

## Original Research Paper

# A Study of Fingerprint in Relation to Gender and Blood Group among Medical Students in Uttarakhand Region

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### Abstract

Finger print (dermatoglyphic) is considered as the best tool of identification. A total of 140 first year and second year MBBS students belonging to the age group 18- 25 year with known blood groups of Government Medical College, Haldwani were included in the study. An attempt has been made in the present work to analyze their correlation with gender and blood group of an individual. Loops were the most common (58.29%) fingerprint pattern while whorls were moderate (37.00%) and arches were the least common (4.71%). Males had a higher incidence of whorls and females had a higher incidence of loops. Loops are predominant in blood group A, B, AB and O in both Rh positive and Rh negative individuals except in 'A' positive blood group where whorls predominate slightly. Whorls were highest in A & AB positive blood group and loops were highest in O & B blood group. Arches were least in all blood groups. There is an association between distribution of fingerprint patterns, blood group and gender and thus prediction of gender and blood group of a person is possible based on his fingerprint pattern.

**Key Words:** Finger Print, Dermatoglyphic, Identification, Whorl, Loop, Arch, Blood Groups

### Introduction:

The various identification data used are fingerprints, handwriting, bite marks, DNA fingerprinting etc. Fingerprints are constant and individualistic and form the most reliable criteria for identification. Fingerprint is one of the oldest, reliable and mature biometric technologies and is considered one of the best, cheapest and legitimate proofs of identification. [1, 2]

Fingerprint patterns are genotypically determined and remain unchanged from birth till death. [3] Fingerprints collected at a crime scene can be used to identify suspects, victims and other persons who touched the surface.

Fingerprint scans can be used to validate electronic registration, cashless catering and library access especially in schools and colleges. The secretions in the fingerprints contain residues of various chemicals and their metabolites which can be detected and used for the Forensic purposes. [1]

Due to the immense potential of fingerprints as an effective method of identification an attempt has been made in the present work to analyse their correlation with gender and blood group of an individual.

This correlation between fingerprint pattern and these parameters may help in using fingerprints as an important aid in sex and blood group determination and vice versa, thus, enhancing the authenticity of finger-prints in detection of crime and criminals.

Dermatoglyphic is defined as the scientific study of epidermal ridges and their configuration on the volar aspect of the palmer and plantar regions. [4] The ridge pattern depends upon cornified layer of epidermis as well as dermal papillae.

The characteristic patterns of epidermal ridges are differentiated in their definitive forms during third and fourth month of foetal life. [5]. Faulds [6] mentioned that the pattern of these papillary ridges remain unchanged in an individual throughout life.

Herschel [7] used finger prints for personal identification in India. Galton [8] classified the types of finger prints depending upon their primary pattern as loops, whorl and arches. Cummins [4] found that the configurations of ridge pattern are determined partly by heredity and partly by accidental or environmental influence, which produce stress and tension in their growth during foetal life.

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DOR: 07.05.2013 DOA: 18.01.2014

Blood group system was discovered in 1901 by Karl Landsteiner. 19 major groups have been identified which vary in their frequency of distribution amongst various races of mankind. Clinically, only 'ABO' and 'Rhesus' groups are of major importance. 'ABO' system is further classified as A, B, AB, O blood group types according to presence of corresponding antigen in plasma. 'Rhesus' system is classified into 'Rh +ve' and 'Rh -ve' according to the presence or absence of 'D' antigen.

Hahne [9] in his study asserted that blood group O is associated with more loops and less whorls than blood group A. Herch [10] found high frequency of loops in blood group A.

Gowda and Rao [11] study in India on Gowda Saraswat Brahmin community of south Kannada district (Karnataka) reported high frequency of loops with moderate whorls and low arches in the individuals of A, B and O blood group. They also found significantly greater number of loops in Rh-Positive and whorls in Rh-negative subjects.

The objective of this study was to ascertain trends of finger prints in individuals with different ABO and Rh blood groups along with evaluation of relationship of finger prints pattern in ABO blood groups and in male female gender. Fingerprints pattern are classified into three patterns by Galton [8]-

1. Loops (60-65%)
2. Whorls (30-35%)
3. Arches (5%)

Apart from use of dermatoglyphic in predicting the diagnosis of genetic disorders, it is used in forensic science for criminal identification. The arrangement of skin ridges is never duplicated in two persons even in monozygotic twins; the similarities are closer among some individuals while in others the differences are marked.

### **Materials and Methods:**

This study was carried out over a period of six months among medical students of Govt Medical College, Haldwani. Total 140 students (65 male & 75 female) belonging to the age group 18- 25 year of batches 2010 and 2011 voluntarily participated in the study. Students with permanent scars on their fingers or thumbs, with any hand deformities due to injury, birth defect or disease, those having worn fingerprints, extra webbed or bandaged fingers were excluded from the study.

For taking dermatoglyphic, Ink Method suggested by Cummins [4] was used. Each subject was asked to wash his hands thoroughly with soap and water and dry them by using a

towel. He was then asked to press his fingertip on the stamp pad and then to the paper to transfer the fingerprint impression.

The same method was repeated for all the finger of both hands. In this way, the plain fingerprints of all the ten digits were taken separately on the respective blocks on the same sheet of paper. Care was taken to avoid sliding of fingers to prevent smudging of the print. After the fingerprints were acquired, details such as name, sex and age were noted.

The details of their blood group were noted. Each subject was assigned a serial number. The fingerprint patterns were studied with the help of a magnifying lens and were identified as: Loops, Whorls and Arches based on the appearance of ridge lines according to Henry's system of classification.

This system assigns each finger a number according to the order in which it is located in the hand, beginning with the right thumb as number one (1) and ending with the left little finger as number 10. The distribution of dermatoglyphic fingerprint patterns in both hands of individuals and its relationship with gender and different ABO and Rh blood groups was evaluated and analyzed statistically.

### **Observation and Result:**

A total of 140 subjects participated in the study out of which 65 were males and 75 were females. Majority of the subjects in the study belonged to blood group B (37.86%) followed by blood group O (28.57%), A (20%) and AB (13.57%) respectively.

Maximum subjects in the study were Rh positive, of which 39.06% belonged to blood group B, 28.13% belonged to blood group O, 18.75% subjects had blood group A while only 14.06% had blood group AB. Among Rh negative individuals, 33.33% belonged to blood group O and A, 25 % belonged to blood group B. 8.33% of the subjects showed blood group AB negative. (Table 1)

Fingerprint pattern analyses showed that, loops were the most common pattern in the study (58.29%), followed by whorls (37.00%) while arches were present in a smaller percentage (4.71%) of the study group. (Table 2) Frequency of loops was highest in both the Rh-positive and Rh-negative subjects of ABO blood groups except 'A' positive blood group where whorls predominate slightly.

Among the subject of different blood groups, blood group O (63.06% & 65.00%) and B (62.00% & 66.67%) showed highest loops and lowest in blood group 'A' (46.25%). Whorls showed highest frequency (47.08 %) in 'A'

positive and AB positive (47.22%) blood group. Lowest in blood group B and O (34.80%, 31.39%). Arches were highest in A, and O positive (7.08%, 5.56%) blood group. Lowest in B blood group (3.20%). (Table 3)

The middle, ring and little fingers of A, B and O blood group showed high frequency of loops i.e. Blood group A (l-24.63%, r-20.15%), blood group B ( m-23.94% , l- 23.03%) and blood group O ( m-24.90% , l- 22.45% ). While in AB blood group thumb, index middle and little finger show higher frequency of loops (21.05%).

Whorls were more in thumb and ring fingers in blood group 'A'( t-23.44 %), 'B'(t-27.87%, r-28.42%) and 'O'(t-27.82%, r-27.07%), AB (r-26.44). Index and middle fingers of all blood groups showed comparatively high frequency of arches then other fingers. Fingerprint distribution show that loops is highest among all digits and arches are rare. In comparison of Rt and Lt hand digits the digit pattern is same in both hands. (Table 4 & 5)

### **Discussion and Conclusion:**

Many criteria were used for the purpose of identification like race, sex, age, complexion, hair, scar, tattoo, footprint and occupation marks but fingerprint is found to be the most reliable.

The various classification systems used throughout the world are based on the pattern of friction ridges seen on pulp of terminal part of all the ten fingers. Single-finger files are kept only for a limited number of known criminals.

Consequently, for the most part, it is impossible to make identification from fingerprint files on the basis of a single print found at the scene of a crime.

These patterns fall into three general classes called arches, loops, and whorls. Arches are the simplest patterns and also the rarest.

Loops are formed by ridge lines that flow in from one side of the print, sweep up in the centre like a tented arch, and then curve back around and flow out or tend to flow out on the side from where they entered.

Loops are designated as being either radial or ulnar, depending on which side of the finger the lines enter. The loop is the most common of all the patterns.

The present study showed that there is an association between distribution of fingerprint patterns, blood group and gender. Majority of the subjects in the study belonged to blood group B, followed by blood group O, A and AB.

Majority of subjects were Rh positive than Rh negative. The general distribution pattern of the primary fingerprint was of the same order in individuals with A, B, AB and O

blood groups i.e. high frequency of loops, moderate of whorls and low of arches. This is in accordance with other studies. [12-14]

Eboh DEO [15] study of Aniomas and Urhobos population in Nigeria observed loop pattern to have the highest frequency, followed in order by whorl, then arch pattern. Similar findings were seen in Rh-positive and Rh-negative individuals except in blood group 'A' positive where whorls predominated slightly.

In our study highest percentage of loops showed in blood group O and B, and lowest in blood group 'A'. In the study of Mehta AA & Mehta AA [14] Percentage of loops was highest in O blood group and lowest in AB blood group. However, Kshirsagar SV et al [12] observed higher percentage of loops in B and AB blood groups respectively; while lower percentage in O blood group. In this study whorls showed highest frequency in 'A' and 'AB' positive blood group.

Lowest in blood group B and O, which is supported by the study of other authors [13, 14] but Contrary to the findings of Kshirsagar SV et al [12] who observed higher percentage of whorls in O blood group and lower percentage in AB blood group.

Sharma P R [16] found association between blood group type (ABO) and fingerprint pattern within cohorts, but not among different cohorts. In Northern cohort, about 10 % of the participants with blood group O were having whorls while a maximum of 19% were with blood group A in the west cohort. 21% participant of the blood group O had loops In Northern cohort.

Our study is also of northern region and shows that blood group B and O had a higher frequency of loops in comparison to whorl.

Arches were highest in A, B and O positive blood group. Lowest in AB blood group in our study group similar to study of Bharadwaja A et al [13].

Contrary to findings of Mehta AA & Mehta AA [14] study in which percentage of arches in AB blood group was highest and lowest in B blood group which correlates with the finding of Kshirsagar SV et al [12] of lowest percentage of arches in B blood group. On the basis of gender in our study frequency of loops was found to be higher in females than in males whereas whorls were more frequent in males as compared to females.

Arches were present more in females than in males. This is supported by the study of various other authors. [15, 17-19]

On the basis of the pattern of digits the middle, ring and little fingers of A, B and O blood group showed high frequency of loops. While in

'AB' blood group thumb and index finger also shows higher frequency of loop. Whorls were more in thumb and ring fingers in all blood groups. Index and middle fingers of all blood groups showed comparatively high frequency of arches correlated with other studies. [13, 21]

According to Nayak SK. & Patel S [22] commonest occurrence of loop happens to be in finger V and III. The highest percentage of whorls occurred in I and II fingers of AB blood group whereas in IV fingers of all other blood groups. We can conclude that Finger print distribution show loops is highest among all digits after that whorl is common and arches are rare. In comparison of Rt and Lt hand digits the digit pattern is same in both hands. There is also an association is found between distribution of fingerprint patterns, blood group and gender.

Thus prediction of gender and blood group of a person is possible based on his fingerprint pattern.

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**Table 1: Blood Group According to Rh factor**

Rh factor	Blood Group				Total (%)
	A (%)	B (%)	AB (%)	O (%)	
Rh +ve	24(18.6)	50(39.1)	18(14.1)	36(28.1)	128(91.4)
Rh -ve	4(33.3)	3(25.0)	1(8.3)	4(33.3)	12(8.6)
Total	28(20)	53(37.9)	19(13.6)	40(28.6)	140(100)

**Table 2: Fingerprint Pattern According to Gender**

Pattern (%)	Gender	
	Male (65)	Female (75)
Loop (58.29)	342 (52.62%)	484(64.53%)
Whorl (37.0)	280 (43.08%)	229(30.53%)
Arch (4.71)	28 (4.31%)	37(4.93%)

**Table 3  
Pattern of Fingerprints among A, B, AB, O and Rh Blood Groups**

Type of Finger Print (%)	Blood Group and Digit							
	A(28) & Digit (280)		B(53) & Digit (530)		AB (19) & Digit (190)		O (40) & Digit (400)	
	Rh +ve(24)	Rh -ve(4)	Rh +ve(50)	Rh -ve(3)	Rh +ve(18)	Rh -ve(1)	Rh +ve(36)	Rh -ve(4)
Loops	111(46.3)	23(57.5)	310(62.0)	20(66.7)	87(48.3)	8(80.0)	227(63.1)	26(65.0)
Whorls	113(47.1)	15(37.5)	174(34.8)	9(30.0)	85(47.2)	2(20.0)	113(31.4)	12(30.0)
Arches	17(7.1)	1(2.5)	16(3.2)	1(3.3)	8(4.4)	0(0)	20(5.6)	2(5.0)

**Table 4**  
**Fingerprint Pattern according to Digits among A, B, AB & O Blood Groups**

Individual Finger	Blood groups											
	A (28)			B (53)			AB (19)			O (40)		
	L	W	A	L	W	A	L	W	A	L	W	A
Thumb (t)	24 (17.9)	30 (23.4)	2 (11.1)	54 (16.4)	51 (27.9)	1 (5.9)	20 (21.1)	17 (19.5)	1 (12.5)	42 (17.1)	37 (27.8)	1 (4.6)
Index (i)	26 (19.4)	26 (20.3)	4 (22.2)	68 (20.6)	28 (15.3)	10 (58.8)	20 (21.1)	15 (17.2)	3 (37.5)	46 (18.8)	25 (18.8)	9 (40.9)
Middle (m)	24 (17.9)	25 (19.5)	7 (38.9)	79 (23.9)	22 (12.0)	5 (29.4)	20 (21.1)	15 (17.2)	3 (37.5)	61 (24.9)	13 (9.8)	6 (27.3)
Ring (r)	27 (20.2)	27 (21.1)	2 (11.1)	53 (16.1)	52 (28.4)	1 (5.9)	15 (15.8)	23 (26.4)	0 (0.0)	41 (16.7)	36 (27.1)	3 (13.6)
Little (l)	33 (24.6)	20 (15.6)	3 (16.7)	76 (23.0)	30 (16.4)	0 (0.0)	20 (21.1)	17 (19.5)	1 (12.5)	55 (22.5)	22 (16.5)	3 (13.6)
Total	134 (47.9)	128 (45.7)	18 (6.43)	330 (62.2)	183 (34.5)	17 (3.2)	95 (50)	87 (45.8)	8 (4.2)	245 (61.2)	133 (33.2)	22 (5.5)

**Table 5**  
**Frequency Distribution of Digital Patterns**

Patterns (%)	RIGHT HAND DIGITS					LEFT HAND DIGITS				
	RI(140)	RII(140)	RIII(140)	RIV(140)	RV(140)	LI(140)	LII(140)	LIII(140)	LIV(140)	LV(140)
loop (L)	74 (52.9)	83 (59.2)	94 (67.1)	70 (50.0)	94 (67.1)	74 (52.9)	77 (55.0)	90 (64.3)	70 (50.0)	90 (64.3)
Whorl (W)	62 (44.3)	46 (32.9)	38 (27.1)	66 (47.1)	43 (30.7)	65 (46.4)	48 (34.3)	37 (26.4)	67 (47.9)	46 (32.9)
Arch (A)	4 (2.9)	11 (7.9)	8 (5.7)	4 (2.9)	3 (2.1)	1 (0.7)	15 (10.7)	13 (9.3)	03 (2.1)	04 (2.9)