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Assessment of Dermatoglyphic Pattern in Relation with Blood Group: A Cross-Sectional Study

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Abstract

Objectives: The study was contemplated to ascertain the trends of dermatoglyphic pattern in individuals with different ABO and Rh blood groups and to evaluate the relationship between the pattern of fingerprints and blood groups. *Methodology:* The study was carried out in the Department of Forensic Medicine at Government Medical College of southern Haryana. Medical students of the age group 18–24 years knowing their blood group and considering their accessibility to the department of Forensic Medicine were randomly selected for the study. Plain and rolled fingerprints for all digits of both hands were taken with ink pad on non-glazed paper. *Results:* The study revealed that loop was most frequently seen fingerprint followed by whorl, arch and composite. B positive is the most common blood group, and loops pattern of the fingerprint is predominant in all blood groups and Rh-positive and negative subjects, followed by whorls. *Conclusion:* Each fingerprint is unique; hence, it can be effectively used for corroborative identification of an individual in mass disasters as well as in other forensic applications. More studies with larger sample size should be conducted to enhance the reliability of correlation of dactylographic pattern with sex and blood group.

Keywords: Fingerprint; Dactylography; Dermatoglyphics; ABO blood group; Identification

Introduction

Dermatoglyphics (fingerprint/dactylography) is defined as the scientific study of natural occurring epidermal ridges and their configuration on the volar region of digits, palms, and soles apart from flexion crease and secondary folds. It is derived from the Greek word "Derma meaning Skin, Glyphe meaning Carve." The Anatomist Harold Cummins in 1926 observed that the sole and foot have some ridge designs which are determined by heredity and accidental or environmental influence during intrauterine life and then term dermatoglyphics was first established.[1] The development of fingerprint start developing from 12th to 16th week of intrauterine life and accomplished by 20th week of intrauterine life.[2] Fingerprint pattern is persistent and distinctive even in monozygotic twins from birth till death. Therefore, it is one of the valuable and inimitable personal identification tools of a human being.[3,4] They are supportive in medicolegal cases for recognition of suspect or victims in solving criminal cases. Fingerprint scans also used in the digital mission of India, biometric, validate electronic registration, cashless, library access, and forensic purpose.[5]

Sir Francis Galton was the first to publish a book called Fingerprint in 1892 and categorise dermatoglyphic primary pattern as loop (60–65%), whorl (30–35%), and arches (5%).[6] Loop is of two types: ulnar or radial. It is such a prototype in

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which one or more ridges enter from either-side, re-curve, touch or pass an imaginary line between delta and core, and pass out upon the same side as the ridges entered. A typical concentric design characterises the whorl. The majority of ridges incline to make a consummate circuit around the core, a pivotal feature in the interior of the pattern. The arches are the simplest of all. They are described as patterns in which ridges enter from one side, elevate or curve at the centre and flow out from the opposite side.[7]

Karl Landsteiner, an Austrian physician, revealed Blood group system in 1901.[8] Amongst varied races of human, several blood group systems are recognized till date. Clinically, only "ABO" and "Rhesus" groups are of key significance. "ABO" system is further classified as "A", "B", "AB" and "O" blood groups according to the presence of the corresponding antigen in plasma. "Rhesus" system is categorized into "Rh +ve" and "Rh−ve" accord to the presence or absence of "D" antigen.[9] The inheritance of dermatoglyphic patterns and ABO blood group is polygenic.[10] Bernstein revealed the exact manner of inheritance of the ABO blood group.[11] The study was contemplated with an objective to ascertain the trends of dermatoglyphic pattern in individuals with different ABO and Rh blood groups and to evaluate the relationship between the pattern of fingerprints and blood groups.

Materials and Methods

The study was carried out in the Department of Forensic Medicine at Government Medical College of southern Haryana. Medical students of the age group 18–24 years knowing their blood group and considering their accessibility to the department of Forensic Medicine were randomly selected for the study. Their fingerprints were obtained and studied after taking their informed oral consent.

Inclusion criteria

Participants with known blood group.

Exclusion criteria

Participants with permanent scars, lesion, cuts, bandaged fingers.

Subjects with hand deformity due to injury, congenital defect or disease.

Collection of the fingerprints

Before taking fingerprints, the hands were subjected to thorough washing with soap water and allowed complete drying. The subjects were then asked to press their fingertips on the camel ink pad and then to the plain non-glazed paper to transfer the fingerprint impression. Both rolled, and plane prints of each finger of right and left hand were taken. The same method was followed for all the participants. The necessary details, such as name, age and sex along with blood group, were also noted down.

Assessment of the fingerprints

The pattern of fingerprints was analyzed by using a powerful magnifying hand lens. The fingerprint patterns were identified as loop, whorls, arches and composite based on the appearance of the ridgelines with the help of a magnifying lens. In order to classify the finger-prints, the classification scheme proposed by Galton was used depending upon their primary pattern. The pattern of fingerprints was assessed by two observers separately to remove any observer bias.

The data obtained were evaluated and incorporated on Microsoft Excel sheet, and descriptive analysis in terms of percentage was carried out.

Results

Among 164 students who took part in the study, 133 (81.1%) were male, and 31 (18.9%) were female.

Table 1 shows the distribution of blood groups according to gender. Majority of subjects belonged to blood groups B (36%) followed by A, AB and O. Blood group B was predominantly found in males

Table 1: Distribution of sex and blood groups

Blood group	Sex		Total
	Male	Female	
A	34 (82.9%)	7 (17.1%)	41 (25%)
B	46 (77.9%)	13 (22.1%)	59 (36%)
O	29 (93.5%)	2 (6.5%)	31 (19%)
AB	24 (72.7%)	9 (27.3%)	33 (20%)
Total	133 (81.1%)	31 (18.9%)	164

and females, but in males, B>A>O>AB and females B>AB>A>O was the order of frequency.

Table 2 shows the distribution of subjects according to Rh factors. Among 164 subjects, 155 (94.5%) belong to Rh positive whereas 9 (5.5%) were Rh negative. Out of 155 Rh positive subjects, majority belonged to blood group B followed by A, AB and blood group O.

Table 3 shows the distribution of fingerprint patterns among both the genders. The total number of loops found in all the digits was 920 (57%). Similarly, whorls in all the digits of both the hands were 430 (26.7%), and the number of arches was 256 (15.9%). Frequency of loops, whorls and composite were found to be higher in males.

Table 4 shows the distribution of fingerprint patterns of all the fingers digits in both the hands. Loops were of high frequency on the little finger (71%), whorls on the ring finger (45.4%) and arches were of high frequency on the thumb (24.7%).

Table 5 shows the distribution of fingerprint patterns among Rh factor in all the fingers. Loops were seen in higher frequency in both Rh positive and negative blood group.

Table 6 shows the distribution of fingerprint patterns among ABO blood groups in the entire fingers. Blood group B^{+}ve showed more loops, whorls, arches and composite.

Table 2: Distribution of Rh factor

Rh factor	Blood group				Total
	A	B	O	AB	
Rh positive	38 (24.5%)	58 (37.4%)	28 (18.1%)	31 (20%)	155 (94.5%)
Rh negative	3 (33.3%)	1 (11.1%)	3 (33.3%)	2 (22.3%)	9 (5.5%)

Table 3: Fingerprint pattern sexwise

Fingerprint pattern	Male	Female	Total
Loop	762 (58.2%)	158 (52.1%)	920 (57%)
Whorl	356 (27.2%)	74 (24.4%)	430 (26.7%)
Arches	185 (14.1%)	71 (23.4%)	256 (15.9%)
Composite	7 (0.5%)	0	7 (0.4%)

Table 4: Fingerprint pattern viz-a-viz digits

Finger print pattern	Thumb	Index finger	Middle finger	Ring finger	Little finger
Loop	168 (51.2%)	165 (50.3%)	206 (62.8%)	148 (45.1%)	233 (71%)
Whorl	79 (24.1%)	90 (27.4%)	63 (19.2%)	149 (45.4%)	49 (14.9%)
Arches	81 (24.7%)	70 (21.3%)	59 (18%)	30 (9.1%)	43 (13.1%)
Composite	0	3 (0.9%)	0	1 (0.4%)	3 (0.9%)

Table 5: Fingerprint pattern in Rh factor

	Loop	Whorl	Arches	Composite
Rh positive	859 (55.7%)	409 (26.5%)	275 (17.8%)	6 (0.4%)
Rh negative	61 (62.3%)	21 (21.6%)	12 (12.4%)	3 (3.7%)

Table 6: Fingerprint pattern in different blood groups

Blood group	Loop	Whorl	Arches	Composite
A+ve	206 (22.4%)	94 (21.4%)	78 (27.6%)	2 (28.6%)
A-ve	23 (2.5%)	3 (0.7%)	4 (1.4%)	0
B+ve	310 (33.7%)	138 (31.4%)	128 (45.2%)	3 (42.8%)
B-ve	0	10 (2.3%)	0	0
AB+ve	177 (19.2%)	99 (22.5%)	34 (12%)	0
AB-ve	13 (1.4%)	5 (1.1%)	2 (0.7%)	0
O+ve	166 (18%)	88 (20%)	35 (12.4%)	2 (28.6%)
O-ve	25 (2.7%)	3 (0.7%)	2 (0.7%)	0

Table 7: Summary table of comparative studies of dermatoglyphic in relation to ABO Blood Group

Studied by	Year	Loops		Whorls		Arches	
		Highest	Lowest	Highest	Lowest	Highest	Lowest
Kshirsagar et al.[18]	2003	B	O	O	AB	AB	B
Bhardwaja et al.[13]	2004	A	O	AB	A	B	AB
Rastogi & Pillai[14]	2010	A	–	O	–	O	–
Mehta & Mehta[19]	2011	O	AB	B	O	AB	B
Deopa et al.[12]	2014	O	A	AB	B	A	AB
Singh et al.[15]	2016	B	AB	O	AB	AB	O
Hamid S et al.[17]	2016	B	AB	B	AB	B	AB
Shivhare et al.[16]	2017	B	AB	A	B	AB	B
Current study	2019	B	AB	B	O	B	AB

Discussion

The present study concluded that the majority of subjects belonged to blood groups B (36%) followed by A, AB and O. Blood group B was predominantly found in males and females but in males B>A>O>AB and in females B>AB>A>O was the order of frequency. Similar observations were made by Bhavna et al.[2] and Deopa et al.[12], who concluded in their study that the majority of the subjects belonged to the blood group B in both males and females. In contrast, Bhardwaja et al.[13] and Rastogi and Pillai[14] in their study observed majority of cases belonged to blood group O; followed by blood group B, A and AB.

The present study revealed that among 164 subjects, 155 (94.5%) belong to Rh positive, whereas 9 (5.5%) were Rh negative. Out of 155 Rh-positive subjects, the majority belonged to blood group B followed by A, AB and blood group O. Bhavna et al. in their study observed that out of 200 subjects, the majority (190) belonged to Rh +. Out of 190 Rh+ subjects majority of the subjects, 35% belonged to blood group B, 34% belonged to O, 19.5% belonged to A and only 6.5% belonged to blood group AB.[2] Bhardwaja et al. concluded 95.67% cases were Rh-positive in their study, of which 36.0% each belonged to blood group B and O, and 15.67% cases had A blood group.[13] Rastogi and Pillai also concluded that maximum (96%) subjects in the study were Rh-positive, of which 34.5% belonged to blood group O, 30.5% belonged to blood group B, 26.5% subjects had blood group A while only 4.5% had blood group AB.[14] Deopa et al. concluded that out of maximum number of Rh-positive cases, 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.[12]

The present study revealed that the number of loops found in all the digits was 920 (57%). Similarly, whorls in all the digits of both the hands were 430 (26.7%), and the number of arches were 256 (15.9%) which is consistent with study results of Bhavna et al.[2] who observed loops 58.9%, whorls 29.6% and arches 11.5% in all the digits. Kanchan and Chattopadhyay[4], Deopa et al.[12], Bhardwaj et al.[13], Rastogi and Pillai[14], Singh et al.[15] and Shivhare et al.[16] in their respective studies also observed that loops were the most common pattern followed by whorls and arches in both hands among males and females. It signifies that loops govern the chart followed by whorls and arches.

The current study indicates that loops were of high frequency on the little finger (71%), whorls on the ring finger (45.4%) and arches were of high frequency on the thumb (24.7%). Our study results were some what consistent with the study conducted by Kanchan and Chattopadhyay[4] who concluded that loop pattern was most often found in the little finger (77.7%) followed by middle finger (73.7%) and index finger (49.1 %). Frequency of whorls was maximum on the ring finger (55%) followed by thumb (53.6%) and index finger (38.2%). Contrary to this, Hamid et al. observed that loops were of high frequency on the middle finger, whorls on the thumb, index finger and ring finger, arches on the middle finger, thumb and index finger.[17]

In the current study, the distribution of fingerprint patterns among ABO blood groups in all the fingers depicts that B+ve blood group showed more loops, whorls, arches and composite.However, the results are comparable with the studies conducted by various authors, while few studies differ in this. Table 7 depicts the various comparative studies of dermatoglyphic in relation to ABO Blood Group.

This study revealed that loops are the most commonly occurring fingerprint pattern followed by whorls and arches while composite is the least common fingerprint pattern. Blood group B is the most common blood group in both males and females. Loops are predominant in blood group B

+ve followed by A+ve. Whorls and arches are also most commonly found in B+ve individuals. Thus the prediction of blood group of a person is possible based on his fingerprint pattern.

Limitation of the Study

Small sample size and unequal sex distribution were the main limitations of this study. Similar studies should be conducted on a larger sample to predict the more accurate correlation of dermatoglyphic pattern with sex and ABO blood group.

Conclusion

Each fingerprint is unique; hence, it can be effectively used for corroborative identification of an individual in mass disasters as well as in other forensic applications. Also, retrieving the fingerprints and examination of dactylography pattern is economical, less time consuming and non-invasive, more studies with large sample size should be conducted to enhance the reliability of correlation of dactylographic pattern with sex and blood group.

Key message: Each fingerprint is unique; hence, it can be effectively used for corroborative identification of an individual in mass disasters as well as in other forensic applications.

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