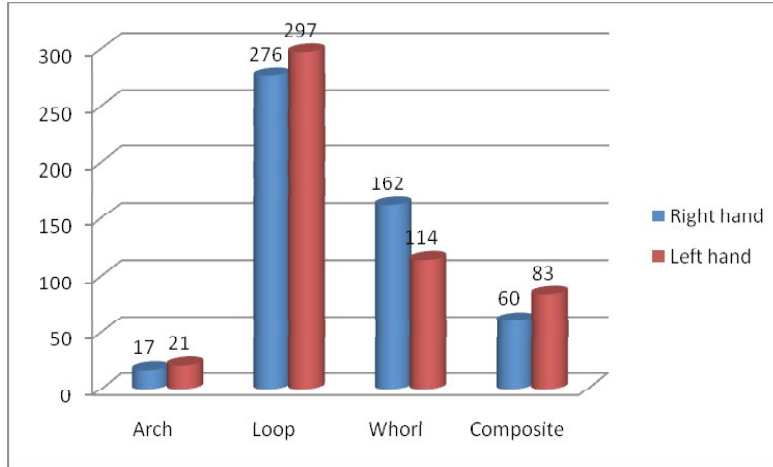

Table-4: the Frequency distribution of Pattern Types in Right and Left hand of Females

Sr. no.	Pattern Type	Total numbers of Finger mark samples collected					Percentage
		Number of samples having pattern					
		Right hand	Percentage	Left hand	Percentage	Total	
1	Arch	20	4.12	26	5.36	46	4.74
2	Loop	298	61.44	279	57.52	577	59.48
3	Whorl	121	24.94	110	22.68	231	23.81
4	Composite	46	9.48	70	14.43	116	11.95
		485		485		970	
Chi Square				6.898			
P value				0.075			

Figure-3: Frequency distribution of Pattern Types in Right and Left hand of Females
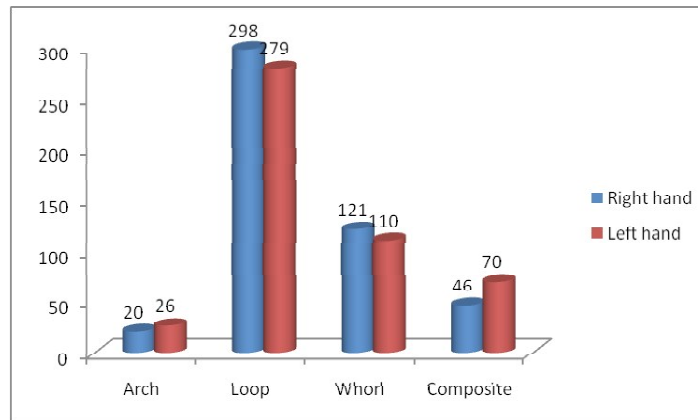
Table-3 and Figure-2 show the distribution of 4 main fingerprint pattern types among the Right and Left hand of males of Jat Sikh population of Punjab. It is evident from the table that from total 1030 fingerprints of male Jat Sikh samples, there were total 38 (3.68 %) arch patterns, 21 (4.07 %) in left hand and 17 (3.30 %) in the right hand. Similarly, total 573 (55.63 %) pattern types were loop patterns encountered among which 297 (57.66 %) belongs to left hand and 276 (53.59 %) belongs to right hand. Total 276 (26.79 %) fingerprints were found to have whorl, among which 114 (22.13 %) were present in left hand and 162 (31.45 %) in right hand. Total 143 (13.88%) composites patterns were encountered including accidental patterns among which 83 (16.11 %) were found in left hand and 60 (11.65 %) were found in right hand of male population of Jat Sikh residing in Punjab.

From the Table-3 and Figure-2, it has been observed that fingerprint patterns of right hand and left hand differ significantly in males, as depicted by its p-value (0.004) which is lower than 0.05.

Table-4 and Figure-3 shows the distribution of 4 main patterns among Jat Sikh females of Punjab. It shows that, from 970 fingerprints of female Jat Sikh samples, there were total 46 (4.74 %) arch patterns, 26 (5.36 %) were in left hand and 20 (4.12 %) were found in right hand. Similarly, total 577 (59.48 %) loops were encountered, among which 279 (57.52 %) belonged to left hand and 298 (61.44 %) belonged to right hand in the Jat Sikh female population. In case of whorls, total 231 (23.81 %) were found, among which 110 (22.68%) were present in left hand and 121 (24.94 %) were found in right hand. Total 116 (11.95 %) composite patterns were encountered, among which 70 (14.43 %) were found in left hand and 46 (9.48 %) were found in right hand of the Jat Sikh females in the present sample.

From the Table-4 and Figure-3, it has been observed that fingerprint patterns of right hand and left hand do not differ significantly in females as depicted by its p value (0.075), which is greater than 0.05.

Table-5: Comparison of frequency of pattern types of right hand of males with right hand of females

SR. No.	Pattern type	Males	Percentage	female	Percentage
1	Arch	17	3.30	20	4.12
2	Loop	276	53.59	298	61.44
3	Whorl	162	31.45	121	24.94
4	Composite	60	11.65	46	9.48
		515		485	
Chi square			7.983		
P value			0.0046		

Figure-4: Comparison of frequency of pattern types of right hand of male population with right hand of female population
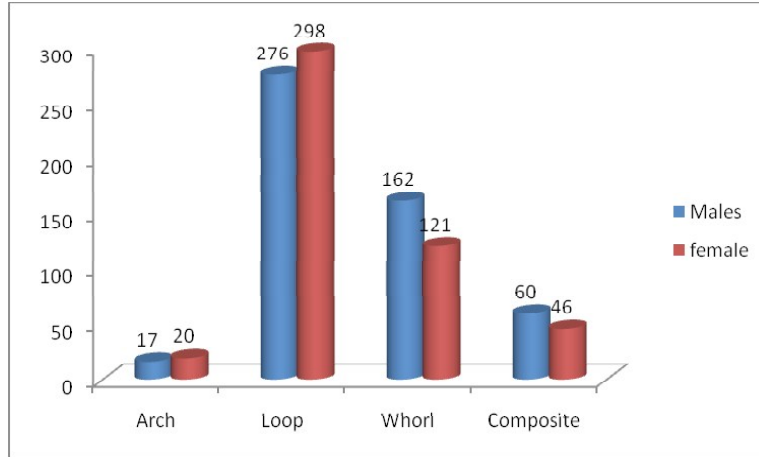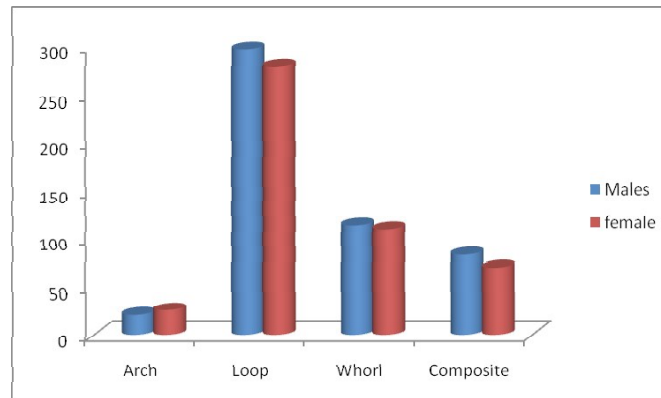

When fingerprint patterns frequency of right hand in male population was compared with right hand of female population the results were found to be significant (p=0.046), which is less than 0.05.

Table-6: Comparison of frequency of pattern types found in left hand of males with left hand of females

Sr. No.	Pattern type	Males	Percentage	female	Percentage
1	Arch	21	4.07	26	5.36
2	Loop	297	57.66	279	57.52
3	Whorl	114	22.13	110	22.68
4	Composite	83	16.11	70	14.43
		515		485	
Chi square			1.372		
P value			0.712		

Figure-5: Comparison of frequency of pattern types found in left hand of males with left hand of females

But when fingerprint patterns frequency of left hand in male population is compared with left hand of female population, the differences were found to be non-significant as its p value is higher than 0.05 (P=0.072).

The pattern type results of Jat Sikh population were compared with other populations.The results shows that the trend of fingerprint pattern distribution was found to be similar to the Muslim population of Central India, South Indians, Medical Students of Gangtok, India, Rarhi Brahmins of Bengal and Danguria Tharu of Uttar Pradesh (India). In these populations, the loop pattern was found to be predominant as compared to whorl pattern but varies from Rengma Nagas population of Nagaland (India) and Dhimals population of North Bengal (Bengal), where whorl pattern found to be predominant than loop patterns (Table-1).

DISCUSSION

During the study, the frequencies of occurrence of fingerprint pattern types were determined. The frequency of different pattern types was found to be maximum for ulnar loops (51.51%), followed by whorls pattern (25.35%), central pocket loop (9.10 %), radial loop (5.95%), plain arch (3.30%), twinned loop (2.40%), lateral pocket loop (1.35%), and minimum of tented arch (0.90%). The results were evaluated statistically. The t-test results were statistically significant ($p < 0.05$) when applied to male population and the results were found to be statistically insignificant ($p > 0.05$) in case of female population of Jat Sikhs residing in Punjab.

Further when the frequency of pattern types of right hand of male population was compared with right hand of female population, the results were found to be statistically significant ($p < 0.05$) and but when the frequency of pattern types of left hand of male population were compared with left hand of female population, the results were found to be statistically insignificant ($p > 0.05$).

The results of finger pattern types Jat Sikh population were found to be similar to the Muslim population of Central India, South Indians, Medical Students of Gangtok, India, Rarhi Brahmins of Bengal and Danguria Tharu of Uttar Pradesh (India), the loop pattern dominant as compared to whorl pattern but varies from Rengma Nagas population of Nagaland (India) and Dhimals population of North Bengal (Bengal), where whorl pattern found to be dominant than loop patterns.

SUMMARY AND CONCLUSIONS

Fingerprint samples of Jat Sikh population from Punjab were taken and pattern types were identified to calculate the frequency of fingerprint pattern. The Ulnar loops were found to be dominant in Jat Sikh population of Punjab and accidental patterns were found to be least occurring. Patterns of left and

right hand of male population differs significantly but in case of female population it is found insignificant. Pattern of right hand of male population differs significantly from the right hand of female population whereas left hand does not differ significantly in male and female population. The frequency of fingerprint pattern types of Jat Sikh population were found to be similar to the Muslim population of Central India, South Indians, Medical Students of Gangtok, India, Rarhi Brahmins of Bengal and Danguria Tharu of Uttar Pradesh (India) and dissimilar to Rengma Nagas population of Nagaland (India) and Dhimals population of North Bengal (Bengal). More extensive studies should be conducted to generate data of different ethnic groups residing in Punjab so that more conclusive results can be drawn and used for identification of perpetrator of various crimes by the investigators.

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