

Comparison between ABO Blood Group and Fingerprint Patterns

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Abstract: Fingerprints are one of the most effective and reliable pieces of evidence found at the crime scene. The major source of identification of fingerprints is their unique pattern and characteristics left behind by the ridges. The study aims to correlate fingerprint patterns with the blood group of subjects.

We had conducted a study on 134 individuals out of which 58 were male and 76 female subjects with different ABO blood groups. This study was carried out in Srinivas University Campus, Mukka, Mangalore. The samples of all 10 fingers of the subject's fingerprints were collected with the help of an inkless fingerprint pad and imprinting the fingerprint across a fingerprint recording slip. The fingerprint patterns were divided according to the sub-classification of four main classifications of fingerprints i.e, Arches, Whorls, Loops, and Composites.

The study indicated that the most common fingerprint pattern found among respondents was Ulnar Loop and the blood group was 'O' and a significant relationship between blood group "B" and Plain arch pattern were found. Twinned loop pattern amongst the respondents belong to blood group "O" was more frequent compared to rest of the fingerprint patterns

Keywords: fingerprint; friction ridges; latent prints

I. INTRODUCTION

A fingerprint is not a modern science it is one of the oldest techniques used in the identification and authentication of documentation. Fingerprints and palm prints were used to demonstrate the individuality of their work. Though the fact that "fingerprints are unique" was not known to them, they used fingerprints as signatures. Following Locard's Principle of exchange which states there is always an exchange of material whenever two objects come in contact with each other, a fingerprint becomes one of the most common pieces of evidence that needs to be searched at the crime scene. Fingerprints are not just the common evidence but are also considered the best evidence because of their uniqueness, reliability, permanence, and universality. They also have the advantage over DNA analysis, where DNA fails in the case of monozygotic twins whereas fingerprints are unique to each individual. They are famously termed as 'Burglars visiting card' or 'Chance Prints' as they are left by chance in the crime scene by the offenders.

Our palmer surface and sole of the foot have finely detailed friction ridges which are meant to provide grip and helps to grasp surfaces firmly, and the creases help the skin to flex¹. These friction ridges which are present on the tip of the finger is known as a fingerprint. At around 10.5 weeks of EGA localized cellular proliferations grow together to form what we call the ridge². The friction ridges run from one end to the other end of our fingers and palms creating a unique pattern among every individual. These friction ridges make the raised and grooved part of our fingers which helps in the formation of patterns of the fingerprints. Ridges start to develop during the embryonic stage of the twelfth to sixteenth week and form completely by the fourteenth week i.e. regarding the sixth vertebrate month³. Fingerprints once formed during the embryonic development stage do not change or modify until the death of that individual. They only get enhanced as the fetus grows.

Fingerprints in the crime scene can be recovered in the form of latent, patent, and plastic prints. Latent fingerprints are the best type of fingerprints to be searched for at the crime scene. The only appendage of friction ridge of the skin is the eccrine sweat gland which acts in group. Eccrine sweat glands are the simple tubular glands where its ducts open towards the surface of the skin⁴. It is the result of secretions from the fingerprints including a minute quantity of sweat, oil, organic and inorganic materials such as albumin, fatty acids, salt, etc. The major part of these secretions is water, which constitutes 99- 99.5%⁵. The rest of the 1 to 0.5% constitutes sodium chloride, potassium, ammonia, urea, lactate, uric acid, creatinine and creatine, amino acids, sugars, immunoglobulin A, epidermal growth factor, and selected hormones, enzymes, and vitamins⁵. These secretions are the reason for leaving behind a latent fingerprint accidentally in the crime scene by the offenders.

There are four major classification of fingerprints i.e. arches, loops, whorls and composite. These major classifications are further classified as tented arch and plain arch, radial loop and ulnar loop, central pocket loop, lateral pocket loop, twinned loop and accidental pattern.

The most common blood grouping system based on Landsteiner's law of ABO is based on the principle that human blood is a composition of two components, the plasma, and the serum. The serum further consists of cells which include RBCs, WBC's and Platelets. The antigens which are present over the RBC are an important base for ABO blood grouping and Rh factor determination. This study aims to correlate the blood groups of the respondents with their fingerprint patterns. Hence the common blood group considered for the study irrespective of the "Rh" factor are A, B, AB, and O

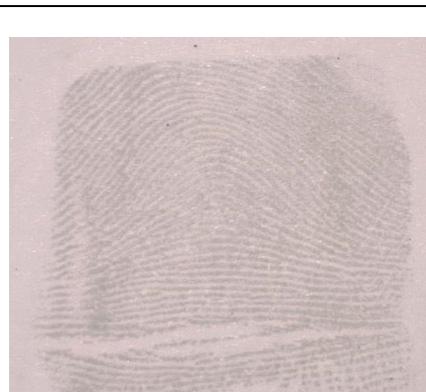
II. MATERIALS AND METHODS

The most common blood grouping system based on Landsteiner’s law of ABO is based on the principle that human blood is a composition of two components, the plasma, and the serum. The serum further consists of cells which include RBCs, WBC’s and Platelets. The antigens which are present over the RBC are an important base for ABO blood grouping and Rh factor determination. This study aims to correlate the blood groups of the respondents with their fingerprint patterns. The common blood group considered for the study irrespective of the “Rh” factor are A, B, AB, and O The present study was carried out by the Department of Forensic Science at Srinivas University, Mukka, Mangalore throughout the month of September 2020 to December 2020. A total of 77 respondents were taken for the study which included both males and females. The total numbers of male respondents were 30 and female subjects was 43. Only the subjects who knew their ABO blood group were selected for the study. The samples of fingerprints were collected in the fingerprint recording slip, which is a white non-glossy paper. The fingerprint recording slip has two sections, the first half is for the primary data collection which includes serial number, gender, and blood group and the next half is for secondary data collection, used for collecting fingerprint samples. The secondary data collection section has two different sections for collecting right handprints and left handprints. For right handprints, there were five columns and for the left hand, there were five columns for each finger impression to be recorded against the respective column. The finger impressions were collected from the thumb, index, middle, ring, and little finger of both right and left hand.

The impressions were collecting using an inkless fingerprint pad of JKC forensic products of size 5x3.6 dimension. The fingerprints were collected in the following fashion.

The respondents were instructed to wash their hands using soap and clean water to free their hands from dirt. Then the respondent was asked to pat dry his hand, and only after the hands were free from moisture the further procedure was followed. The fingerprint recording slip was folded at the respective folding part and placed towards the edge of the table and placed a paperweight over the slip. The respondent was asked to bend the lower arm parallel to the table and bend himself a bit. Further, the subject was asked to leave his arm and fingers free. Standing at the right of the respondent, his left hand was rolled against the respective column of the fingerprint recording slip and stood at the respondents’ left side to collect right-hand impressions. Both rolled and plain impressions were collected from the respondent by rolling the thumb of both the thumb from outwards to the center of the body and the rest of the fingers from the center of the body to outwards. While rolling the finger of the respondent was held towards the edge of the nails and above the third joint of the finger. While collecting the plain impression the fingers were just pressed against the fingerprint pad and then pressed against the slip. The collected fingerprints were further analyzed with the help of a handheld lens.

Table 1: Patterns of fingerprints

	
<p>Whorl</p>	<p>Loop</p>
	
<p>Twinned Loop</p>	<p>Plain Arch</p>



III. RESULT AND OBSERVATION

The following observations were made from the collected samples.

Out of 134 respondents, the majority of the respondents were female 76, and male 58 (Table 2). The majority of the respondents were of blood group “O” i.e. 54 (40.30%), followed by blood group “A” 33 (24.63%), and blood group “B” 33 (24.63%), blood group “AB” 14 (10.44%). The most common blood found among the respondents was blood group ‘O’ followed by blood group ‘A’ and blood group ‘B’ and the least number of respondents had ‘AB’ blood group.

The common fingerprint pattern found among the respondents was ulnar loop 645 (48.13%) followed by whorl pattern 427 (31.87%), central pocket loop 98 (7.31%), twinned loop 67 (5%), plain arch 40 (2.99%), tented arch 34 (2.54%), radial loop 15 (1.12%), accidental 09 (0.67%) and lateral pocket loop 05 (0.37%). The majority of the respondents had ulnar loop pattern, followed by whorl pattern, central pocket loop, twinned loop, plain arch, tented arch, radial loop, accidental pattern, and least number of respondents had lateral pocket loop pattern in their fingertip.

Among the female respondents, majority of them had ulnar pattern 367 (48.29%), followed by whorl 249 (32.76%), central pocket loop 62 (8.16%), twinned 27 (3.55%), plain arch 18 (2.37%), tented arch 16 (2.11%), radial loop 15 (1.97%), accidental 05 (0.66%) and lateral pocket loop 01 (0.13%).

The male respondents, majority of them had ulnar pattern 278 (47.93%), followed by whorl pattern 178 (30.69%), twinned 40 (6.90%), central pocket 36 (6.21%), plain arch 22 (3.79%), tented arch 18 (3.10%), lateral pocket 04 (0.69%), accidental 04 (0.69%). (Table 3)

The majority of the respondents in ‘A’ blood group are having ulnar pattern of fingerprint 155 (24.03%), followed by whorl 110 (25.76%), central pocket loop 22 (22.45%), twinned 14 (20.90%), tented arch 13 (38.23%), accidental 04 (44.44%) and radial loop 04 (26.67%), lateral pocket 03 (60%) and plain arch 02(5%)

Respondents having ‘B’ blood group have majority of Ulnar loop pattern 125 (19.37%), followed by whorl pattern 107 (25.05%), plain arch 36 (90%), central pocket loop 32 (32.65%), twinned 16 (23.88%), tented arch 07 (20.59%), radial loop 02 (13.33%)

Respondents belonging to ‘AB’ blood group have majority of ulnar loop pattern 87 (13.48%), followed by whorl pattern 27 (6.32%), central pocket loop 12 (12.24%), twinned 07 (10.45%), tented arch 05 (14.71%), radial loop 03 (20%), accidental 1 (11.11%)

Respondents with ‘O’ blood group have a majority of ulnar loop pattern 278 (43.10%), whorl 183 (42.86%), central pocket loop 32 (32.65%), twinned 30 (44.78%), tented arch 09 (26.46%), radial loop 06 (40%), accidental 04 (44.44%), plain arch 02 (5%) and lateral pocket loop 02 (40%). (Table 4)

The ‘B’ blood group has the maximum number of plain arch 36 (90%) followed by blood group ‘A’ 02 (5%) and ‘O’ blood group 02 (5%), and no plain arch was present in AB blood group. (Table 5)

The tented arch was maximum among ‘A’ blood group 13 (38.23%), followed by ‘O’ blood group 09 (26.46%) ‘B’ blood group 07 (20.59%) and among ‘AB’ blood group tented arch was least 05 (14.71%). (Table 6)

Whorl pattern was most common among ‘O’ blood group 183 (42.86%), followed by ‘A’ blood group 110 (25.76%), ‘B’ blood group 107 (25.05%), and ‘AB’ blood group 27 (6.32%). (Table 7)

The radial loop was most common among ‘O’ blood group 06 (40%), followed by ‘A’ blood group 04 (26.67%) and ‘AB’ blood group 03 (20%), and least found among ‘B’ blood group 02 (13.33%). (Table 8)

The ulnar loop was most common among ‘O’ blood group 278 (43.10%), followed by ‘A’ blood group 155 (24.03%), ‘B’ blood group 125 (19.37%), ‘AB’ blood group 87 (13.48%). (Table 9)

The central pocket loop was common among ‘B’ and ‘O’ blood group 32 (32.65%) and 32 (32.65%), followed by ‘A’ blood group 22 (22.45%) and least found among ‘AB’ blood group 12 (12.24%). (Table 10).

The lateral pocket loop was common among ‘A’ blood group 03 (60%) followed by ‘O’ blood group 02 (40%). The lateral pocket loop was absent among the ‘B’ blood group and ‘AB’ blood group. (Table 11)

The twinned loop was common among ‘O’ blood group 30 (44.78%), followed by ‘B’ blood group 16 (23.88%) and ‘A’ blood group 14 (20.90%) and least found among ‘AB’ blood group 07 (10.45%). (Table 12)

The accidental pattern was common among ‘A’ and ‘O’ blood group 04 (44.44%) and 04 (44.44%) followed by ‘AB’ blood group 1 (11.11%). An accidental pattern was absent among respondents belonging to the ‘B’ blood group. (Table 13)

Table 2: Distribution of respondents based on gender

Gender	Number of respondents
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Male	58 (43.28%)
Female	76 (56.72%)
Total	134 (100%)

Chart 1: Gender Distribution

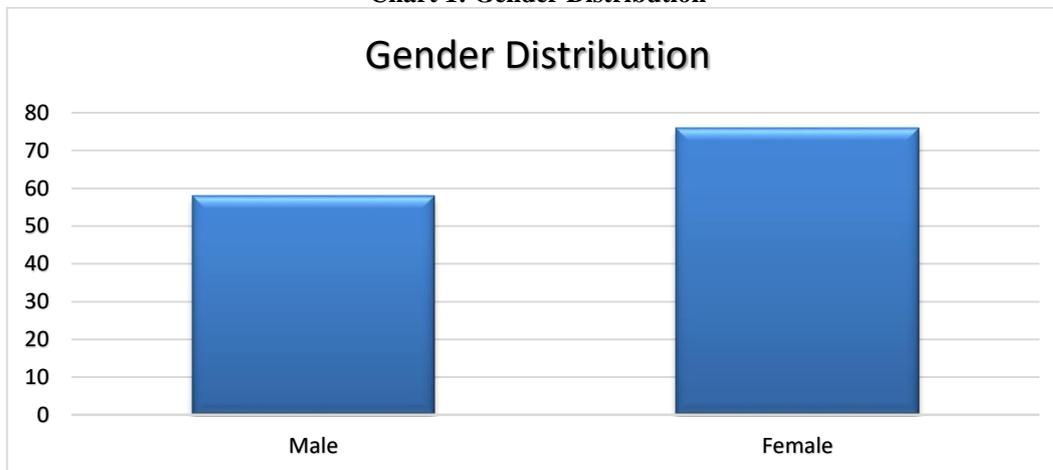


Table 3: distribution of respondents based on gender and fingerprint pattern

Gender	Fingerprint pattern									Total
	Plain arch	Tented arch	whorl	Ulnar loop	Radial loop	Central pocket	Lateral pocket	Twinned	accidental	
Male	22 (3.79%)	18 (3.10%)	178 (30.69%)	278 (47.93%)	0 (0.00%)	36 (6.21%)	04 (0.69%)	40 (6.90%)	04 (0.69%)	580 (43.28%)
Female	18 (2.37%)	16 (2.11%)	249 (32.76%)	367 (48.29%)	15 (1.97%)	62 (8.16%)	01 (0.13%)	27 (3.55%)	05 (0.66%)	760 (56.72%)
Total	40 (2.99%)	34 (2.54%)	427 (31.87%)	645 (48.13%)	15 (1.12%)	98 (7.31%)	05 (0.37%)	67 (5%)	9 (0.67%)	1,340 (100%)

Table 4: distribution of respondents based on blood group and fingerprint pattern

Blood group	Fingerprint pattern									Total
	Plain arch	Tented arch	whorl	Ulnar loop	Radial loop	Central pocket	Lateral pocket	Twinned	accidental	
A	02 (5%)	13 (38.23%)	110 (25.76%)	155 (24.03%)	04 (26.67%)	22 (22.45%)	03 (60%)	14 (20.90%)	04 (1.11%)	327 (24.40%)
B	36 (90%)	07 (20.59%)	107 (25.05%)	125 (19.37%)	02 (13.33%)	32 (32.65%)	00 (0.00%)	16 (23.88%)	00 (0.00%)	325 (24.25%)
AB	00 (0.00%)	05 (14.71%)	27 (6.32%)	87 (13.48%)	03 (20%)	12 (12.24%)	00 (0.00%)	07 (10.45%)	01 (1.25%)	142 (10.58%)
O	02 (5%)	09 (26.46%)	183 (42.86%)	278 (43.10%)	06 (40%)	32 (32.65%)	02 (40%)	30 (44.78%)	04 (0.66%)	546 (40.77%)
Total	40 (2.99%)	34 (2.55%)	427 (31.88%)	645 (48.14%)	15 (1.14%)	98 (7.32%)	05 (0.38%)	67 (5%)	09 (0.68%)	1340 (100%)

Table 5: Distribution of respondents based on plain arch and blood group

Blood group	Plain arch	Percentage
A	02	(5%)
B	36	(90%)

AB	00	(0.00%)
O	02	(5%)
Total	40	(100%)

Table 6: Distribution of respondents based on tented arch and blood group

Blood group	Tented arch	Percentage
A	13	(38.24%)
B	07	(20.59%)
AB	05	(14.71%)
O	09	(26.46%)
Total	34	(100%)

Table 7: Distribution of respondents based on whorl and blood group

Blood group	Whorl	Percentage
A	110	(25.76%)
B	107	(25.05%)
AB	27	(6.32%)
O	183	(42.87%)
Total	427	(100%)

Table 8: Distribution of respondents based on radial loop and blood group

Blood group	Radial loop	Percentage
A	04	(26.67%)
B	02	(13.33%)
AB	03	(20%)
O	06	(40%)
Total	15	(100%)

Table 9: Distribution of respondents based on ulnar loop and blood group

Blood group	Ulnar loop	Percentage
A	155	(24.03%)
B	125	(19.37%)
AB	87	(13.49%)
O	278	(43.11%)
Total	645	(100%)

Table 10: Distribution of respondents based on central pocket loop and blood group

Blood group	Central pocket loop	Percentage
A	22	(22.45%)
B	32	(32.65%)
AB	12	(12.25%)
O	32	(32.65%)
Total	98	(100%)

Table 11: Distribution of respondents based on lateral pocket loop and blood group

Blood group	Lateral pocket loop	Percentage
A	03	(60%)
B	00	(0.00%)
AB	00	(0.00%)

O	02	(40%)
Total	05	(100%)

Table 12: Distribution of respondents based on twinned loop and blood group

Blood group	Twinned loop	Percentage
A	14	(20.90%)
B	16	(23.88%)
AB	07	(10.45%)
O	30	(44.77%)
Total	67	(100%)

Table 13: Distribution of respondents based on accidental pattern and blood group

Blood group	Accidental pattern	Percentage
A	04	(44.44%)
B	00	(0.00%)
AB	01	(11.11%)
O	04	(44.44%)
Total	09	(100%)

IV. DISCUSSION

A study done in Nepal by Gupta and Shah⁶, the study proved that there was no significant relationship among fingerprint patterns, blood groups either in the ABO system or in the Rh system. The common fingerprint pattern was loop followed by whorl and arch and the most common blood group was group B and Rh-positive.

A study conducted by Kamaradgi⁷ in Davangere mentioned in his study that the highest number of respondents had loop pattern followed by whorl pattern and least respondents had an arch pattern of fingerprint and majority of the subjects in the study were Rh-positive. It was noted in the study that loop and whorl fingerprint pattern showed significant association with blood group B and females showed a high predominance of blood group O whereas male showed a high predominance of blood group B.

A study conducted by Amit Patil⁸ in Navi Mumbai (2017) found in his study that loop was the most common type of fingerprint pattern and found a significant association between fingerprint pattern and ABO blood group. It was noted that the study failed to link the association between gender and fingerprint pattern

A study done by Bhardwaj⁹ conducted a study in Rajasthan on 300 medical students as respondents with different blood groups. The study showed that the majority of respondents belonging to the A blood group had a loop pattern.

In the study conducted by Dr. Sajad Hamid¹⁰ in Srinagar, J&K, it was found that there is an association between the distribution of fingerprint and blood group. Arches and whorl were of high frequency in B positive blood group and were found least in the AB negative. Arches were of high frequency on the middle finger and distribution of pattern in individual fingers had a high frequency of loop in the middle finger, little finger, and thumb. In index finger, ring fingers, and thumb had more of the whorl. The index, thumb, and middle fingers had a high number of arch patterns.

A study done by Harem, Dlnya, and Zhino¹¹ in Koya, Iraq on 450 students belonging to the age group of 18-25 years, they found an association between the distribution of fingerprint patterns and some type of blood groups (A, B and AB) and from each finger (thumb, index, middle, ring and little) among students in the University of Koya it is possible to predict blood group of a person based on fingerprint pattern.

A study done by Desai¹² in 2013 mentioned that in his study there was a large number of loop patterns of fingerprint in every blood group. Whorl was seen in dominance only in O negative blood group. Arch and loop patterns were seen among females and among males it was whorl.

V. CONCLUSION

From this study, it was concluded that the most common fingerprint pattern among the respondents are ulnar loop, followed by whorl pattern, central pocket loop, twinned loop, plain arch, tented arch, radial loop, an accidental pattern whereas the least found pattern among the respondents are the lateral pocket loop.

The common blood group found among the respondents was blood group 'O', followed by blood group 'A' and 'B', and blood group 'AB' was rare.

Respondents with blood group 'O' have diverse fingerprint pattern than compared to other blood groups

The researcher could find a significant relationship between blood group "B" and the Plain arch pattern.

Occurrence of twinned loop pattern amongst the respondents belong to blood group "O" was more frequent compared to rest of the fingerprint patterns.

Further, a few fingerprint pattern relations with blood groups were found through the study.

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