RESEARCH ARTICLE

STUDY OF FINGERPRINT PATTERNS IN RELATIONSHIP WITH BLOOD GROUP AND GENDER

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ABSTRACT

A fingerprint is an impression left by the friction ridges of a human finger. Fingerprint patterns are unique in each individual. Since the beginning of twentieth century, fingerprint detection and analysis are being commonly used. It has become an important part of forensic investigation in crime scene. Therefore, it has got a great application in the court of law. Out of many blood grouping systems available, ABO and Rh systems are the most important and are considered for the present study. Aim of this study is to correlate the fingerprint patterns with gender and blood group of individuals. This prospective study was carried out in a time period of 2 months among 300 medical students (150 male and150 female) of Yenepoya Medical College, Mangalore. The fingerprint patterns are classified under loops, whorls and arches. Results show that loops are the most commonly found pattern followed by whorls and arches. Loops are predominant in females whereas whorls and arches are seen more in males. Highest frequency of loops was seen in O positive blood group.

INTRODUCTION

The term Identity, also called sameness is defined as whatever makes an entity definable and recognizable. There are various methods by which identity of a person can be known which includes DNA profiling, iris imaging, bite marks, lip prints, foot prints, fingerprints etc. Fingerprint is one of the most interesting, reliable and unique feature of human body. For many years now, it has been considered as the primary method of identification of a person. No two fingerprints are exactly alike. Therefore it is being used as main evidence in the court of law. A fingerprint is an impression of the friction ridges of all or any part of the finger. The raised portion of the palmar or plantar skin epidermis is called the friction ridge. These ridges are also referred to as 'dermal ridges' or 'dermal papillae'. Each ridge contains pores, which are attached to sweat glands under the skin. Primary ridge development occurs along the basement membrane and becomes visible in histological foetal preparations between 12 – 16 weeks gestation in the early part of second trimester. The alignment of the ridges in an individual never changes once they are formed. Two fingerprints of a same individual may differ in ridge and pattern characteristics. Fingerprint identification, also referred to as dactyloscopy is the process of comparing questioned and known friction skin ridge impressions from fingers, palms, and toes to determine if the impressions are from the same finger or palm and toe. Thus the presence of a victim or a suspect in the scene of crime can be known.

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Fingerprints are also used for electronic registration in offices and colleges. Medico legal importance of fingerprinting includes identifying the criminal, in cheques, in bank notes or passports as a means of identification, in case of mass disasters, to prevent impersonation, in case of accidental exchange of new born infants and to identify unknown corpses A blood type (also called a blood group) is a classification of blood based on the presence or absence of inherited antigenic substances on the surface of RBC's. A total of 32 human blood group systems are now recognized by the International Society of Blood Transfusion. The two most important ones are ABO and the Rh system. The ABO type is further divided into A, B, AB and O groups. The Rh type is divided into 'Rh positive' and 'Rh negative' based on the presence of D antigen. In this study, an attempt has been made to correlate fingerprint patterns with gender and blood group of an individual. This study may aid the investigators trying to solve a case using fingerprints.

MATERIALS AND METHODS

This prospective study was carried out after obtaining ethical clearance from the ethical committee of the institution. The study was done among medical students of Yenepoya Medical College over a time period of two months. 300 students of age group 18-25 participated in the study which included 150 males and 150 females. The procedure was clearly explained to each student. Each subject was asked to clean his/her hands before the procedure. Special care was taken to avoid smudging of the print. The materials used for the study were a

stamp pad of Faber Castell Company of size 110mm * 69mm, a white sheet of paper with ten different blocks for all digits of both the hands and a magnifying lens. The subject was asked to press the fingertip on the stamp pad and thereafter to the paper to transfer the fingerprint impression. Fingerprints of all 10 digits were taken separately on a single sheet of paper which consisted of 10 different blocks for all fingers of right and left hand respectively. Specific number was assigned to each finger. Right thumb was numbered as 1 and number 10 was given to left little finger. After obtaining the fingerprints, other details such as age and sex were noted. Blood groups of all subjects were noted down from their id cards. Each subject was assigned a serial number. Students having any hand deformity or permanent scars on their fingers and those who didn't know their blood groups were excluded from the study.

RESULTS

The study was carried out in 300 medical students of age group 18-25 years of which 150 were males and 150 were females.

Table 1. Distribution of blood groups of subjects according to gender

Blood Group	Male		Female		Total	
A	37	12.3%	31	10.3%	68	22.6%
B	40	13.3%	48	16	88	29.3%
AB	08	2.7%	09	3	17	5.7%
O	65	21.7%	62	20.7%	127	42.4%
TOTAL	150		150		300	

Table-1 shows distribution of blood groups of subjects according to gender. Majority of the subjects (127, 42.4%) belonged to blood group O, followed by B (88, 29.3%), A (68, 22.6%) and AB (17, 5.7%). Blood group O had the highest frequency in both males and females followed by blood groups B, A and AB.

Table 2. Distribution of blood groups of subjects according to Rh factor

Blood Group	Rh positive		Rh negative	
A	60	20%	8	2.7%
B	80	26.7%	8	2.7%
AB	17	5.6%	0	0
O	121	40.3%	6	2%
Total	278	92.6%	22	7.4%

Table 2 shows distribution of blood groups of subjects according to Rh factor. Among 300 individuals, 278 were Rh positive and 22 were Rh negative. O group (121, 40.3%) had the highest frequency among Rh positive followed by B (80, 26.7%), A (60, 20%) and blood group AB (17, 5.6%) had the least frequency. Among Rh negative subjects, blood groups A and B were equally predominant with 2.7% followed by O (2%). AB negative was the rarest group.

Table 3. Distribution of primary fingerprint patterns among the subjects

Finger print patterns	Total number	Percentage
Loops	1826	60.9%
Whorls	970	32.3%
Arches	204	6.8%
Total	3000	100%

Table-3 shows distribution of primary fingerprint patterns among the subjects. Among the fingerprint patterns studied in all fingers of both the hands, loops had the highest frequency of 60.9% followed by whorls with 32.3% and arches showed the least number with 6.8%.

Table 4. Distribution of fingerprint patterns according to gender

Fingerprint patterns	Male		Female	
Loops	854	46.8%	972	53.2%
Whorls	533	54.9%	437	45.1%
Arches	113	55.4%	91	44.6%

Table-4 shows distribution of fingerprint patterns according to gender. Frequency of loops were found to be higher in females (53.2%) compared to that of males (46.8%). Whorls and arches were seen higher in males compared to females. Table-5 shows distribution of fingerprint patterns among different blood groups with Rh factors. Loops had the highest frequency in all Rh positive and Rh negative blood groups followed by whorls and arches. O positive blood group had the highest number of all the patterns among Rh positive blood groups. Among Rh negative, loops were more in blood group B, whorls in A and arches in O negative blood group. Least number of all the patterns was seen in AB blood group. Arches were the least commonly found pattern in all the blood groups.

DISCUSSION

Fingerprints are the friction ridge impressions of terminal part of the finger. History of fingerprints dates to around 3000 years back when Chinese used fingerprints to sign legal documents. The advantages of using fingerprint patterns as a means of identification is that it can be filed and saved and are possible to recover it at any point of time. The system of classification which is in use even today was proposed by Sir Edward Henry. The classification is known as Henry's system of classification (http://en.wikipedia.org/wiki/Fingerprint; Pillay, 2009). The three basic fingerprint patterns which are used in this study are loops (60-65%), whorls (30-35%) and arches (5%). (Fig-1). Arch pattern is the rarest. It 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 upthrusting ridge which tends to bisect superior ridges at right angles. The loop pattern consists of one delta and one or more recurving edges that enter and leave on the same side.

It is divided into ulnar and radial loop depending on the side from which they enter and leave (Mehta and Mehta 2011). Whorl pattern consists of two points of delta and ridge lines which rounds the core to form a circle or spiral form. Whorl pattern can be subdivided into plain whorl, central pocket whorl, double loop whorl and accidental whorl. Any pattern that does not suit into the above classifications can be called 'composite (Raloti et al., 2013; Sangam et al., 2011; Tanuj and Saurabh 2006). The blood grouping systems used are ABO and Rh which are being widely used today. (Bijlani, 1997) Dr. Rastogi et al. in 2010 had conducted a similar study on 200 medical students of Kasturba Medical College, Mangalore (Dr. Rastogi et al., 2010). Bhavana et al. in 2013 completed a study on 200 individuals from Hubli, Dharwad, Karnataka (Bhavana et al., 2013). The results of these studies are compared with the results of the present study.

Table 5. Distribution of fingerprint patterns among different blood groups with Rh factors

Type of pattern	Blood Group A		Blood Group B		Blood Group AB		Blood Group O	
	Rh+ve	Rh-ve	Rh+ve	Rh-ve	Rh+ve	Rh-ve	Rh+ve	Rh-ve
Total loops	368	43	500	49	102	-	728	36
Percentage%	61.3%	53.8%	62.5%	61.3%	60%	-	60.2%	60%
Total whorls	179	35	240	30	64	-	404	18
Percentage%	29.8%	43.8%	30%	37.5%	37.6%	-	33.4%	30%
Total arches	53	02	60	01	04	-	78	06
Percentage%	8.8%	2.5%	7.5%	1.25%	2.35%	-	6.5%	10%
Total	600	80	800	80	170	-	1210	60

Table 6. Distribution of blood groups of subjects according to gender

Blood group	Bhavana D			Dr. Rastogi P			Present Study		
	M	F	Total	M	F	Total	M	F	Total
A	11%	10%	21%	16.5%	11.5%	28%	12.3%	10.3%	22.6%
B	17.5%	19.5%	37%	16.5%	15.5%	32%	13.3%	16%	29.3%
AB	3.5%	3.5%	7%	2%	2.5%	4.5%	2.7%	3%	5.7%
O	18%	17%	35%	15%	20.5%	35.5%	21.7%	20.7%	42.4%

LOOP

WHORL

ARCH

Fig. 1. The three fingerprint patterns

Table-6 shows comparative study on distribution of blood groups of subjects according to gender. The results of the present study were in accordance with the results obtained from Dr. Rastogi's study where blood group O dominates followed by blood groups B, A and AB. Whereas in Bhavana D's study, blood group B dominates followed by O, A and AB.

Table 7. Distribution of blood groups of subjects according to Rh factor

Blood group	Bhavana D		Dr. Rastogi P		Present Study	
	Rh positive	Rh negative	Rh positive	Rh negative	Rh positive	Rh negative
A	19.5%	1.5%	26.5%	1.5%	20%	2.7%
B	35%	2%	30.5%	1.5%	26.7%	2.7%
AB	6.5%	0.5%	4.5%	0	5.6%	0
O	34%	1%	34.5%	1%	40.3%	2%
Total	95%	5%	96%	4%	92.6%	7.4%

Table-7 shows comparative study on distribution of blood groups of subjects according to Rh factor. Rh positive blood groups dominated in the present study and AB negative blood group was found to be the rarest. The results were in accordance with the findings from past studies.

Table 8. Distribution of primary fingerprint patterns among the subjects

Fingerprint patterns	Bhavana D	Dr. Rastogi P	Present Study
Loops	58.9%	60.95%	60.9%
Whorls	29.6%	32.55%	32.3%
Arches	11.5%	6.5%	6.8%

Table-8 shows comparative study on distribution of primary fingerprint patterns among the subjects. Loops dominated in all the three studies followed by whorls and arches.

Table 9. Distribution of fingerprint patterns according to gender

Fingerprint patterns	Bhavana D		Dr. Rastogi P		Present Study	
	Male	Female	Male	Female	Male	Female
Loops	47.38%	52.63%	47.58%	52.42%	46.8%	53.2%
Whorls	57.09%	42.90%	55.78%	44.22%	54.9%	45.1%
Arches	48.26%	51.73%	44.61%	55.38%	55.4%	44.6%

Table-9 shows comparative study on distribution of fingerprint patterns according to gender. Loops were more in females and whorls were more in males in all the three studies. Distribution of arches differed from the past studies. It is more in females in the past studies whereas in the present study it was seen more in males. Frequency of loops was highest in all Rh positive and Rh negative blood groups followed by whorls and arches according to the present study. In the study done by Bhavana in 2013 and Dr. Rastogi in 2010, similar findings are observed except for O negative which shows predominance of whorls. O positive blood group had the highest number of all the patterns among Rh positive blood groups which differed comparatively from other studies. According to Dr. Rastogi, loops and arches are found to be more in blood group A and whorls in blood group O among Rh positive groups. In Bhavana D's studies, loops and arches are more in blood group B and whorls are equally dominant in both B and O blood groups. In 2000-2001, Bharadwaja *et al* conducted a study on 300 medical students in Rajasthan. The study reveals that subjects with blood group A have more of loops and those with blood group AB have more of whorls (Bharadwaja *et al.,* 2004). Study conducted by Sharma *et al* in 2008 shows that blood group O have highest frequency of whorls which is similar to the result obtained in the present study (Sharma *et al.,* 2008).

Conclusion

Present study is an attempt to associate fingerprint patterns with gender and blood group of an individual. Fingerprint patterns can be of help in predicting the gender and blood group of an individual. It may enhance the authenticity of fingerprints in detection of criminals. Following results were obtained

- Loops were the most commonly found pattern and arches the least
- Blood group O positive was the most common and AB negative was found to be the rarest
- Rh positive blood groups were more compared to Rh negative blood groups.
- O positive was the most common among Rh positive blood groups followed by B and A blood groups.
- Among Rh negative B and A blood groups were equally dominant followed by O and AB.
- Loops were highest in females and arches and whorls were highest in males
- Loops were predominant in all the blood groups
- Highest number of all the patterns was found in blood group O and least in AB among Rh positive blood groups.
- Arches were least commonly found in all the blood groups

Many studies have been done separately on fingerprint patterns and blood groups. Only very few studies has been done correlating fingerprint patterns and gender. Therefore more studies need to be conducted in this field. Study of palmar dermatoglyphics can be done along with study of fingerprint patterns. "Our fingerprints never lie as our faces do".

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