Original Article

Study of Fingerprint Patterns in Relation to Gender and ABO Blood Groups

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Abstract

Fingerprints are considered as the best tool of identification of a person. Fingerprint evidence is by far the most effective and reliable evidence in the court of law. The reason being fingerprint pattern persist same throughout the life and no two individual has similar pattern. Both blood group and dermatoglyphic pattern have genetic inheritance so an attempt has been made to analyze their correlation with gender and blood group of an individual. The objective of the study was to determine correlation (if any) between the fingerprint pattern, blood group and gender. The study was conducted on 150 students (88 males and 62 females) in the age group of 18-25 years. The fingerprint pattern of the study participants was compared with the gender and ABO-Rh blood group after taking their Informed written consent. Amongst ABO blood group, the most common blood group was O (40%), followed by B (35.33%), A (19.33%) and AB (5.34%). Rh + ve was the most common rhesus factor (97.33%). The loop was the most common pattern (69.14%), followed by whorl (26.06%) and arch (4.80%). Frequency of loops were highest in both the Rh-positive and Rh- negative subjects of ABO blood groups except O -ve blood group where whorls dominate. Loops are maximum seen in blood group B while whorls are more common in blood group O and arches with blood group A. The present study confirms that loop is the most common type of fingerprint pattern while arch was the least common. The study revealed significant association between the Fingerprint pattern, Gender and ABO blood group.

Keywords: Fingerprint pattern, ABO blood group, Gender, Identification

Introduction

After decades of scientific research, the hand has come to be recognized as a powerful tool in the diagnosis of psychological, medical, and genetic conditions. The term dermatoglyphics was coined by Harold Cummins in 1926, which is used for the studies of epidermal ridges on the non-hairy part of palm, fingers, toes, and soles. He found that the configurations of ridge patterns are determined partly by heredity and partly by accidental or environmental influence, which produce stress and tension in their growth during fetal life. It has been accepted and adopted internationally.[1]

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Identification means fixation of individuality of a person. Fingerprint patterns have been normally used for identification of an individual. A fingerprint is an impression of the friction ridges of all or any part of the finger. A friction ridge is a raised portion of the epidermis on digits or on the palmar and plantar skin. These ridges are also referred to as 'dermal ridges' or 'dermal papillae'. Now a day's every organization either Private or Government institutes in India, uses fingerprint verification to identify everyone uniquely and it also have been used as a biometric modality. An individual is their own key; behind this catchy principle biometrics have become an attractive alternative to traditional identification methods such as tokens or passwords.[2]

Primary ridge development occurs along the basement membrane and becomes visible in histological foetal preparations between 12–16 weeks of embryonic development and their formation gets completed by the 24th week, i.e. about the 6th foetal month.[1]

The ridges thus formed during the foetal period do not change their course or alignment throughout the life of an individual until destroyed by decomposition of the skin after death. Fingerprint is one of the most interesting, reliable and unique feature of human body. No two fingerprints are exactly alike.[3]

Fingerprints follow the Locard's principle of exchange. The secretions in the fingerprints contain residues of various chemicals and their metabolites, which can be detected and used for forensic purposes.[4]

The blood group system was discovered way back in 1901 by KarlLandsteiner. Till date, 19 major groups have been identified which vary in their frequency of distribution amongst various races

Ofmankind. Clinically, only 'ABO' and 'Rhesus' groups are of major importance.

'ABO' system is further classified as A, B,AB and O blood group types on the basis of corresponding antigen in plasma. 'Rhesus' system is classified into 'Rh+ve' and 'Rh–ve' according to the presence or absence of 'D' antigen.[5]

Due to the immense potential of fingerprints as an effective method of identification an attempt has been made in the present study to analyze 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 gender and blood group determination and vice versa, thus, enhancing the authenticity of fingerprints in detection of crime and criminals by restricting the field of searching and narrowing the line of investigation.

Aims and Objectives

The present study was conducted with the following aims and objectives.

1. To determine the predominant fingerprint patterns among medical students of Pacific Institute of Medical sciences, Udaipur.
2. To determine any pattern co relation with gender and blood group.

Material and Method

After obtaining clearance from the institutional ethics committee, this prospective study was carried out over a period of three months among medical students of Pacific Institute of Medical sciences, Udaipur. Total 150 students (88 male &62 female) belonging to the age group 18- 25 years, 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 likeleprosy, burns, laceration, amputation, surgical scar, those having worn fingerprints, extra, webbed or bandaged fingers, were excluded from the study. Informed written consent was obtained prior to taking the fingerprints with proper procedure explained to the subjects.

The methodology involved using the Glass slab Inking Roller method for collection of fingerprints. Each subject was asked to wash his hands thoroughly with soap and water and dry them using a towel. 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 fingers 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 from their college identity cards. 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, Arches and Composite 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 and ending with the left little finger as number 10. The distribution of dermatoglyphic fingertip patterns in both hands of individuals and its relationship with gender and different ABO and Rh blood groups was evaluated and analyzed statistically.

Results

A total of 150 subjects participated in the study out of which 88 were males and 62 were females. Majority of the subjects, 60 (40.0%), in the study belonged to blood group O, followed by blood group B, A and AB which were 53 (35.33%), 29 (19.33%) and 8 (5.34%) respectively. While blood group O were found to be the most common and least AB among both male and female. (Table No. 1)

Maximum 146 (97.33%) subjects in the study were Rh positive, of which 58 (38.66%) belonged to blood group O, 51(34.0%) belonged to blood group B, 29 (19.34%) subjects had blood group A, while only 8 (5.33%) had blood group AB. Among Rh negative individuals, 2 (1.34%) belonged to blood group O and 2(1.33%) belonged to blood group B. None of the subjects showed blood group A and AB negative. (Table No. 2)

Fingerprint pattern analyses showed that, loops were the most common pattern in the study 1037(69.14%), followed by whorls 391(26.06%), while arches were present in a smaller percentage (4.80%) of the study group. (Table No. 3)

Frequency of loops was found to be higher in males (46.8%) than in females (22.34%) whereas whorls were more frequent in females (18.26%) as compared to males (7.8%). 4.06% of arches were present in males and 0.74% in females. (Table No. 4)

Frequency of loops were highest in both the Rh-positive and Rh- negative subjects of ABO blood groups except O -ve blood group where whorls dominate. Incidence of loops varied between 30% (in "O" negatives) to 80% (in "B" negatives). Among the subject of different blood groups, blood group B –ve and O+ve showed highest loop 80% and 72.93%respectively. Whorls showed moderate frequency ranging between 23.10% (in "O" positives) to 70% (in "O" negatives). Arches were least common ranging from 3.92% (in "B" positives) to 7.93% (in "A" positives). (Table No. 5)

Table 1: Distribution of blood groups according to gender

Blood group	Male	Female	Total
A	18 (12.00%)	11 (7.33%)	29 (19.33%)
B	30 (20.00%)	23 (15.33%)	53 (35.33%)
AB	05 (3.34%)	03 (2.00%)	08 (5.34%)
O	35 (23.34%)	25 (16.66%)	60 (40.00%)
Total	88 (58.67%)	62 (41.33%)	150 (100.00%)

Table 2: Distribution of subject according to RH factor of their blood group

Blood group	RH Positive	RH Negative	Total
A	29 (19.34%)	00	29 (19.34%)
B	51 (34.00%)	02 (1.33%)	53 (35.33%)
AB	8 (5.33%)	00	08 (5.33%)
O	58 (38.66%)	02 (1.34%)	60 (40.00%)
Total	146 (97.33%)	04 (2.67%)	150 (100.00)

Table 3: Distribution of primary fingerprint patterns (n = 1500)

Fingerprint pattern	Total No.	Percentage
Loops	1037	69.14%
Whorls	391	26.06%
Arches	72	4.80%
Total	1500	100%

Table 4: Distribution of fingerprint patterns according to gender(n = 1500)

Fingerprint pattern	Male	Female
Loops	702 (46.8%)	335 (22.34%)
Whorls	117 (7.8%)	274 (18.26%)
Arches	61(4.06%)	11 (0.74%)
Total	880	620
Chi-square test	188.235	
P - value	< 0.0001	
Statistical significant at 5% level	Significant	

Table 5: Distribution of fingerprint patterns among different blood groups with RH factor (n = 1500)

Fingerprint pattern	Blood Group							
	A (+ve)	A (-ve)	B (+ve)	B (-ve)	AB (+ve)	AB (-ve)	O (+ve)	O (-ve)
Loops	181 (62.41%)	0	364 (71.37%)	16 (80%)	47 (58.75%)	0	423 (72.93%)	6 (30.00%)
Whorls	86 (29.65%)	0	126 (24.70%)	4 (35.00%)	27 (33.75%)	0	134 (23.10%)	14 (70.00%)
Arches	23 (7.93%)	0	20 (3.92%)	0	6 (7.50%)	0	23 (3.96%)	0
Chi-square test	17.778							
P - value	< 0.005							
Statistical significant at 5% level	Significant							

Discussion

Fingerprints are the friction ridge impressions of pattern formed by papillary or epidermal ridges of terminal part of the finger. The first ever work for dermatoglyphics was done somewhat around 3000 years back when Chinese used fingerprints to sign legal documents.

Herschel used fingerprints for personal identification in India as a sign in contracts.

The advantages of using fingerprint patterns as a means of identification is that it can be filed and saved and retrieved when needed. The system of classification which is in use even today is a modification of system proposed by Sir Francis Galton and was modified by Sir Edward Henry. The classification is known as Henry Galton method or Henry's system of classification. This system of classification is most efficient and is in almost universal use. The four basic fingerprint patterns, which are used in this study are loops (65-67%), whorls (25-30%), arches (6-7%) and composites (3-4%). Composite pattern is the rarest. A loop is that type of fingerprint pattern in which one or more of

the ridges enter on either side of the impression, re-curve, touch or pass an imaginary line drawn from the delta to core and terminates or tends to terminate on or towards the same side of the impression from where ridge or ridges enter.

A loop has one and only one delta. Loops are subdivided into two main types - radial loop and ulnar loop according to their positioning and the flow of the ridges. Radial loop is so called because the ridges flow or terminate in the direction of radius bone of the forearm. Ulnar loop is so called because the ridges flow or terminate in the direction of ulnar bone of the forearm.

A whorl is characterised by a circular pattern having one or more ridges revolve around the core making a complete circle. The whorl is that type of pattern in which at least two deltas are present with a recurve in front of each. The subdivision of whorl pattern is as follows 1. Plain Whorl 2. Central Pocket Loop 3. Double Loop i. Lateral Pocket Loop ii. Twinned Loop 4. Accidentals.[6]

Arches can be classified into plain arch and tented arch. Plain arch is made up of ridges lying one above the other. Tented arch consists of one up thrusting ridge, which tends to bisect superior ridges at right angles.

Composites are the complex patterns usually composed of different configurations in one pattern, such as tented arch and loop or loop and whorl etc. or any other such combinations, which do not fit appropriately in the basic pattern types.

This study was an approach to associate finger prints, blood groups and gender.

In our study, we observed that maximum participants, irrespective of gender belonged to blood group O followed by B, A and AB which is consistent with other study.[7] Among Rhesus positive groups, AB+ was the least common type and this is also supported by others.[8-10]

In our study, males and females had higher percentage of loops followed by whorls and arches. Loops were more in males and whorls were more in females and Arches more in males, which is consistent with other studies.[11]whereas loops were more in females, whorls were more in males and arches were more in females in other studies.[12- 14]

The distribution of the fingerprint pattern in different ABO blood groups [A, B, AB and O] and in Rhesus blood groups revealed that the Loop had the highest percentage, followed by whorls and the arches. It means that irrespective of the blood group, loop was the commonest fingerprint pattern followed by whorls and arches. Similar findings were observed by previous researchers.[4,11-13,15-17]

The distribution of fingerprint patterns in individuals with the ABO-Rhesus blood groups was the same for A +ve, B +ve, B -ve, AB +ve and O +ve where loop was the commonest except O -ve where whorls dominate, followed by whorls and the least were arches. These findings more or less similar to other studies.[12,13,15,18,19]

This study revealed statistical significant association between fingerprint pattern and ABO blood group. This was in conformity with similar earlier studies done by various researchers.[4,12,17]But this finding did not match with observations of Kshirsagar et al, Dennis Eboh and Odokuma et al, who did not find any association between fingerprint patterns and ABO blood groups.[13,14,18]

Conclusion

The present study has identified loop as the most common type of fingerprint pattern. The study has also revealed a significant association between fingerprint pattern, gender and ABO blood group. The result of this study is significant as it will be helpful for investigators while investigating the crime.

The following findings were obtained.

- Each fingerprint is unique hence it can be very effectively used as an evidence for identification in the court of law.
- Loops are the most commonly occurring fingerprint pattern and Arches are the least common.
- Blood group O positive is the most common and A&AB negative is the rarest.
- Loops are predominant in blood group A, B, AB and O in both Rh positive and Rh negative individuals except in O negative where whorls are more common.

- Whorls are more common in blood group O negative.
- Loops are maximum seen in blood group B while whorls are more common in blood group O and arches with blood group A.
- ALL the blood groups were found to be the most common among males than females.
- Males have a higher incidence of loops and females have a higher incidence of whorls.

Thus prediction of gender and blood group of a person is possible based on his fingerprint pattern. At the same time, It is suggested to carry similar studies in future to increase the accuracy of association between the fingerprint pattern, gender and blood group on a large sample.

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